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Readiness 2030 and the New Fiscal Framework

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Abstract

The National Escape Clause (NEC) offers meaningful fiscal space under the DSA-based fiscal rules for member states to ramp up defense spending.

The NEC allows for up to 1.5 % of GDP in higher spending for 4 years, resulting in an increase of the debt ratio of 6 percentage points. This increases the structural primary balance required to keep debt on a plausible downwards path (after the adjustment period) at most 0.12 percentage points of GDP through two distinct effects.

i) The baseline debt stabilizing primary balance increases by an amount equal to (the maximum of) r-g during the transition period times this increase in the debt ratio. With r-g around 1% for high debt countries, this amounts to 0.06%.
ii) The buffer under the dominant stress scenario, a shock to r-g of 1 %, adds another 0.06 points.

The COFOG measure of military expenditure used by Eurostat seems ill-suited to capture the demand effects of the increase in military expenditure, which, at least over the next years, will be concentrated on orders for expensive long-lived platforms (airplanes, ships, tanks, etc.). This type of expenditure item is recorded under COFOG only upon final delivery, not when orders are placed. However, the demand and employment effects arise already during the production phase. The NATO definition for military expenditure should thus be preferred if one wants to capture demand effects.

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Introduction

Europe faces the necessity to provide for its own security, which implies large increases in defense spending (European Commission 2025d). In the long run, these expenditures will have to be financed through a combination of tax increases and expenditure cuts elsewhere. This is also implicit in the EU's fiscal framework. The new version of the fiscal rules emphasizes the tool of (stochastic) debt sustainability analysis (DSA) to ascertain fiscal sustainability (European Commission 2024a).

But given the need to urgently ramp up defense expenditure without forcing member states to make large cuts elsewhere, the European Commission invited member states in early 2025[2] to activate the NEC (European Commission 2025d). This mechanism allows states to temporarily deviate from the existing consolidation paths mandated under the DSA by excluding defense expenditures up to 1.5% of GDP from the fiscal rules for four years (European Commission 2025d).

A country that uses the fiscal space in the NEC will have at the end of the adjustment period of four years, a deficit that is up to 1.5% higher than under the baseline plan. The Commission (2025) therefore assumes that in this case the country will need a second adjustment plan during which it has to bring down the deficit by 1.5% (or whatever was the increase in military expenditure).

Whatever the time path of the increase in military expenditure and subsequent reduction in the deficit, the NEC would leave a legacy of higher public debt of around 6% in the case of a gradual ramp-up of higher expenditure and a gradual winding down of the higher deficit.

The key questions are then: What does a higher debt level of this order of magnitude mean for the eventual adjustment necessary by the end of a second adjustment period? And, given only 16 countries have requested activation of the NEC (European Commission 2025a), not among them larger debtors like Italy or Spain, is this eventual adjustment prohibitive for high debt countries?

We develop a simple and transparent framework for showing how activation of the NEC impacts the required adjustment of the primary balance. Under the relevant scenario of a buffer to cushion r-g shocks, we find that a country which fully exploits the NEC will have to increase the primary balance by only 0.12 % of GDP at the end of the adjustment period. Applying the framework to Italy, we show that its predictions closely match those from a full-scale model, lending credibility to the rule-of-thumb we propose.[3] We note that under the previous debt adjustment rule, an increase in the debt ratio of 6 percentage points would have required an additional adjustment of 0.30 (6/20) points of GDP, more than double the value under the new rules.

We first give a short overview of the state of the NEC. Then, we derive the simplified DSA framework and use it to show how the NEC would increase the buffers required. This gives an order of magnitude of the adjustment required, even for the countries that have not chosen to ask for the NEC (Part I). We also briefly explain how increases in defense spending are recorded, and the timing issues stemming from it (Part II).

[2] It is surprising that the need for higher defence spending was not foreseen already in 2024, when the new framework was formally approved. At that point the war in Ukraine had been going on for more than 2 years. It took the arrival of Donald Trump for Europe to recognise the need to do more for its own defence.
[3] Many thanks to Niels Lynggård Hansen for suggesting this formulation.

The NEC in action

In its March 2025 Communication, the Commission had invited all member states to use the NEC to increase defense spending without having to fear disapproval under the new fiscal rules (European Commission 2025d). So far, 16 countries have activated the NEC. These states (see figure 1) make up roughly 45% of EU GDP (Eurostat 2025; European Commission 2025a).

The NEC was designed to allow even countries with large fiscal adjustment needs, like France, Italy, and Spain, to increase their defense expenditures in the short term. However, as table 1 shows, the (weighted) average debt ratio of the countries that have not invoked the NEC is at 95 % much higher than that of the NEC countries (66 % of GDP). Apart from the fact that these countries are further away from the war, one explanation for this reticence of high debt countries might be the fear that the higher debt level at the end of the adjustment period might then require an additional stronger adjustment effort. This is the main avenue of research pursued in this paper.

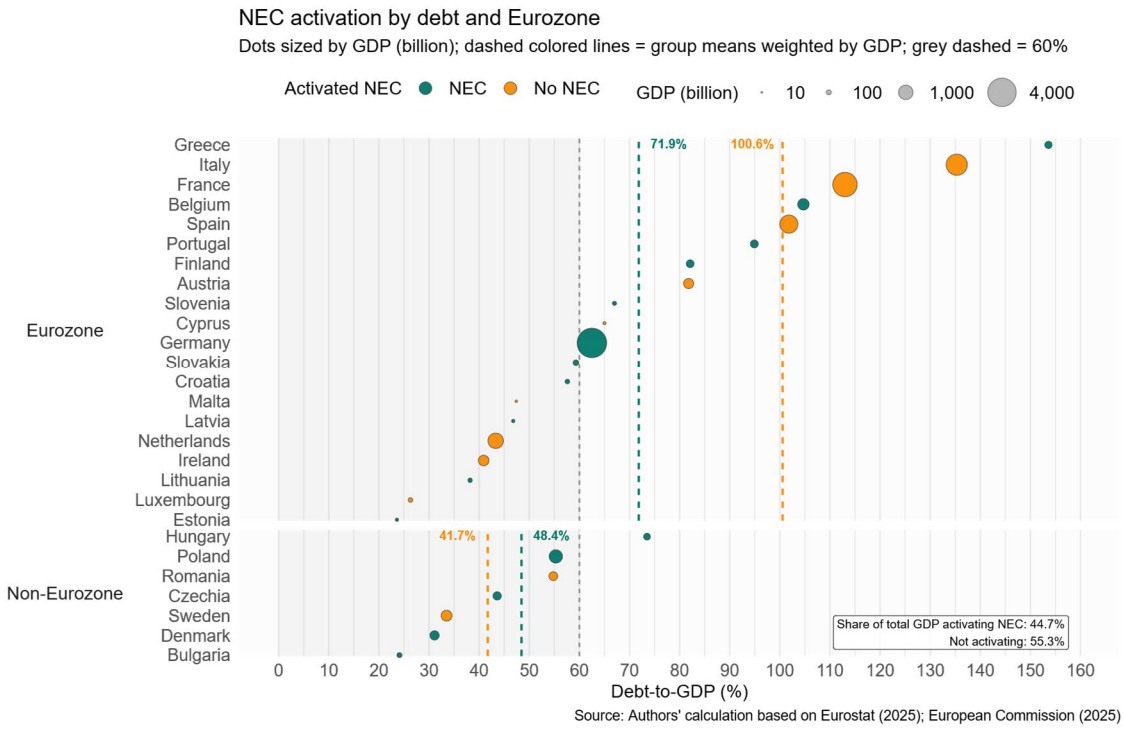

Figure 1 Overview of the activation of the NEC

Finanical Situation of NEC and non-NEC countries (2024)

	NEC	No NEC	NEC % of total
Debt (billion)	5,333	9,434	36
GDP (billion)	8,031	9,919	45
Debt-to-GDP (%)	66	95	

Source: Authors' calculations based on Eurostat (2025); European Commission (2025)

Table 1 The financial situation of NEC and non-NEC countries

Part I: The DSA – Simplified

The debt sustainability analysis (DSA) that forms the backbone of the new fiscal rules process is complex, involving dozens of parameters and complex feedback loops. Bruegel's publicly available implementation (Darvas et al. 2024) takes up more than three thousand lines of code.

To bring some light into this black box, we simplify the DSA to its core dynamics and show that this simplified approach yields results that are very close to the fully fledged simulations.

The simplified dynamics allow us to provide a transparent estimate of the order of magnitude of the required adjustment resulting from an increase in the debt ratio of 6 percentage points (the maximum amount possible under the NEC (European Commission 2025d). Our focus is throughout on the structural primary balance required for debt sustainability at the end of the adjustment period (2029 for most countries).[4]

1. Main elements of the DSA

Debt stabilisation

A debt sustainability analysis is usually based on the idea that debt is sustainable if it stabilizes as a ratio of GDP. For a standard DSA, it does not make any difference whether the debt is stabilized at 60 or 120 % of GDP. It is regarded as sustainable if the ratio does not increase.

Debt stabilization requires that the primary surplus is at least equal to the debt ratio multiplied by the difference between the interest rate and the growth rate ('r-g'). As Blanchard (2019) emphasizes, very high debt levels become sustainable with low interest rates and when growth rates are higher than the interest rate, "public debt may have no fiscal cost".

The DSA of the Commission does not incorporate this scenario of low interest rates. Instead, (long-term) interest rates are assumed to converge towards 4 % and the growth rate to roughly 3 % for most countries, especially those with high debt. This implies that under the DSA, the r-g factor should converge towards 1(%). Under this hypothesis, the increase in the debt ratio allowed under the NEC would eventually require an improvement in the primary balance of 0.06 % of GDP just to maintain debt sustainability. We take this case of r-g as the central scenario, although there is considerable variability in the time path of different countries. If r-g was larger, say 2%, the required adjustment would be twice as high, 0.12%. For countries for which r-g = 0, there would be no adjustment required just to keep the debt ratio constant.[5]

Buffers for a 'plausible downward' path

While higher debt can directly increase the primary balance necessary for debt stability, in the DSA of the Commission, there is a second effect of higher debt levels: higher buffers. These should ensure that the debt ratio is on a 'plausibly downward' path and will decline after the adjustment period even under adverse scenarios. Differently put, the primary balance has to incorporate buffers relative to the one required to stabilize the debt ratio to absorb shocks and still be declining (European Commission 2024a).

[4] We do not discuss ageing costs whose impact is independent of military expenditure.
[5] We will focus on the case where the member states will not bring the debt ratio below 60% during the 10-year period, and so the 'easing up' rule does not apply (European Commission 2024a).

Before we specify what exactly these buffers are, we place them within the DSA framework. The DSA provides a set of requirements that need to be fulfilled to 'pass' the DSA. There are 1) deterministic and 2) stochastic requirements. We focus here on the deterministic requirements. The stochastic requirements are rarely binding[6] since the DSA of the Commission has eliminated the largest shocks during the period used to estimate the variability of key economic variables, arguing they are outliers (European Commission 2024b). We discuss this in a companion paper in more detail. In short, without limiting the largest shocks, the stochastic part of the DSA would often be binding and often lead to a higher primary balance necessary.

The deterministic part can in turn be split into 1a) The debt safeguard and deficit benchmark requirements that apply during the adjustment period and 1b) the main adjustment requirements that govern the long-run trajectory (European Commission 2024a).[7]

Broadly speaking, member states must consolidate their finances (in form of the primary balance) in the adjustment period (four or seven years, 1a) may apply). From that point onwards, the debt trajectory is determined purely by economic forces (e.g., the growth rate, interest rates, inflation, with the achieved primary balance stable). Member states must consolidate enough before the end of the adjustment period to then pass the 1b) checks that apply during the next 10 years (European Commission 2024a).

We concentrate here on 1b) i.e., the long-run checks. The short-run checks 1a) are not relevant for assessing the impact of the NEC (European Commission 2025a). These 1b) checks have as target the primary balance at the end of the adjustment period. It needs to be high enough so that the debt ratio is 'plausibly downward' in the 10 years following the adjustment period. Since some of these checks require a higher primary balance than necessary to simply stabilize debt, we say that they mandate 'buffers' (relative to mere debt stabilization).

The key condition under 1b) is that the debt ratio must decrease every year from the end of the adjustment period until ten years later if the debt ratio is above 60%. Further, this must be the case under three 'scenarios': an interest rate shock bi), an r-g shock 1bii), and a primary balance shock 1biii) (European Commission 2024a). The 'binding' scenario is then the one that creates the largest buffer.

In the following chapters, we first derive the key debt dynamics equation. Then, we take the buffer criteria 1bi-1biii) and cast them into the same from as the key debt dynamics equation. Finally, we use this and show how an increase in debt changes the primary balance necessary under the DSA.

[6] A counter example would be Finland.

[7] We do not discuss one limitation of the NEC. It appears that a country that is still in the corrective arm of the EDP and whose current trajectory would bring the deficit ratio below 3 % of GDP, might not be able to exit the EDP if it were to invoke the NEC and increase military expenditure. If the increased military expenditure is large enough to push the deficit above 3 % of GDP, the country would, under the current rules, not be able to exit the EDP.

2. The essential equations of the DSA (simplified)

The main equation for the DSA debt dynamics is (European Commission 2024b):

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

Where i_t, , denotes the interest rate, g_t the nominal growth rate, f_t stock-flow adjustments, and e_t the exchange rate. Foreign currency debt plays no significant role for most euro area countries, and the stock flow adjustment should be zero in a forward-looking hypothesis. So, leaving out exchange rates and stock flow adjustments, and then subtracting d_{t-1} gives the change in debt every year:

$$d_t = d_{t-1}\frac{1+i_t}{1+g_t} - b_t$$

$$\Delta d_t = d_t - d_{t-1} = d_{t-1}\frac{1+i_t}{1+g_t} - d_{t-1}\frac{1+g_t}{1+g_t} - b_t$$

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

Now, as $1 + g_t$ is usually close to 1, we can write:

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

We solve for the primary balance required to keep the debt ratio non-increasing by setting $\Delta d_t = 0$ and can therefore write:

$$0 = d_{t-1}(i_t - g_t) - b_t$$
$$b_t = d_{t-1}(i_t - g_t) \quad (2)$$

In other words, the primary balance[8] b_t needs to be equal to the debt ratio in the period before d_{t-1} multiplied by the difference between the interest rate i_t and the growth rate g_t. Further, since this must be true every year from the end of the adjustment, we can write:

$$b_t \geq \max\{d_{t-1}(i_t - g_t)\}, \quad \forall t \in [a + 1, a + 11]$$

Assuming the adjustment period ends in a. As example take $d_{t-1} = 1.4$ (i.e., 140%) and $i_t - g_t = 0.01$ (i.e., 4% - 3 %), then, b_t needs to be at least 0.014 for the debt not to increase (i.e., 1.4%), which is the main adjustment condition of the DSA.

[8] We abstract from the ageing costs here. In the DSA, prospective costs of ageing need to be included in the primary balance so that, if they were deducted when they occur, the debt path would still be declining.

3. The Main DSA adjustment condition with its scenarios

Now we turn to the three scenarios, 'financial stress', 'r-g shock', and 'primary balance shock', that must be considered when the key condition is that debt must be falling for all of the 10 years after the end of the transition period. These shocks affect i_t, g_t, and b_t. Further, we will assume that over the course of the 10-year period after the adjustment end $i_t - g_t$ will remain constant. This is a strong assumption, but it allows us to focus on the core mechanism laid out above, without worrying about other movements in $i_t - g_t$. We will discuss the influence of this assumption later.

A note on notation

Take $b_t = d_{t-1}(i_t - g_t)$. Intuitively, b_t should be in percent. If we also write d, i, and g in percent, we will get percent squared. As percent is obviously just a division by 100, this is no issue, and we can easily, for example, write $b_t = 140\%(3\% - 2\%) = 140\%^2 = \frac{140\%}{100} = 1.4\%$. However, we can also simply start with writing d as a ratio, i.e. $d = 140\% = 1.4$. This would avoid the mental math of dividing by 100. We believe this is simpler for our case and so adopt the convention of always writing b, i, and g (or anything else, also normal numbers) as percentages, while keeping d (and later x) as a share. One should note alone standing d are usually implicitly multiplied by 1% (e.g $1bii$)).

Financial stress

The '**Financial Stress**' scenario increases i_t (both long and short-term rates) by a risk premium p in the first year after the adjustment period, depending on d_{t-1}: $p = 1 + (d_{t-1} - 0.9) * 6, \ if\ d_{t-1} > 0.9, \ else\ 1$. A key part of the DSA is the path of the interest rate, which is determined by two parameters, the share of short-term debt (i.e., with a maturity of less than one year), α, and the average maturity of the long-term debt. The proportion of long-term debt that has to be rolled over each year is denoted by β.

When the increase in the risk premium materializes, the interest rate on the proportion of the long-term debt that is not rolled over during this year remains unchanged, i.e., the interest rate on the share $(1-\alpha)(1-\beta)$ of total debt remains unchanged. Meanwhile $\alpha + (1-\alpha)\beta$ (the short-term share + the long-term share that gets rolled over) is changed. We call this share γ.

This implies that the impact of the financial shock on interest payments is given by[9]:

$$increased\ interest\ burden = d_{t-1}[\alpha p + (1-\alpha)\beta p] = d_{t-1}[\alpha + (1-\alpha)\beta]p = d_{t-1}\gamma p$$

$$, where\ p = 1 + (d_{t-1} - 0.9) * 6, \ if\ d_{t-1} > 0.9, \ else\ 1.$$

So, the required primary balance to ensure that debt continues to marginally fall for a high debt country is given by:

$$b_t \geq d_{t-1}[(i_t - g_t) + \gamma(1 + (d_{t-1} - 0.9) * 6)], \ t = a + 1$$

Since this shock only applies in one period, we know the constraining period will be $t = a + 1$. We focus on this period and write:

$$b_t \geq d_{t-1}[(i_t - g_t) + \gamma(6d_{t-1} - 4.4)] = d_{t-1}(i_t - g_t) + \gamma 6 d_{t-1}^2 - \gamma 4.4 d_{t-1}$$

This one-year shock will also increase interest expenses in the following years. But the amounts will be less than in year one as short-term rates return immediately to baseline and only the (small)

[9] The '6' is in percent, the 0.9 is a share.

share of long-term debt contracted during the first period requires higher payments. The biggest impact of the financial shock thus comes immediately, the first year after the end of the adjustment period.

A key insight from writing the financial shock this way is that it shows clearly that the required buffer increases with the square of the debt level (the term d_{t-1}^2). This is very different from the other shocks that contain only linear terms. The squared term implies that the marginal impact of higher debt on the buffer increases with the level of debt itself. Alcidi and Gros (20219) make a similar observation about the increasing marginal cost of public debt.

The impact of the squared term is much reduced by the (composite) factor γ, which for most member countries is about 0.25 (given that the share of short-term debt is usually around 15 % and the maturity of long-term debt around 10 years). Its small size is a consequence of the assumption in the DSA that the financial shock applies only for one period. In a companion paper we also consider what happens if the shock is more persistent. In short, the impact on the required primary balance for high-debt countries is large and the financial shock scenario would become mostly dominant, unlike with the one-year version as we will show below.

'r-g' shock

The **'r-g'** scenario decreases g_t and increases $i_t (= r_t)$ by 0.5% for all $t \geq a + 1$. Here again, debt composition plays a key role since in the first year of this shock only a fall in the growth rate of half a percentage point will affect debt accumulation fully. By contrast, the increase in the interest rate affects only the part of the debt that has been refinanced in the last period.

More formally, we denote β_t' as the share of debt has been replaced with the higher interest rate.

$$b_t \geq max\{d_{t-1}\big((1-\beta_t')i_t + \beta_t'(i_t + 0.5) - (g_t - 0.5)\big)\}, \forall t \in [a + 1, a + 11]$$

Over the 10-year period, we assume the full debt stock has been replaced.[10] So, with a constant $i_t - g_t$, the highest b_t will be necessary once all debt is rolled over. Again, we focus only on this period and write[11]:

$$b_t \geq d_{t-1}(i_t - g_t) + d_{t-1}, t = a + 11$$

The full impact of the 'r-g' shock will come after 10 years – the opposite of the financial shock.[12][13]

Primary balance shock

The '**Lower spb'** scenario subtracts first 0.25 and then 0.5 from b_t. Since this is the same for all periods apart from the first one (where it is 0.25), we can write the constraint as:

$$b_t \geq d_{t-1}(i_t - g_t) + 0.5, \quad \forall t \in [a + 2, a + 11]$$

This case is simple. It implies a 0.5 % buffer with respect to the debt stabilizing primary balance.

[10] This assumes that all long-term debt has a 10-year maturity. The effect might be somewhat lower since any debt with a maturity of more than 10 years will still be at the pre-shock level.
[11] This is a simplification. In the DSA, $i_t = iir_t$. More on this can be found in Annex II.
[12] Here we multiply d_{t-1} by 1%, so it becomes percent as well.
[13] Note: here, we multiply d_{t-1} with 1%, which means the last $d_{t-1} = d_{t-1}$ *1%, but we omit the 1% for brevity.

Comparing Scenarios

Overall, since $i_t - g_t$ constant as we set $\Delta d_t = 0$, we can write the conditions as[14]:

$$1b) \quad b \geq d(i - g) \tag{3}$$

$$1bi) \quad b \geq d(i - g) + \gamma 6 d_{t-1}^2 - \gamma 4.4 d_{t-1} \tag{3a}$$

$$1bii) \quad b \geq d(i - g) + d = d((i - g) + 1) \tag{3b}$$

$$1biii) \quad b \geq d(i - g) + 0.5 \tag{3c}$$

The scenario with the primary balance decreasing is redundant as it will never be binding if debt is above 50 % of GDP.[15] Whether the financial or the r-g scenarios are binding depends on γ, and d. The difference between the two is given by

$$1bi) - 1bii) = \gamma 6 d_{t-1}^2 - \gamma 4.4 d_{t-1} - d_{t-1}$$

The debt ratio at which this difference is zero is thus the crossover point at which the financial shock becomes binding[16]

$$d_{t-1} = \left(\frac{1 + \gamma 4.4}{\gamma 6}\right)$$

It is apparent that if gamma were equal to 1 (a very long financial shock) the financial shock and the snowball shock would have the same impact at a debt ratio of 0.9 (or 90% of GDP). However, with the assumption that the shock last only one year and the low share of short-term debt gamma is only about 0.25. With $\gamma = 0.25$, this yields 140% (of GDP) as the limit up to which the r-g shock is binding. Given that most countries have a debt ratio below this value, it follows that the 'r-g' scenario will most of the time be binding. Italy is the only country on the borderline.

[14] We also display the main adjustment scenario as 1b). It is simply the debt stabilization criterion.
[15] below 60%, countries do not need to consolidate
[16] Set , $1bi) - 1bii) = 0$ and solve for d_{t-1}

Below, we visualized the calculations. The y-axis is the primary balance necessary to keep a constant (or slightly declining) debt trajectory; the x-axis shows the starting debt ratio. As mentioned above, the non-linearity in the financial shock scenario is attenuated by the one-year nature of the financial shock. As described, the primary balance shock (green) is never binding and strictly dominated by the r-g shock (orange). The financial shock (blue) becomes important once a certain level of debt is reached (here with $\gamma = 0.25$, 140%). Through the risk premium dynamics, it is increasing non-linearly.

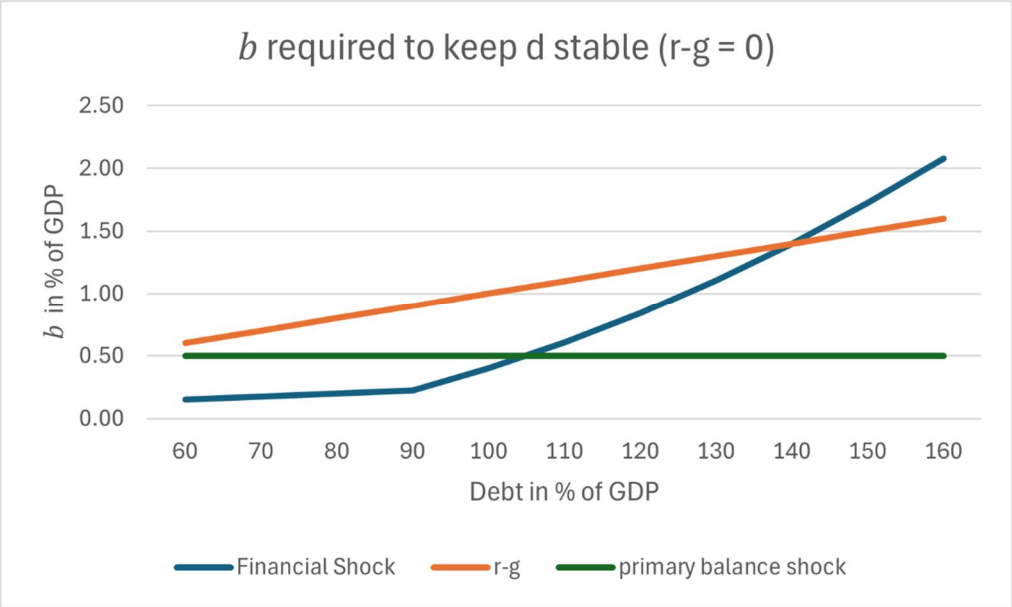

Figure 2 The primary balance required to keep a stable debt level

A note on the r-g

A crucial detail which we mentioned but not discussed so far is that debt needs to decline every year in the 10-year period. This means that the binding r-g is effectively the maximum r-g over this 10-year period (including the shocks applied to it). To see why this matters see table 2 below. It shows the maximum r-g over the 10-year adjustment period when simulating the DSA in the baseline case. The debt ratio is taken at the year of maximum r-g, which is in 2036. The 2036 debt forecast for the Spanish debt ratio for only 80%, is of course based on a considerable adjustment effort until then. For comparison, the current debt ratio for Spain is that 102 %. For the other large countries, there is no large difference between the forecast for 2036 and today. The maximum r-g for most countries is significantly different than the average r-g over the 10 years and subsequently requires a higher primary balance to maintain debt stability (a table with all countries can be found in Annex III).

Maximum and Mean r - g per Country

Based on a 4-year main adjustment period; Mean and Maximum from 2029 to 2039; Debt in year of Maximum.

Country	Year of Maximum	Mean r - g (%)	Max r - g (%)	Debt (% of GDP)	(Mean - Max)*d
ITA	2036	0.88	1.02	135	0.19
FRA	2036	0.29	0.52	121	0.28
ESP	2036	−0.16	0.42	83	0.48
DEU	2036	−0.64	−0.41	61	0.14

Source: Author's calculations based on the DSA implementation in Darvas et al. (2024)

Table 2 The maximum r-g per country. Debt-to-GDP of year in question according to DSA projection

4. The Impact of the NEC

Back-of-the-envelope calculations

This simplified representation of the relative importance of the different scenarios on the required (structural) primary balance at given initial debt levels allows us now to answer a simple question: by how much does the required (structural) primary balance increase if the debt to GDP ratio increases by 6 percentage points? The advantage of our simplified approach is that one does not need to run a fully-fledged simulation to obtain an estimate.

More in general, if we start out with a x percent higher debt stock, we can set $d + x = {}'d$ and calculate the difference between ${}'b$ and b, which will be what an x% increase in debt does to the primary balance necessary to keep debt stable[17]:

$$1b) \quad {}'b - b \geq {}'d(i-g) - d(i-g) = x(i-g) \tag{4}$$

$$1bi) \quad {}'b - b \geq {}'d(i-g) + \gamma 6\,{}'d_{t-1}^2 - \gamma 4.4\,{}'d - [d(i-g) + \gamma 6 d^2 - \gamma 4.4 d] = x(i-g) + x\gamma[12d + 6x - 4.4] \tag{4a}$$

$$1bii) \quad {}'b - b \geq {}'d(i-g) + {}'d - [d(i-g) + d] = x(i-g) + x \tag{4b}$$

$$1biii) \quad {}'b - b \geq {}'d(i-g) + 0.5 - d(i-g) - 0.5 = x(i-g) \tag{4c}$$

We plot this difference in figure 3. We see for an r-g of 1%, the 6% additional debt increases the primary balance differently depending on the scenario simulated. In the financial stress scenario, the increase becomes larger when the debt is higher initially. Further, the additional increase in the shock is quadratic in x. This implies that, especially at high debt levels, at which the financial shock will be dominant, the additional consolidation implied by even a small amount of additional debt becomes non-linear. Meanwhile, in r-g scenario the increase in primary balance is not dependent on the level of debt, same as in the primary balance shock.

[17] The derivation of 1bi) is in Annex I.

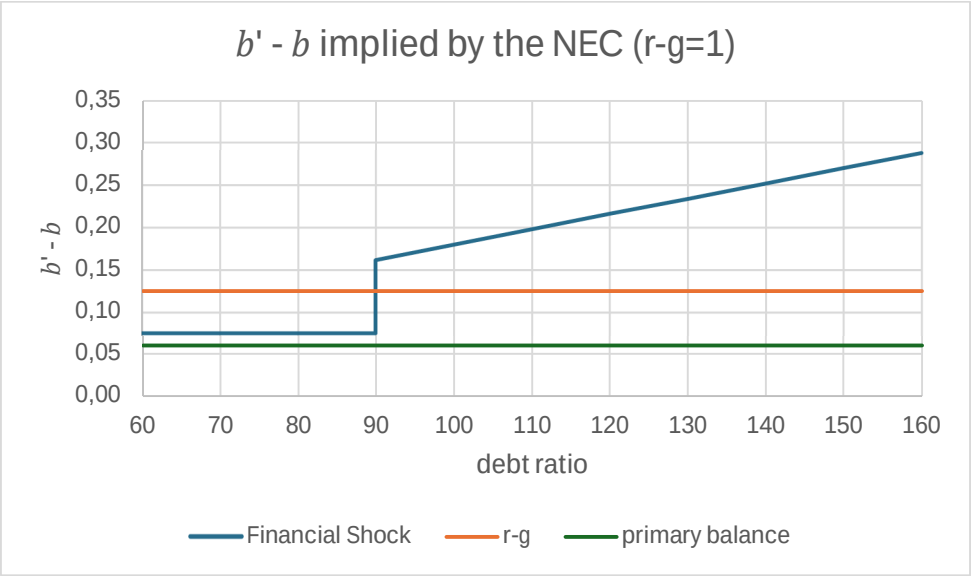

Figure 3 Change in Primary Balance implied by the NEC per Scenario.

For a simple numerical example use $r - g = 1, x = 0.06, d = 1.4, \gamma = 0.25$. Then we get, as can also be seen in figure 3,

$$1b) \quad {}'b - b \geq x(i - g) = 0.06\% \tag{5}$$

$$1bi) \quad {}'b - b \geq x(i - g) + x\gamma[12d + 6x - 4.4] \tag{5a}$$
$$= 0.06 + 0.015 * 16.8 + 0.015 * 0.36 - 0.015 * 4.4$$
$$= 0.2514\ \%$$

$$1bii) \quad {}'b - b \geq x(i - g) + x = 0.06 + 0.06 = 0.12 \tag{5b}$$

$$1biii) \quad {}'b - b \geq x(i - g) = 0.06 \tag{5c}$$

Simply put, as most countries have a debt ratio below 140 % of GDP, the binding scenario will be r-g (as displayed in figure 2), limiting the necessary consolidation because of the use of the NEC by much. However, for high-debt countries that can change quickly once they reach a certain level of debt (see figure 3).

Another angle of looking at the same issue can be found in (Alcidi and Gros 2019), who focus on the marginal cost of debt. The total cost of debt or interest expense is $d_t i_t$, where $i_t = r_t + \alpha(d_t - \text{threshold debt level})$. r_t is the risk-free rate.

This formulation is like the one in the financial shock scenario, where the risk premium is added to the normal rate, so we use this normal rate as a baseline here. Then, $\alpha = 6$, as in the DSA specified. The result is

$$d_t i_t = d_t[r_t + 6(d_t - 0.9)] = d_t r_t + 6d_t^2 - 5.4d_t.$$

Taking the first derivative with respect to d_t gives:

$$\frac{\delta(interest\ expense)}{\delta d_t} = r_t + 12d_t - 5.4$$

This represents the formal form of the conclusion above that the marginal cost increases. The additional cost of one more percent of debt depends on the level of debt to begin with. One additional percentage point of debt increases the primary balance necessary by the product of the debt level and the risk premium that must be accounted for.

The Simulation for Italy

We also use Bruegel's implementation of the DSA (Darvas et al. 2024) to simulate a 6% increase in the debt level and its impact on consolidation. In Annex II we lay some groundwork on the details of where the increased adjustment needs come from in the DSA. In particular, we take a closer look at how the interest rate is modelled in the DSA and how this can be simplified. We use the formalization and the intuition gained by our simplification of the interest rate dynamics to understand through what channels the increased consolidation necessity flows, and how this compares to our approximation.

Importantly, while the Commission uses two four-year adjustment periods in sequence to understand the impact of the NEC on the consolidation necessary (European Commission 2025a), we assume that the 6% of additional debt are added at the last year of the adjustment period and needs to be accounted for within this first four year period. We add this in a way that does not lead to cyclical effects, i.e. a change in the output gap. Instead, it only affects the debt ratio and the interest rate through a higher debt level and refinancing costs. This allows us to focus on the intuition behind the overall increase in consolidation necessary and abstracts from the cyclical effects. Further, we can then decompose through which channels the increased consolidation necessary arises in the DSA and compare that to our simplification. Therefore, one should not read the scenario as 'what would happen if at the end of the adjustment period if all of a sudden the country had a 6% higher debt?', but as 'what would happen structurally, in the long run, with higher debt and subsequently higher adjustment needs?'. Naturally, if the debt were added, in the short-run, we would expect a change in the output gap. However, our goal was to show and analyze the long-run impact, which we think is clearer this way.

Here we present a simulation for Italy, which is the most interesting case since its debt ratio is close to the borderline beyond which the quadratic part of the debt burden becomes dominant.

Our simulation suggests that for Italy using the 6% NEC would increase the required consolidation of the primary balance by 0.132 (% of GDP), close to our simplified calculation above. Further, by the time of the binding case, x dropped to 5.79 as the NEC case consolidated more, and subsequently, the debt decreased faster overall. It should be noted that in the simulation, the binding year is not the last, but the 7th of the 10 years. Further, as specified before, we focus only on the primary balance dynamics and disregard the age-adjustment part.

We can use the framework developed in Annex II to decompose the increase into the four parts. For each part, we see how much it contributed to the total increase of 0.132. While we leave a full discussion of the differences in Annex II, we present the final version for the r-g case here. Note, $'q_t$ is the amount of primary balance increase of the interest rate that influences the r in r-g. Intuitively, an increase in the interest rate today does not fully affect the r-g relevant interest rate as the current debt is still financed through earlier interest rates. So, of the 0.5 increase in the r-g case, only $'q_t$ actually 'arrives' in the r-g dynamics. For details consult the Annex II. The differences in consolidation between the baseline (debt d_t) and an increase in debt ($d_t + x = {}'d_t$) can be decomposed into four terms:

$$'b_t - b_t \geq x_t('i_t - g_t) + x_t('q_t + 0.5) + d_t('i_t - i_t) + d_t('q_t - q_t) \quad (6)$$

Further, we can calculate those terms to understand the relative importance of different channels that lead to an increase in the necessary primary balance:

$$x_t('i_t - g_t) = 0.058$$

$$d_t('i_t - i_t) = 0.019$$
$$d_t('q_t - q_t) = 0.008$$
$$x_t('q_t + 0.5) = 0.050$$

In total, we get 0.135, which we then need to correct by 1/(1+ng) as the DSA does not work with the approximate form (see chapter in the simplified core DSA) to get the above-mentioned 0.132.

The first term is the familiar case as presented in 1b), the second term is a modification of 1bii) $((i - g) + x)$. Simply put, the DSA does not immediately adjust the interest rate after it increases. So, an increase in 0.5% will only increase the DSA relevant interest rate by $'q_t$. These two terms which parallel our simplification closely make up the largest part if the additional consolidation necessary, 0.108. The big difference between the full DSA and our approximation comes from $d_t('i_t - i_t)$ and $d_t('q_t - q_t)$. In short, the DSA relevant interest rate is more complicated than we discussed so far (Details can be found in the Annex II) and is a composite of the long- and short-run interest rates of every year in the simulation. For each year, these two interest rates get a weight, depending on how much of the debt stock they affect is rolled over in that year. For example, if in one year 10% of the long-term debt stock is rolled over, these 10% then become part of the DSA relevant rate in later years (although not necessarily with a weight of 10%).

So, if we add a lot of debt to the debt stock, the share of new debt to overall debt increases, which in turn increases the weight attached to this year's interest rate, compared to no increase in the debt stock. This change in the weight has two effects. First, in relative terms, it lowers the weights of the interest rates of other years, As now the new interest rate already is affected by the 0.5% increase, the weights of the interest rates not yet affected effectively decrease, and therefore the DSA relevant interest rate increase. This is measured by $d_t('q_t - q_t)$. Second, if the interest rate in the year of the added debt is relatively higher than the interest rates in other years, then the increase in weight for this year also increases the DSA relevant interest rate. This is measured by $d_t('i_t - i_t)$ and is the main mechanism that is not captured by our approximation. Intuitively, this is only important if the difference between that year's interest rate and the DSA relevant interest rate is large when we add the debt. If it were zero, i.e. $'i_t - i_t = 0$, their would be no effect[18].

To conclude, even for a high debt country like Italy, the impact of the higher debt resulting from use of the NEC seems manageable (less than 3 billion euro). If debt could be added without increasing the DSA relevant interest rate, e.g., with SAFE loans, the impact of this could be even lower. Overall, we find that our simplification is a parsimonious way to obtain a good estimate of the impact of the NEC.

[18] A more detailed explanation is provided in Annex II.

Part II: Defense Readiness 2030, the end of the peace dividend and the issue of Backloading

Here we deal with some measurement issues for public finances when military expenditure must increase. First, we present some historical context. Then we move on to technical questions about how the spending is measured and discuss the impact of the measurement and how it can lead to backloading.

1. Military Expenditure before the End of History – and now

Many frame the renewed defense efforts as the end of the peace dividend (e.g., Fuest 2025). If one reads this as implying that spending will go back to Cold War levels, one underestimates the scale of the anticipated spending for some countries. A simple calculation can visualize the magnitude. Take the average spending towards the end of the Cold War and the average of the following decades before Russia's annexation of Crimea (see plot below). The peace dividend was significant and broadly enjoyed. For Germany and France, the peace dividend seems to be vanishing. However, for Italy and Spain, the scale of the proposed spending goes far beyond Cold War levels.

So, the 3.5% cannot be characterized as simply the peace dividend vanishing. A better framing is maybe to see it as the price for strategic autonomy from the US. In that framing, even during the Cold War, the US ultimately guaranteed European defense, allowing some countries to keep expenditure lower than theoretically necessary to maintain a credible deterrence. Now, with the USA pivoting to the Pacific, Europe needs to pay for the defense burden itself.

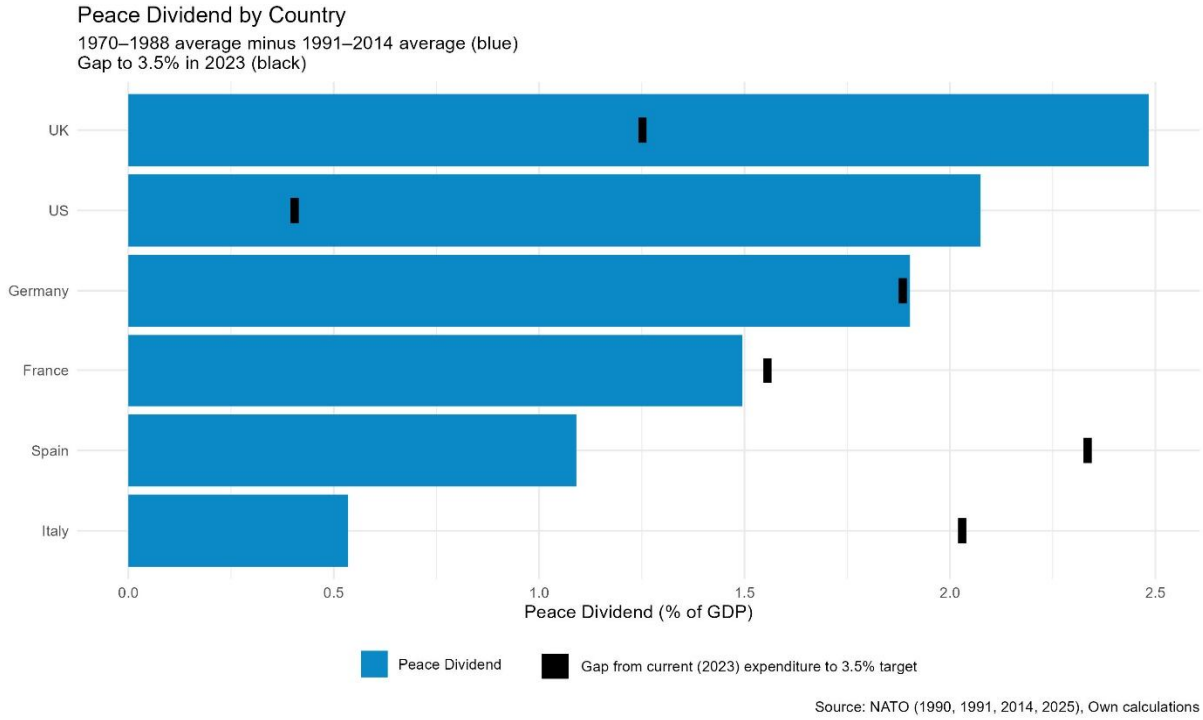

Figure 4 The peace dividend

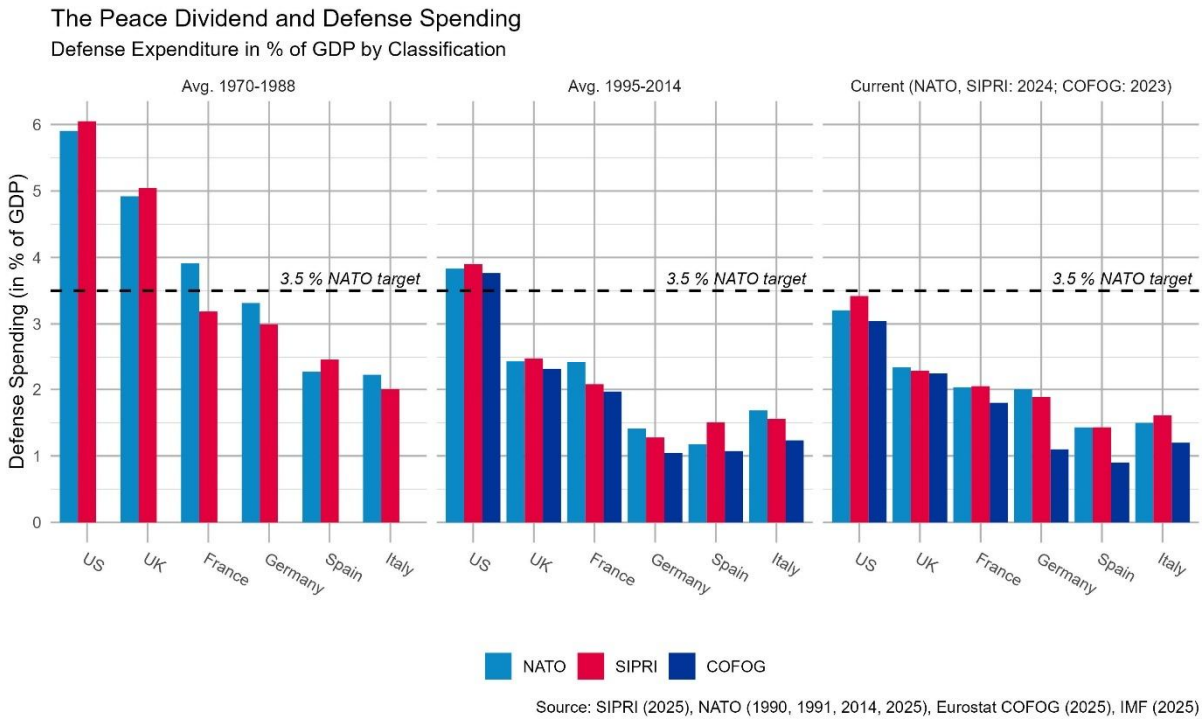

Figure 5 The peace dividend in different measuring methods

2. Measuring Military Expenditure

Military expenditure is often measured in terms of GDP. However, what counts as 'military spending' is hard to define, and different definitions exist. This is relevant for the DSA. Concretely, the 3.5% target by NATO refers to the NATO definition of spending (NATO 2025). However, the DSA runs on the COFOG definitions of the national accounts (Regulation - 549/2013 - EN - EUR-Lex 2013). To understand the differences and why they matter, we shortly compare NATO, COFOG, and SIPRI[19]. In the next chapter, we then explain how this applies in the DSA.

As displayed in the table below, NATO, SIPRI, and COFOG all include the same core components, like personnel, arms, and maintenance spending. The difference emerges mainly in the treatment of pensions and healthcare benefits, the inclusion of paramilitary forces, and when capital purchases are recorded.

Coverage and Recording Differences Across Defense Datasets

Data	Pension + Health	Paramilitaries	When recorded?
SIPRI	Included	Included	Order date
NATO	Included	Included if 'realistically deployable'	Order date
COFOG	Not Included	Included if in Function 2: Defense	Arrival date

Sources: *SIPRI (2017); Eurostat (2024); European Commission (2025b)*

Table 3 Comparison of different defense expenditure accounting methods

[19] We add SIPRI for completion and because it allows for longer standardized time series to contextualize the military spending.

According to the European Commission (2025c), only the timing of the recording is expected to lead to 'systematic differences' between COFOG and NATO. However, this is not quite correct. Differences in the inclusion/exclusion of pension payments and/or paramilitaries should lead to a relatively stable difference between NATO, COFOG, and SIPRI. It is the difference in the timing between NATO and COFOG that becomes relevant when expenditure increases rapidly.

Looking at Spain, Italy, France, and Germany, the series roughly track each other. Apart from France and Italy in the early 2000s, the lines are roughly in parallel, although some changes might have come from differences in reporting standards in the early 2000s. Likely, without them, the lines would have been closer to the other two. Recently, although 2024 data is not yet available for COFOG, the increase in spending by Germany is already visible in NATO but has yet to fully materialize in COFOG.

The differences are further exemplified by the Baltic states. For most countries, the spending as percentage of GDP per capita according to NATO is significantly higher than in COFOG, but not for the Baltics. This is because the Baltics 1) don't have the large paramilitary forces that count towards their NATO commitment, 2) have reconstituted their militaries after gaining independence and so have lower pension benefits now, and 3) their military aid to Ukraine counts immediately under COFOG, but not under NATO. Especially the last point underestimates spending in NATO. This, in conjunction with large orders (and subsequent increase in NATO, but not already COFOG), leaves the balance roughly even. Meanwhile, Poland does have a significant difference over time.

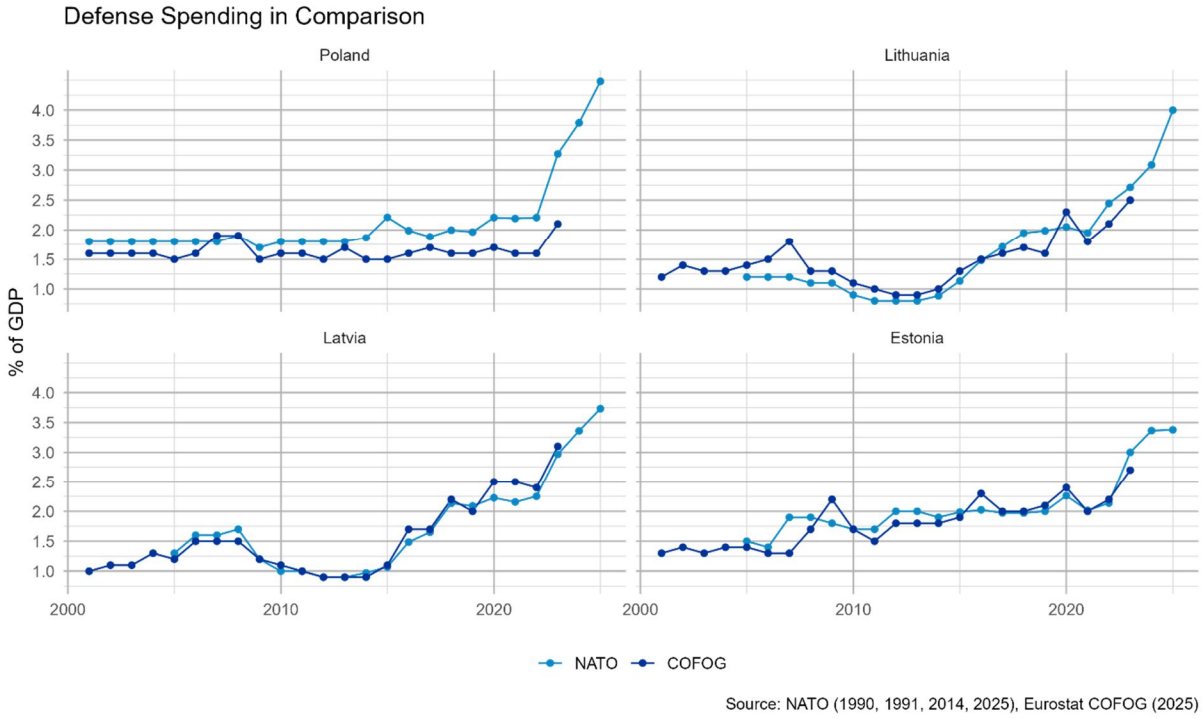

Figure 6 NATO and COFOG spending for selected countries

Case Study: F-35 procurement by Germany

Germany decided to buy new F-35s to replace old 'Tornado' fighter jets in March 2022 and signed a contract with the US government in December 2022 (Bundeswehr 2022). Then, in the 2023 budget of the Ministry of Defense, 635 million EUR were budgeted for 2023 for procurement of the F-35. Additionally, 8.8 billion EUR were already budgeted for the coming years, without indication when these costs would materialize (Bundesministerium für Verteidigung 2023). Then in 2024, 1.38 bn. EUR were budgeted for the F-35 in 2024, with details of future spending up to 2031: from 2025 to 2027, the budgeted amount was small, totaling only around 15 million EUR. However, from 2028 to 2031, between 400 and 865 million EUR were budgeted yearly (Bundesministerium der Verteidigung 2024). However, that changed again in the 2025 budget, where for 2026 and 2027 around 200 million EUR were budgeted (Bundesministerium der Verteidigung 2025).

Further, the first deliveries are planned for 2026, 4 years after signing the contract, and 3 years after the first payments (Bundeswehr 2022). With regard to NATO vs. COFOG accounting, the yearly payments would count towards NATO defense expenditure. Meanwhile, in COFOG, an effect would only start to appear in 2026, when the first jets arrive.

Below you see a graphical representation (arrows not to scale) of how COFOG and NATO would record these purchases. NATO would immediately book them once payments are made. Meanwhile, COFOG only starts booking them once the deliveries start to arrive.

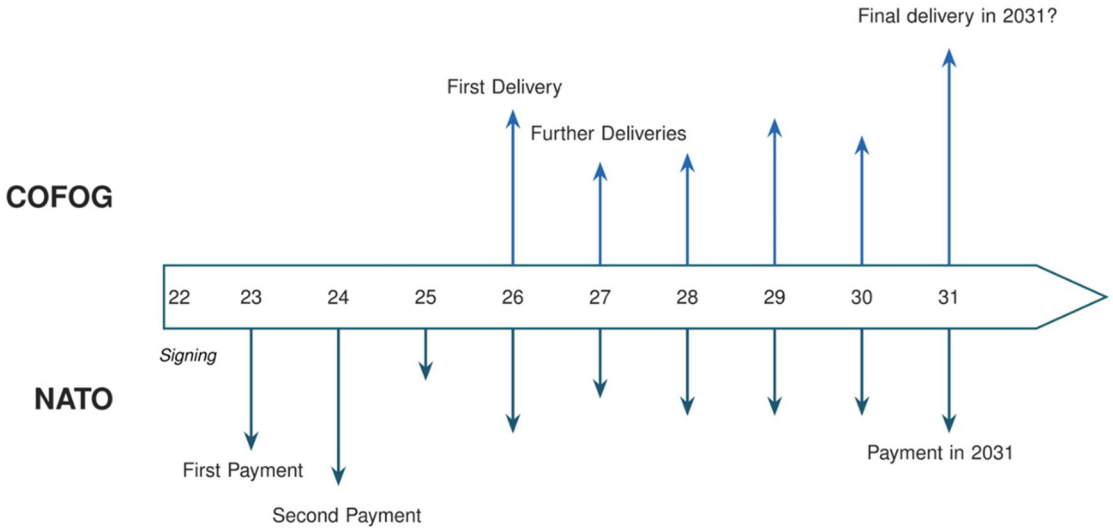

Figure 7 Recording of defense spending in NATO and COFOG

3. Ukraine Support

Since the NATO summit 2025, support for Ukraine will count towards the 5% target (NATO 2025), while before it did not (Litra 2025). Within COFOG, the contributions are not yet standardized and are not all recorded in 'foreign military aid'. However, according to EUROSTAT, it should not 'affect the total level of expenditure'. We take that to mean that the spending is recorded in defense, but not necessarily correctly under military aid. Importantly, for Slovakia, the 'military defense' category is negative. This is because the equipment delivered to Ukraine was booked as negative capital formation, leading to a negative entry.

4. The issue of Backloading in COFOG

As discussed, timing could lead to important differences between COFOG and NATO figures. COFOG forms the basis of assessing the impact of defense spending on a government's financial position in the new fiscal framework (European Commission 2025b). The Commission also recognizes the issue of timing differences in COFOG vs. NATO in relation to the NEC (European Commission 2025b), and grants leeway in these matters (details below). However, disregarding the NEC, timing difference can lead to issues; Procurement now, recorded according to NATO, will only appear in COFOG in years to come (see Figure 7). This leads to an apparent backloading in expenditure, which can become an issue when evaluating the DSA.

Take a scenario with an order in year 1 with value x, equal payment tranches in years 1,2, and 3, and delivery in year 3. NATO would record the spending every year as x/3. However, COFOG would record 0 in years 1,2, and then x in year 3. This makes the DSA harder to analyze in two ways. First, while monitoring the progress of consolidation, the first two years would look promising, while in the third period, suddenly, this progress would be wiped out; this is exacerbated by a potentially positive stimulus from added spending. Second, since this spending is foreseeable, one could argue it needs to be considered when finding the consolidation necessary to achieve a plausibly downward path. This would be analogous to the costs of ageing, which are considered during the adjustment period, even if they increase only later.

Concretely, applying a similar logic to COFOG defense spending as for costs of ageing could look like this: Assume all orders are scheduled to arrive 2 years after the end of the adjustment period. Given the 'plausibly downward' requirement and no policy change assumption, an MS would need to consolidate enough to absorb this one-off shock while remaining plausibly downward and would run a much higher budget surplus before and after only because of that one year. Had the added spending been recorded as in NATO, the spike would have been avoided, and less consolidation would have been necessary.

Now, such an extreme scenario is unlikely[20]. More likely, COFOG spending is 'just' lagging NATO spending[21] and rises continuously once orders start to arrive. However, the same logic applies. The spending is foreseeable, and assuming no policy change, governments would need to take it into account when planning consolidation. Otherwise, deviations from the plausibly downward path will happen when equipment starts to arrive, even if in the short term the net expenditure path is met.

With regards to the NEC, the COFOG lag could mean that if an MS starts procuring now, it could only use the room created in year 3 (e.g., in the scenario outlined above) and would forego the room created by the NEC in years 1 and 2. Given timelines for large and complex procurement projects[22], such scenarios are likely. So, since the NEC is limited to 4 years, governments might miss out on parts of the flexibility the NEC offers, as the COFOG military spending only increases with a lag. The Commission recognizes this issue and, in the acceptance of Germany's national medium-term fiscal structural plan, provided for that by stating that orders signed during the NEC activation, but delivered later, will be subject to the NEC (European Commission 2025b).

[20] EC has given e.g. the Czech Republic a pass on large on-off deficits (Palowski 2024).
[21] Adjuted for constant differences in what is included.
[22] See the F-35 example.

Concluding remarks

The debt sustainability analysis that forms the backbone of the new fiscal rules is a black box. Its implementation requires thousands of lines of code. This makes it very difficult for policymakers to rapidly calculate the implications of policy decisions today on future adjustment needs.

In this paper, we have provided a sort of 'rule of thumb' to calculate the increased adjustment needed resulting from higher debt levels, which has two elements:

i) A higher debt level requires an additional adjustment in the primary balance of $d(r - g)$ just to keep the debt level constant.

ii) A higher debt level increases the buffers required to keep the debt level on a 'plausibly downward' path.

We find that up to a debt level of around 140 % of GDP, the main driver of the second element of future adjustment needs is the so-called 'r-g' shock of the DSA (which specifies an increase in the interest rate and a fall in the growth rate of half a percentage point). At higher debt ratios, the financial shock becomes more important because it contains a quadratic element.

We apply this rule of thumb to the hypothetical case of Italy using the NEC and find that the results are close to the full simulations. The results indicate that even at high debt levels the NEC offers meaningful fiscal space without unduly compromising long-term debt sustainability, requiring an additional increase in the primary balance of around 0.12% for high r-g countries.

We also look closer at the measurement of military expenditure from various sources and find in some cases important differences between those coming from NATO and those used from Eurostat that are used in the EU fiscal framework. The NATO figures represent an important political signal, but they can differ substantially from the Eurostat figures, which use a different approach. These differences are particularly acute when military expenditure increases rapidly, as now. We argue that the NATO figures should be preferred if one is interested in the impact on the economy and public debt.

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Annex I: Derivations

Derivation for 1bi)

$b \geq d(i\ -g)\ + \gamma 6 d_{t-1}^2 - \gamma 4.4 d_{t-1}$

$'b\ - b \geq d'(i\ -g)\ + \gamma 6' d_{t-1}^2 - \gamma 4.4' d\ - [d(i\ -g) + \gamma 6 d^2 - \gamma 4.4 d]$

$'b - b \geq (d + x)(i\ -g) + \gamma 6(d + x)^2 - \gamma 4.4(d + x)\ - d(i\ -g)\ - \gamma 6 d^2 + \gamma 4.4 d$

$'\mathrm{b} - b \geq d(i\ -g) + x(i\ -g) + \gamma 6[d^2 + 2dx + x^2] - \gamma 4.4 d\ -\ \gamma 4.4 dx - d(i\ -g) - \gamma 6\mathrm{d}^2 + \gamma 4.4 d$

$b' - b \geq x(i\ -g) + \gamma 6[d^2 + 2dx + x^2] -\ \gamma 4.4 x - \gamma 6 d^2$

$b' - b \geq x(i\ -g) + \gamma 6 d^2\ \ + dx\gamma 12\ +\ \gamma x^2 6\ -\ \gamma 4.4 x - \gamma 6 d^2$

$b' - b \geq x(i\ -g) + dx\gamma 12\ +\ \gamma x^2 6\ -\ \gamma 4.4 x$

$b' - b \geq x(i\ -g) + x\gamma[12d + 6x\ -\ 4.4]$

Derivation of the iir

$iir_t = \alpha_{t-1} i_t^{ST} + (1 - \alpha_{t-1}) iir_t^{LT}$

$iir_t^{LT} = \beta_{t-1} i_t^{LT} + (1 - \beta_{t-1}) iir_{t-1}^{LT}$

First, focus and expand the long-term iir, with

$$iir_t^{LT} = \beta i^{LT} + (1 - \beta) iir_{t-1}^{LT} = \beta i^{LT} + (1 - \beta)[\beta i^{LT} + (1 - \beta) iir_{t-2}^{LT}]$$

$$iir_t^{LT} = \beta \mathrm{i}^{\mathrm{LT}} \sum_{\mathrm{k}=0}^{t-t_0-1} (1 - \beta)^{\mathrm{k}} + (1 - \beta)^{\mathrm{t}-\mathrm{t}_0} iir_{t_0}^{LT}$$

Using the properties of the geometric series:

$$\sum_{k=0}^{t-t_0-1} (1 - \beta)^k\ = \frac{1 - (1 - \beta)^{t-t_0}}{\beta}$$

$iir_t^{LT} = i^{LT}(1 - (1 - \beta)^{t-t_0}) + (1 - \beta)^{t-t_0} iir_{t_0}^{LT}$

$iir_t^{LT} = i_t{}^{LT} + \left(iir_0^{LT} - i_t{}^{LT}\right)(1 - \beta)^{t-0}$

And subsequently:

$iir_t = \alpha i^{ST} + (1 - \alpha) iir_t^{LT}\ = \alpha i^{ST} + (1 - \alpha)[i^{LT} + (iir_0^{LT} - i^{LT})(1 - \beta)^t]$

$iir_t = \alpha i^{ST} + (1 - \alpha) iir_t^{LT}\ = \alpha i^{ST} + (1 - \alpha) i^{LT} + (1 - \alpha)(iir_0^{LT} - i^{LT})(1 - \beta)^t]$

$iir_t = \alpha i^{ST} + (1 - \alpha) i^{LT} - i^{LT}(1 - \alpha)(1 - \beta)^t\ +\ iir_0^{LT}(1 - \alpha)(1 - \beta)^t$

Annex II: Details of the interest rate path under the DSA relative to the simplified approach

To understand where our approximation differs from the full simulations, we first need to understand how an increase in the debt ration generally affects the DSA. We do this in the formalization right below. From that point, we need to better understand the interest rate dynamics in the DSA, as it is much more complex that our simplified assumptions. We do this first under simplifying assumptions (The iir – Simplified) to build the intuition how interest rates, in the DSA mainly the iir, evolve, but then move on the more general case (The iir – with changing refinancing shares and interest rates). Then we turn our attention to the r-g scenario, as this is usually binding. We apply our formalization to it, and also connect it to our approximations. Finally, we put numbers to our approximations and decompose the simulation to understand the differences.

Baseline formalization of the difference in consolidation:

Looking at the baseline debt dynamics equation, the increased consolidation can come from three places: The added debt x_t, a changed interest rate $'i_t$ or a change in the growth rate $'g_t$. We denote with " ' "the scenario with added debt. We can write this as:

$$'b_t - b_t \geq d_t('i_t - 'g_t) - d_t(i_t - g_t) = x_t('i_t - 'g_t) + d_t('i_t - i_t) + d_t(g_t - 'g_t) \quad (6)$$

In the DSA, the output gap closes within 3 years after the adjustment end. Since, as seen above, r-g will usually be binding and is strongest towards the end of the adjustment period, we will assume $'g_t = g_t$ going forward.

What the equation above makes clear is that the interest rate, and especially changes in it, become very important to understand the difference in consolidation. We will subsequently give a quick overview of how the interest rate in the DSA evolves, and how it can be simplified.

The iir – simplified

So far, we assumed that over 10 years, the full debt stock gets rolled over. However, the DSA uses a different procedure. Namely, i_t is the iir_t, the weighted average of the short-term debt share α_{t-1} with interest rate i_t^{ST} and the long-term iir_t^{LT}. The iir_t^{LT} in turn is a weighted average of the newly rolled over long-term debt share β_{t-1} and the iir_t of the continuing long-term debt. This can be written as:

$$iir_t = \alpha_{t-1} i_t^{ST} + (1 - \alpha_{t-1}) iir_t^{LT}$$

$$iir_t^{LT} = \beta_{t-1} i_t^{LT} + (1 - \beta_{t-1}) iir_{t-1}^{LT}$$

First, we simplify again by assuming $\beta_{t-1} = \beta$, $\alpha_{t-1} = \alpha$, $i_t^{LT} = i^{LT}$, and $i_t^{ST} = i^{ST}$ for all periods after the end of the adjustment period and iir_0^{LT} the iir_t in the last year of the adjustment period. We can use the properties of a finite sum geometric series and some algebra to get[23]:

$$iir_t = \alpha i^{ST} + i^{LT}(1 - \alpha)(1 - (1 - \beta)^t) + iir_0^{LT}(1 - \alpha)(1 - \beta)^t \quad (4)$$

Intuitively, iir_t is the weighted average of the short-term interest rate i^{ST}, the long-term interest rate i^{LT}, and the never rolled over long-term interest rate iir_0^{LT}. The difference to our assumptions above is that there is a share that is never rolled over, although with decreasing importance as t increases. We use a, b, and c, which sum up to one, to write:

$$iir_t = a i^{ST} + i^{LT} b_t + iir_0^{LT} c_t$$

Now, assume we add the r-g shock again. This can be written as:

$$iir_t = a(i^{ST} + 0.5) + b_t(i^{LT} + 0.5) + c_t iir_0^{LT}$$

Assuming $i^{ST} = i^{LT} = iir_0^{LT} = i_0$:

$$iir_t = a(i_0 + 0.5) + b_t(i_0 + 0.5) + c_t i_0 = i_0 + (a + b_t)0.5$$

Now, it becomes clear how the r-g shock feeds through to the iir_t. Over time b_t increases, and so does the share of the new interest rate. Meanwhile, the share of iir_0^{LT} becomes smaller. This is why the t subscript is important here. The higher t, the more the shock becomes important. If we plug in realistic values for Italy, $\alpha = 0.13$, $\beta = 0.11$ at $t = 10$, we get:

$$i_t = i_0 + 0.35$$

Differently put, the shock to the interest rate is muted. Even after 10 years, the iir_t only increased 0.35, instead of the full 0.5 that we assumed so far:

$$i_t = i_0 + 0.5$$

To generalize, we call q the amount of r shock passed through to the irr. Above, $q = 0.35$.

Referring to 1bii), we would need to modify it to:

$$1bii) \quad b' - b \geq x(i - g) + x(0.5 + q)$$

Using 0.35 as above, this would give us an adjustment necessary of 0.111.

[23] Derivation in Annex I.

The iir – with changing refinancing shares and interest rates

So far, we assumed a constant β and interest rates. This works well to build the intuition of the iir. However, in the DSA, this is not the case.

The starting point of the interest rates are national current (2025) short- and long-term rates. It is assumed that from this starting point the rates will converge linearly to the 3m10y and 10y10y forward rates respectively within ten years (i.e. 2034). From these 2034 levels, they will then converge to 2% (short) and 4% (long) withing another 20 years and then remain there (European Commission 2024b).

The share of long-term debt that gets rolled over every year, β_t, changes over time and is sensitive to changes in the debt stock. So, by adding x_t, we change β_t, and subsequently the weighting of the no longer constant interest rates. This is because of how we implement the added debt x_t. We added it to the gross financing needs in the last year of the adjustment period and the debt ratio d. Then, we deduct x_t again when the check for decreasing debt is performed. While α is constant, β_t can change as it is set in every period to the share of new long-term debt to overall debt. However, neither the new long-term debt nor the total debt stock is constant over time. As the primary balance is chosen so that debt is always at least marginally declining, there are periods of stronger decline and a change in the total debt stock. This also leads to the gross financing needs to change, in varying years, the primary balance used to pay back the debt changes.

So, simply put, adding x_t changes β_t, which in turn changes the weighting of ${i_t}^{ST}$, ${i_t}^{LT}$, and iir_0^{LT}. To clarify this, consider the full version of the interest rate dynamics again:

$$iir_t = \alpha_{t-1} i_t^{ST} + (1 - \alpha_{t-1}) iir_t^{LT}$$

$$iir_t^{LT} = \beta_{t-1} i_t^{LT} + (1 - \beta_{t-1}) iir_{t-1}^{LT}$$

Since neither β_t nor i_t^{ST} or ${i_t}^{LT}$ are constant, we can no longer compress the iir dynamics into a neat form but instead must write it out as a sum and product of each year. However, the core intuition remains. Remember again the simplified form for the above:

$$iir_t = \alpha i^{ST} + i^{LT}(1 - \alpha)(1 - (1 - \beta)^t) + iir_0^{LT}(1 - \alpha)(1 - \beta)^t \quad (5)$$

It is a weighted average of different interest rates. The full form just expands this to have a weight for each year and interest rate (i_t^{ST}, ${i_t}^{LT}$, iir_0^{LT}).

Similarly, we can reuse q from above. It is simply the part of the iir that never received the additional 0.5 interest rate shock. Looking at the long-term iir, we see that always a share $(1 - \beta_{t-1})$ is not updated. Subsequently, we can easily expand this to find the part that has never been updated c_t:

$$iir_t^{LT} = \beta_{t-1} i_t^{LT} + (1 - \beta_{t-1}) iir_{t-1}^{LT}$$

$$c_t = \Pi_{j=1}^{m}(1 - \beta_{t-1})$$

$$q_t = (1 - c_t) * 0.5 = (1 - \Pi_{j=1}^{m}(1 - \beta_{t-1})) * 0.5$$

There will thus be always some proportion of overall debt that has not been affected by the shock. This implies that our calculations regarding the r-g scenario represent an upper bound.

Changing refinancing shares and interest rates in the r-g scenario

We can then use a similar formulation as above to understand the r-g scenario:

$$b_t \geq d_t\big(i_t + q_t - (g_t - 0.5)\big) = d_t(i_t - g_t) + d_t(q_t + 0.5)$$

$$'b_t - b_t \geq 'd_t('i_t - g_t) + 'd_t('q_t + 0.5) - d_t(i_t - g_t) - d_t(q_t + 0.5)$$

$$'b_t - b_t \geq x_t('i_t - g_t) + d_t('i_t - i_t) + d_t('q_t - q_t) + x_t('q_t + 0.5) \quad (8)$$

It is made up of four terms ($'g_t = g_t$, so that term disappears): The first two are familiar and the same as in the baseline case. Now, however, we also add q_t, which is changing over time and between scenarios. Intuitively, the last two terms indicate how strongly the change in weights that affects how quickly the shock feeds through in the iir, changes the consolidation necessary.

The approximations in our framework

We now have the necessary ingredients to analyze our simulation and compare it to the simplified calculations. The focus is on the r-g scenario as this is usually binding as discussed.

First, take full decomposition:

$$'b_t - b_t \geq x_t('i_t - g_t) + d_t('i_t - i_t) + d_t('q_t - q_t) + x_t('q_t + 0.5) \quad (8)$$

Now we assume $'i_t = i_t = i$, $g_t = g$, and $'q_t = q_t$. Further, as q_t is increasing in t and $x_t = x$ under $\Delta d_t = 0$, we know the binding period will be $t = 10$ and so assume we are in $t = 10$ and remove time indices. This then reduces to:

$$'b - b \geq x(i - g) + x(q + 0.5)$$

Which is the extended Baseline case as described at the start of the chapter. If we go another step further and assume that $q = 0.5$, i.e., that it will fully affect the interest rate, we write:

$$'b - b \geq x(i - g) + x$$

Which is the baseline case we discussed at the beginning.

The approximations in our framework – Calculations

Baseline

Our baseline approximation for a 6% increase in debt yields for the r-g scenario:

$'b - b \geq x(i - g) + x = 0.06 + 0.06 = 0.12$

Importantly, this does not depend on the debt rolled over every year or the debt level. However, it does depend on r-g = 1% by the end of the 10-year trajectory.

Baseline – Extended

Here, we introduce more realistic iir dynamics and make it explicit that only part of the 0.5% increase in the interest rate will reach the iir within the 10-year period. Now, the share of debt that has rolled over and the difference between short and long-term debt have become important.

$$'b - b \geq x(i - g) + (0.5 + q)x = x(i - g) + (0.5 + q)x = 0.111$$

Simulation – Decomposed

We start with our established framework:

$$'b_t - b_t \geq x_t('i_t - g_t) + d_t('i_t - i_t) + d_t('q_t - q_t) + x_t('q_t + 0.5) \quad (8)$$

However, the values of $'i_t, i_t, 'q_t, q_t$ are not directly observable. However, we can rearrange:

$'b_t - b_t \geq x_t('i_t + 'q_t - g_t + 0.5) + d_t('i_t + 'q_t - i_t - q_t)$

$'b_t - b_t \geq x_t('iir_t - ng_t) + d_t('iir_t - iir_t)$

We use $ng_t = g_t + 0.5$ as the observed growth rate in Breugels' implementation, as well as $iir_t = i_t + q_t$, the observed iir[24]. Further, we can calculate $'q_t$ using the β_t from the simulation. Then, we can backtrack i_t[25]. This then allows us to decompose the difference fully. For each part, we see how much it contributed to the total increase of 0.132:

$$x_t('i_t - g_t) = 0.058$$
$$d_t('i_t - i_t) = 0.019$$
$$d_t('q_t - q_t) = 0.008$$
$$x_t('q_t + 0.5) = 0.050$$

In total, we get 0.135, which we then need to correct by 1/(1+ng) as the DSA does not work with the approximate form (see chapter in the simplified core DSA) to get the above-mentioned 0.132.

Importantly, we now know where the additional consolidation comes from. Roughly half comes from the main mechanism $x_t('i_t - g_t)$, which is also in this form, part of the simplified version[26]. The second important contribution comes from $x_t('q_t + 0.5)$, which we discussed in detail in the part about the simplified iir. The form is the same with q being again the increase in the interest rate that went through to the iir. Notice, the first two come to 0.108, very close to what we predicted in that chapter.

[24] The i_t here does not exist in the simulation. It is the counterfactual iir where the 0.5 were never added. We can only imply it via q_t, which we can compute.
[25] An R script for these calculations is available upon request.
[26] r-g is approximately 1 also in the full DSA in the binding period.

The big difference between the full DSA and our approximation comes from $d_t('i_t - i_t)$ and $d_t('q_t - q_t)$. They both increase the consolidation in a very similar way. We add the 6% to the debt stock in the last year of the adjustment period. By how the simulation works, the β used for the next year's iir calculation is calculated from the relative new long-term debt added in the year before. Naturally, β spikes relative to the case without x from 11% to 15%. This then got used in the next period.

So, compared to no NEC, the added debt leads to a change in the refinancing rate of the long-term iir. This changes two things: First, how much of the 0.5% shock feeds through to the iir. The effect of this is captured in $d_t('q_t - q_t)$. Second, if there is a large difference between the long-term interest rate and the iir, then the 4% leads to an increase in the iir by way of refinancing with a higher interest rate. This is captured by $d_t('i_t - i_t)$. Naturally, these differences in the iir need to be multiplied by d to capture the effect on the primary balance. In Italy's case, that is exactly what happened. In the first period after the adjustment ended, the difference between i^{LT} and iir^{LT} is around 1.25. The increase in refinancing immediately raises the iir^{LT} more than if the debt were not added.

To conclude, even for a high debt country like Italy, the impact is minimal, and in the binding scenario (safeguards excluded), the consolidation only increases by 0.132 % of GDP, which is above the 0.12 we would expect in the baseline r-g scenario. This is primarily driven by the faster increase in the implicit interest rate stemming from the addition of more debt at higher interest rates, leading the iir to increase. If debt could be added without increasing the iir, e.g., with SAFE loans, the impact of this could be mitigated. Overall, we hold that the simplification is a parsimonious way to get a good estimate of the impact of the NEC.

Annex III: Maximum r-g

Maximum and Mean r - g per Country

Based on a 4-year main adjustment period; Mean and Maximum from 2029 to 2039; Debt in year of Maximum.

Country	Year of Maximum	Mean r - g (%)	Max r - g (%)	Debt (% of GDP)	(Mean - Max)*d
HUN	2034	2.27	2.80	62	0.33
POL	2039	0.79	1.63	64	0.54
ROU	2039	0.13	1.30	60	0.70
ITA	2036	0.88	1.02	135	0.19
CZE	2039	0.47	0.94	63	0.30
LTU	2039	−0.10	0.61	63	0.45
BGR	2039	−0.19	0.57	63	0.48
FRA	2036	0.29	0.52	121	0.28
PRT	2036	0.11	0.50	73	0.29
ESP	2036	−0.16	0.42	83	0.48
LVA	2039	−0.12	0.38	61	0.31
SVK	2039	−0.58	0.33	61	0.55
BEL	2036	−0.38	−0.12	101	0.26
GRC	2036	−0.40	−0.14	121	0.31
AUT	2038	−0.43	−0.20	84	0.19
SVN	2039	−1.24	−0.24	61	0.61
DEU	2036	−0.64	−0.41	61	0.14
FIN	2032	−0.68	−0.45	88	0.20
IRL	2039	−1.94	−0.96	63	0.62
MLT	2039	−2.51	−1.11	62	0.87

Source: Author's calculations based on the DSA implementation in Darvas et al. (2024)

Table 4 High debt countries maximum r-g over the 10-year period

Maximum and Mean r - g per Country

Based on a 4-year main adjustment period; Mean and Maximum from 2029 to 2039; Debt in year of Maximum.

Country	Year of Maximum	Mean r - g (%)	Max r - g (%)	Debt (% of GDP)	(Mean - Max)*d
DNK	2029	−0.32	0.58	30	0.27
EST	2029	−0.69	0.06	35	0.26
HRV	2036	−0.47	−0.05	59	0.25
CYP	2031	−0.78	−0.37	49	0.20
NLD	2036	−0.82	−0.44	56	0.21
LUX	2036	−1.12	−0.80	52	0.17
SWE	2029	−1.70	−1.37	40	0.13

Source: Author's calculations based on the DSA implementation in Darvas et al. (2024)

Table 5 Low High debt countries maximum r-g over the 10-year period

This is a working paper, and hence it represents research in progress.
This paper represents the opinions of the authors, and is the product of professional research.
It is not meant to represent the position or opinions of IEP Bocconi, nor the official position of any staff members.
Any errors are the fault of the authors.