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by Cecilia Gabbriellini, Gianluigi Nocella e Flavio Padrini

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Parliamentary Budget Office
Via del Seminario, 76
00186 Rome, Italy
segreteria@upbilancio.it

Assessing Italy's public debt dynamics in the medium term with the PBO framework: Illustrative scenario analysis for the post-Covid period

di Cecilia Gabbriellini, Gianluigi Nocella and Flavio Padrini[1]

Abstract

This paper describes the main tool used by Italy's Parliamentary Budget Office (PBO) to assess public debt dynamics in the short-to-medium term, i.e. the deterministic DSA framework, and illustrates possible scenarios for Italy's post-Covid public debt ratio using this framework. The main characteristic of the PBO's deterministic DSA framework is to consider the feedback effects between fiscal consolidations/expansions and the macroeconomic scenarios. Moreover, the treatment of interest expenditure takes into account a relatively wide range of instruments characterising Italy's public debt. The results of the illustrative scenarios show that in the 2021-24 period, the debt ratio should decrease, although at a mild rate from 2023, even if nominal GDP growth resulted lower than expected by the government. In the period after 2024, with a neutral fiscal stance and assuming that the current low interest rates gradually return to higher historical levels, projections of the debt ratio depend crucially on the assumptions of post-pandemic trend GDP. If it is assumed that GDP returns to pre-pandemic or higher trend levels, the decline of the debt ratio should continue in the medium term. Conversely, if it is assumed that the pandemic has inflicted a permanent negative "shift" on trend levels ("partial loss" scenario), a reverse towards rising public debt dynamics cannot be excluded. Thus, a neutral fiscal stance from 2025 would not suffice to ensure a declining or stable public debt dynamics in a more conservative, but still realistic, scenario. Alternatively, a significant structural fiscal consolidation from 2025 (half a percentage point each year) could stabilise the debt ratio, albeit at a high level, even in the "partial loss" scenario.

[1] Parliamentary Budget Office, Rome, Italy. We are grateful to Giuseppe Pisauro, Chiara Goretti and Alberto Zanardi for encouragement and for the many suggestions on the deterministic DSA framework over the years. We thankfully acknowledge contributions and assistance on earlier versions of the framework from Michele Savini Zangrandi and Claudio Battiati. Finally, we would like to thank participants to an internal seminar at the PBO and to a seminar of the Annual Meeting of Società Italiana degli Economisti Pubblici (SIEP 2019) at Università degli Studi di Torino as well as Elton Beqiray for comments. The views expressed in this paper are our own and do not necessarily reflect those of the Parliamentary Budget Office.

1 Introduction

One of the main challenges facing governments is to ensure that their policy decisions are viable in the short term as well as sustainable in the medium term. Safeguarding the sustainability of public debt is indeed one of the main constraints facing fiscal policy. For example, Italy's Constitution requires public administrations to ensure public debt sustainability, consistently with EU legislation.

Monitoring of such Constitutional clause is one the main tasks of Parliamentary Budget Office (*Ufficio parlamentare di bilancio,* UPB), Italy's fiscal council. Indeed, the sustainability of public debt is a key aspect, and ultimately one of the main objectives, of the assessment of public finances carried out by the PBO. These evaluations are performed throughout the year, and in particular in the context of the parliamentary examinations of the Government's Medium-term fiscal strategy contained in the Economic and Financial Document (*Documento di economia e finanza*, DEF) in spring and of its Update (*Nota di aggiornamento del DEF*, NADEF) in autumn.

The objective of the first part of this paper is to present one of the tools used by the PBO to assess public debt sustainability in the short-to-medium term for Italy: the “deterministic” debt sustainability analysis (DSA) framework. The tool is labelled as "deterministic" as it has only a light use of statistical or econometric methods built in. However, the framework tries to take into account, at least partially, the call for greater consideration of the links between the variables that are key for public debt dynamics, a priority highlighted for example by Corsetti (2018).[2] These links are calibrated internalising the econometric tools used by the PBO to carry out other tasks, like for example the econometric model used to perform the endorsement process of the government’s macroeconomic forecasts. For this and other characteristics, although building on the frameworks used by international organisations, in particular on that of the European Commission,[3] the PBO deterministic DSA framework departs in important ways from them to take into account Italy's macro-fiscal specificities.

In the second part of the paper, the framework is used to assess the dynamics of Italy’s public debt in the post-Covid period. This assessment is carried out through a “scenario analysis” showing different paths for the public debt as a ratio of GDP up to 2030 according to alternative assumptions on the fiscal and non-fiscal determinants of public debt dynamics in the medium-term.[4]

[2] Corsetti G. (2018), "Debt sustainability assessments: The state of the art", Document requested by the European Parliament's Committee on Economic and Monetary Affairs, November.

[3] See for example European Commission (2014), "Assessing public debt sustainability in EU Member States: A guide", *European Economy Occasional Papers*, No. 200.

[4] For a similar exercise covering a number of euro area countries, see Network of the EU IFIs (2021), “The public debt outlook in the EMU post-Covid: A key challenge for the EU fiscal framework”, paper presented at the EFB Annual Conference, February.

The rest of the paper is organised as follows. Section 2 describes in detail the model used for the assessment of the public debt ratio dynamics. Section 3 presents some ad-hoc simulation exercises that provide an assessment of Italy's public debt in the post-Covid period under different assumptions on the variables affecting public debt dynamics. Section 4 contains some concluding remarks. In the Appendix, the assumptions on the calibration of the model's parameters are illustrated.

2 The model

The medium-term projections and simulations on Italy's public debt are based on the dynamic equation of its evolution over time:

$$(1) \quad D_t = D_{t-1} - PB_t + IE_t + SFA_t$$

where:

D_t = public debt stock at the end of year t;

PB_t = primary budget balance (i.e. overall budget balance net of interest expenditure) in year t;

IE_t = interest expenditure on public debt at year t;

SFA_t = stock-flow adjustment (i.e. the part of debt change that is not accounted for by the overall budget balance as defined in the European system of national accounts, ESA2010) at year t.

From Eq. (1), the dynamics of the public debt as a ratio of GDP (henceforth debt ratio) can be formulated as:

$$(2) \quad d_t = \frac{d_{t-1}}{(1+g_t)\cdot(1+\pi_t)} - pb_t + ie_t + sfa_t$$

where:

d_t = debt ratio at the end of year t;

g_t = real GDP growth rate at year t;

π_t = GDP deflator growth rate at year t;

pb_t = primary budget balance as a ratio of GDP (henceforth primary balance ratio) at year t;

ie_t = interest expenditure as a ratio of GDP (henceforth interest expenditure ratio) at year t;

sfa_t = stock-flow adjustment as a ratio of GDP at year t.

The primary balance ratio is assumed to be the sum of a structural component (i.e. determined by potential or trend output and net of one-off measures) pb_t^*, of a cyclical component that depends on the output gap og_t through the semi-elasticity α, and of the amount of one-off measures oo_t:

$$(3)\quad pb_t = pb_t^* + \alpha \cdot og_t + oo_t$$

As it is common in the literature and in institutional models,[5] the semi-elasticity α is expected to be positive as the impact of a more favourable cycle is negative for public spending, and positive for nominal GDP (the denominator) and revenues.

2.1 *Assumptions on the macro-fiscal variables in sensitivity analyses*

When carrying out sensitivity analyses, the real GDP growth rate, the GDP deflator growth rate, the structural primary balance ratio and the output gap are assumed to be characterised by the following relations:

$$(4)\quad g_t = g(\overset{-}{pb_t^*}; \overset{-}{\boldsymbol{dm}_t})$$

$$(5)\quad \pi_t = \pi(\overset{+}{ind_t})$$

$$(6)\quad Y_t = (1 + g_t) \cdot Y_{t-1}$$

$$(7)\quad P_t = (1 + \pi_t) \cdot P_{t-1}$$

$$(8)\quad pb_t^* = pb^*(\overset{+}{P_t})$$

$$(9)\quad og_t = \frac{Y_t - Y_t^*}{Y_t^*}$$

where:

[5] See, for example, Robert W. Price, Thai-Thanh Dang, Jarmila Botev (2015). "Adjusting fiscal balances for the business cycle: New tax and expenditure elasticity estimates for OECD countries", *OECD Economics Department Working Papers*, No. 1275.

$\boldsymbol{dm}_t$ = vector of discretionary budget-improving measures affecting general government aggregates as a ratio of GDP at year t;

ind_t = indirect taxes as a ratio of GDP (henceforth indirect tax ratio) at year t;

P_t = GDP deflator level at year t;

Y_t = real GDP level at year t;

Y_t^* = real potential or trend GDP level at year t.

In Eq. (4), real GDP growth is expected to respond negatively to a positive shock on the structural primary balance ratio induced by a fiscal restriction for the latter's detrimental impact on aggregate demand.[6] In general, such impact is modelled through the average multiplier as derived from the PBO macro-econometric model. However, if enough information is available on the budgetary discretionary measures ($\boldsymbol{dm}_t$) being implemented, more detailed simulations are carried out by using the specific multipliers of the PBO macro-econometric model. Similarly to a positive shock to the structural primary balance induced by a fiscal restriction, budget-improving discretionary measures have a negative effect on real GDP growth.

In Eq. (5) the specific impact of the indirect tax ratio on the inflation rate is highlighted. The impact of indirect tax shock on inflation is positive as it is generally estimated that indirect tax increases are transmitted, at least partially, to prices.

Moreover, from Eq. (8) it is assumed that the structural primary balance ratio is positively influenced by prices, hence by the inflation rate via Eq. (7). The impact of a price shock on the structural primary balance ratio is expected to be positive as the effect of inflation on public spending should be generally lower than that on nominal GDP (the denominator). This is because not all spending is fully indexed (at least automatically) to inflation.

Eq. (9) describes the formula for calculating the output gap that is common in the institutional literature.[7] It should be noticed that in the model a higher (lower) real GDP growth rate has a positive (negative) impact on the primary balance through a higher (lower) output gap (Eqs. (6), (9) and (3)). In particular, this means that a higher structural primary balance ratio does not imply a one-to-one increase of the primary balance ratio because of the negative effect on GDP growth and the output gap that in turn have a detrimental impact on the cyclical component of the primary balance ratio.

[6] Notice that, compared to a baseline scenario, the structural primary balance can be expected to be higher not only as a consequence of a fiscal restriction but also if potential or trend GDP is assumed to rise more than in the baseline scenario.

[7] See, for example, the analyses on the output gap carried out at the PBO: Marco Fioramanti, Flavio Padrini e Corrado Pollastri (2015), "La stima del PIL potenziale e dell'*output gap*: analisi di alcune criticità", *Nota di lavoro UPB* 1/2015; Cecilia Frale and Sergio De Nardis, "Quando il *gap* si fa incerto: stime alternative del potenziale e dell'*output gap* nell'economia italiana", *Nota di lavoro UPB* 2/2017; Tommaso Proietti, Marco Fioramanti, Cecilia Frale and Libero Monteforte (2020), "Un approccio sistemico per la stima dell'*output gap* dell'economia italiana", *Nota di lavoro UPB* 1/2020.

2.2 The treatment of interest expenditure

Building on the method used by the European Commission[8], interest expenditure is expressed as the sum of three components. The first component (IE^S) is the interest expenditure paid on the short-term portion of public debt.[9] This portion includes both the short-term debt of the previous year which is renewed and the part of any new borrowing needs arising during the year that is financed by new short-term debt issues. The second component ($IE^{L,M}$) is the interest expenditure paid both on the long-term debt that matures during the year and that is renewed, and on the part of any new borrowing needs arising during the year and that is financed by new long-term debt issues.[10] The third component ($IE^{L,NM}$) is represented by the interest expenditure paid on part of the long-term debt that does not mature during the year.

In formulas, interest expenditure can therefore be expressed as:

$$(10)\quad IE_t = IE_t^S + IE_t^{L,M} + IE_t^{L,NM}$$
$$= i_t^S \cdot \gamma^S \cdot (D_{t-1} + \Delta D_t) + i_t^L \cdot (\gamma^{L,M} \cdot D_{t-1} + \gamma^L \cdot \Delta D_t) + i_t^{L,NM} \cdot \gamma^{L,NM} \cdot D_{t-1}$$

where:

γ^S = share of short-term public debt over the total;

γ^L = share of long-term public debt over the total;

$\gamma^{L,M}$ = share of long-term public debt over the total maturing during the year;

$\gamma^{L,NM}$ = share of long-term public debt over the total not maturing during the year; given the above definitions, notice that $\gamma^L = \gamma^{L,M} + \gamma^{L,NM}$;

i_t^S = short-term interest rate in year t;

i_t^L = long-term interest rate in year t;

$i_t^{L,NM}$ = implicit interest rate on the share of long-term public debt not maturing during the year.

Extending and refining the European Commission method, the share of long-term debt $\gamma^{L,NM}$ not maturing during the year is further decomposed into four components, one related to the debt issued at fixed interest rates ($\gamma^{L,NM,F}$), one related to the debt issued at interest rates indexed to the EURIBOR rate ($\gamma^{L,NM,V}$), one related to the debt issued at interest rates indexed to the euro area inflation rate ($\gamma^{L,NM,€}$) and, finally, one related to the debt issued at interest rates indexed to the Italian inflation rate ($\gamma^{L,NM,I}$). Therefore,

[8] See European Commission (2021), *Debt Sustainability Monitor 2020*, Institutional Paper 143, Bruxelles.

[9] Short-term debt is assumed debt with an (original) maturity of one year or less.

[10] Long-term debt is assumed debt with an (original) maturity of more than one year.

notice that $\gamma^{L,NM} = \gamma^{L,NM,F} + \gamma^{L,NM,V} + \gamma^{L,NM,€} + \gamma^{L,NM,I}$. The corresponding implicit interest rates are denoted with $i^{L,NM,F}$, $i^{L,NM,V}$, $i^{L,NM,€}$ and $i^{L,NM,I}$, respectively.

Thus, the implicit interest rate on the part of the debt not maturing in year t can be expressed as a weighted average of the four implicit interest rates described before:

$$(11)\quad i_t^{L,NM} = \frac{\gamma^{L,NM,F}}{\gamma^{L,NM}} \cdot i_t^{L,NM,F} + \frac{\gamma^{L,NM,V}}{\gamma^{L,NM}} \cdot i_t^{L,NM,V} + \frac{\gamma^{L,NM,€}}{\gamma^{L,NM}} \cdot i_t^{L,NM,€} + \frac{\gamma^{L,NM,I}}{\gamma^{L,NM}} \cdot i_t^{L,NM,I}$$

In projections and simulations, it is assumed that the implicit interest rate on fixed-rate long-term debt not maturing in year t ($i_t^{L,NM,F}$) is a weighted average of the same rate in year t-1 and of the long-term rate in the same year. In formulas, this implicit rate is therefore estimated by the following equation:

$$(12)\quad i_t^{L,NM,F} = \frac{\gamma^{L,NM,F} \cdot D_{t-2}}{\gamma^{L,F} \cdot D_{t-1}} \cdot \, i_{t-1}^{L,NM,F} + \left(1 - \frac{\gamma^{L,NM,F} \cdot D_{t-2}}{\gamma^{L,F} \cdot D_{t-1}}\right) \cdot i_{t-1}^{L} + \epsilon_t^{L,NM,F}$$

where $\gamma^{L,F}$ is the share of fixed-rate long-term debt over total long-term debt and $\varepsilon_t^{L,NM,F}$ is an error term.[11]

By multiplying and dividing the right side of Eq. (12) by nominal GDP in year t-1, the implicit interest rate on fixed-rate long-term debt not maturing in year t can be expressed as:

$$(13)\quad i_t^{L,NM,F} = \frac{\gamma^{L,NM,F} \cdot \left(\frac{d_{t-2}}{(1+g_{t-1})(1+\pi_{t-1})}\right)}{\gamma^{L,F} \cdot d_{t-1}} \cdot \, i_{t-1}^{L,NM,F} + \left(1 - \frac{\gamma^{L,NM,F} \cdot \left(\frac{d_{t-2}}{(1+g_{t-1})(1+\pi_{t-1})}\right)}{\gamma^{L,F} \cdot d_{t-1}}\right) \cdot i_{t-1}^{L} + \epsilon_t^{L,NM,F}$$

Moreover, the long-term implicit interest rates of the government debt not maturing in year t linked to the euro area or Italian inflation rates are modelled as the sum of implicit (*ex post*) real interest rates and the relevant inflation rates:

$$(14)\quad i_t^{L,NM,€} = r_t^{L,NM,€} + \pi_t^{€}$$

$$(15)\quad i_t^{L,NM,I} = r_t^{L,NM,I} + \pi_t$$

where $r^{L,NM,€}$ is the implicit (ex-post) real interest rate on long-term debt indexed to the euro area inflation rate $\pi^{€}$ and $r^{L,NM,I}$ is the implicit (ex-post) real interest rate on long-term

[11] See the Appendix for more details on the error terms.

debt indexed to the Italian inflation rate.[12] In sensitivity analyses, it is taken into account the influence of shocks to Italy's inflation rate on the euro area's inflation rate, hence:

$$(16)\quad \pi_t^{€} = \pi^{€}(\pi_t)$$

Analogously to Eq. (13), the implicit (ex-post) real interest rates are estimated through the following equations:

$$(17)\quad r_t^{L,NM,€} = \frac{\gamma^{L,NM,€} \cdot \left(\frac{d_{t-2}}{(1+g_{t-1})(1+\pi_{t-1})}\right)}{\gamma^{L,€} \cdot d_{t-1}} \cdot r_{t-1}^{L,NM,€} + \left(1 - \frac{\gamma^{L,NM,€} \cdot \left(\frac{d_{t-2}}{(1+g_{t-1})(1+\pi_{t-1})}\right)}{\gamma^{L,€} \cdot d_{t-1}}\right) \cdot r_{t-1}^{L,€} + \epsilon_t^{L,NM,€}$$

$$(18)\quad r_t^{L,NM,I} = \frac{\gamma^{L,NM,I} \cdot \left(\frac{d_{t-2}}{(1+g_{t-1})(1+\pi_{t-1})}\right)}{\gamma^{L,I} \cdot d_{t-1}} \cdot r_{t-1}^{L,NM,I} + \left(1 - \frac{\gamma^{L,NM,I} \cdot \left(\frac{d_{t-2}}{(1+g_{t-1})(1+\pi_{t-1})}\right)}{\gamma^{L,I} \cdot d_{t-1}}\right) \cdot r_{t-1}^{L,I} + \epsilon_t^{L,NM,I}$$

where $r_{t-1}^{L,€}$ and $r_{t-1}^{L,I}$ are the (ex-post) real interest rates on long-term debt in year t-1, $\gamma^{L,€}$ is the share of long-term debt indexed to the euro area inflation rate over total long-term debt, $\gamma^{L,I}$ is the share of long-term debt indexed to the Italian inflation rate over total long-term debt, and the ϵ_t*'s* are error terms.

Furthermore, the long-term implicit interest rate of government debt not maturing in year t indexed to the EURIBOR is modelled as the sum of the 6-month EURIBOR (eur_t) plus an implicit term premium ($prm_t^{L,NM}$) as follows:

$$(19)\quad i_t^{L,NM,V} = eur_t + prm_t^{L,NM}$$

In turn, the implicit term premium is estimated through the equation:

$$(20)\quad prm_t^{L,NM} = \frac{\gamma^{L,NM,V} \cdot \left(\frac{d_{t-2}}{(1+g_{t-1})(1+\pi_{t-1})}\right)}{\gamma^{L,V} \cdot d_{t-1}} \cdot prm_{t-1}^{L,NM} + \left(1 - \frac{\gamma^{L,NM,V} \cdot \left(\frac{d_{t-2}}{(1+g_{t-1})(1+\pi_{t-1})}\right)}{\gamma^{L,V} \cdot d_{t-1}}\right) \cdot prm_{t-1}^{L} + \epsilon_t^{L,NM,V}$$

[12] Notice that, in sensitivity analyses, changes in inflation are assumed to have an impact also on nominal interest rates as it is assumed that half of these changes are translated into both i^S and i^L.

where prm_{t-1}^{L} is the term premium in year t-1 (calculated as i_{t-1}^{L} - eur_{t-1}), $\gamma^{L,V}$ is the share of long-term debt indexed to the 6-month EURIBOR over total long-term debt, and $\varepsilon_t^{L,NM,V}$ is an error term.

Finally, replacing the expression of the debt from Eq. (1) into Eq. (10), after some arithmetic steps[13] and expressing the variables in relation to GDP, the following expression for interest expenditure as a ratio of GDP is obtained:

$$(21)\quad ie_t = \frac{1}{1 - i_t^S \cdot \gamma^S - i_t^L \cdot \gamma^L} \cdot \left[\left(i_t^S \cdot \gamma^S + i_t^L \cdot \gamma^{L,M} + i_t^{L,NM} \cdot \gamma^{L,NM} \right) \cdot \frac{d_{t-1}}{(1+g_t)(1+\pi_t)} - \left(i_t^S \cdot \gamma^S + i_t^L \cdot \gamma^L \right) \cdot \left(pb_t - sfa_t \right) \right]$$

where $i_t^{L,NM}$ is obtained by solving the system of Eqs. (11)-(20).

3 Scenario analysis of public debt dynamics in the post-Covid period

3.1 Debt ratio dynamics in the short term

The assessment of public debt ratio dynamics in the post-Covid period starts with a sensitivity analysis up to year 2024 of the government's official forecast presented in the 2022-24 Economic and Financial Document (EFD) Update published in September 2021[14]. In particular, by using the framework presented in section 2, the sensitivity of the official forecasts is assessed with respect to alternative assumptions for the inflation rate and the real growth rate.

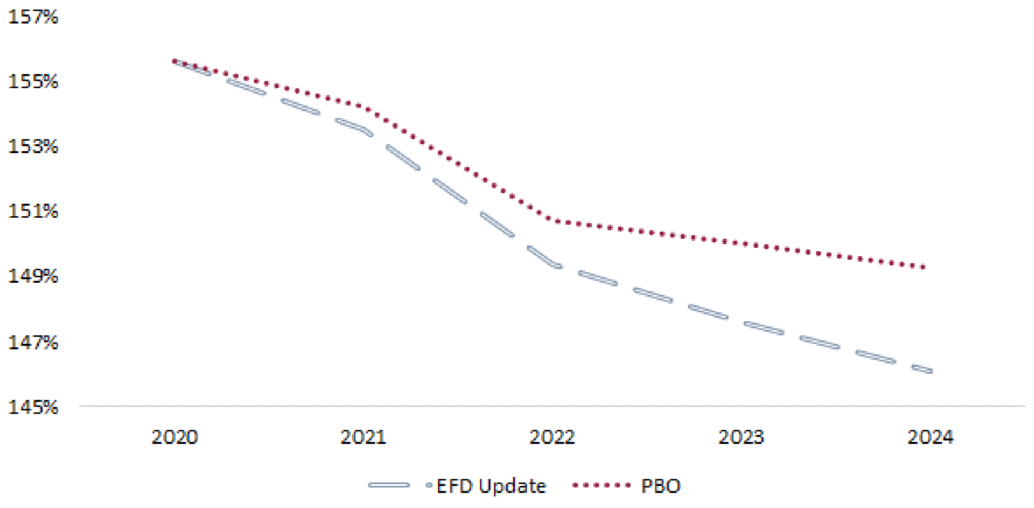
Thus, the baseline scenario for the analysis (the "EFD Update scenario") is represented by the policy evolution of the debt/GDP ratio outlined by the EFD Update for the 2021-2024 period. In the official forecast, the debt ratio would decrease from 155.6 per cent registered in 2020 to 146.1 per cent in 2024 (Figure 1).

The alternative scenario (the "PBO scenario") is based on the growth forecasts for real GDP and the GDP deflator developed by the PBO up to 2024 as part of the endorsement exercise for the "with-policy" scenario in the EFD. With these assumptions, the level of the debt ratio in the PBO scenario would be higher than that in the EFD Update scenario for the entire 2021-2024 period. As regards the dynamics of the ratio, it would decline from 2021 but more slowly than in the EFD Update scenario, especially from 2023.

[13] Available on request.

[14] Hearing of the PBO as part of the examination of the Update to the 2021 Economic and Financial Document available at: https://en.upbilancio.it/hearing-of-the-pbo-as-part-of-the-examination-of-the-update-to-the-2021-economic-and-financial-document/.

Figure 1 – Debt/GDP ratio scenarios for 2021-24
(percentages)



Source: based on EFD Update data.

This is due to the fact that compared with the government forecasts in the EFD, the PBO scenario is characterised by a less rapid recovery during the time horizon forecast. At the end of 2024, with the macroeconomic assumptions of the PBO scenario, the debt ratio would thus be projected over three percentage points higher than in the EFD Update scenario.

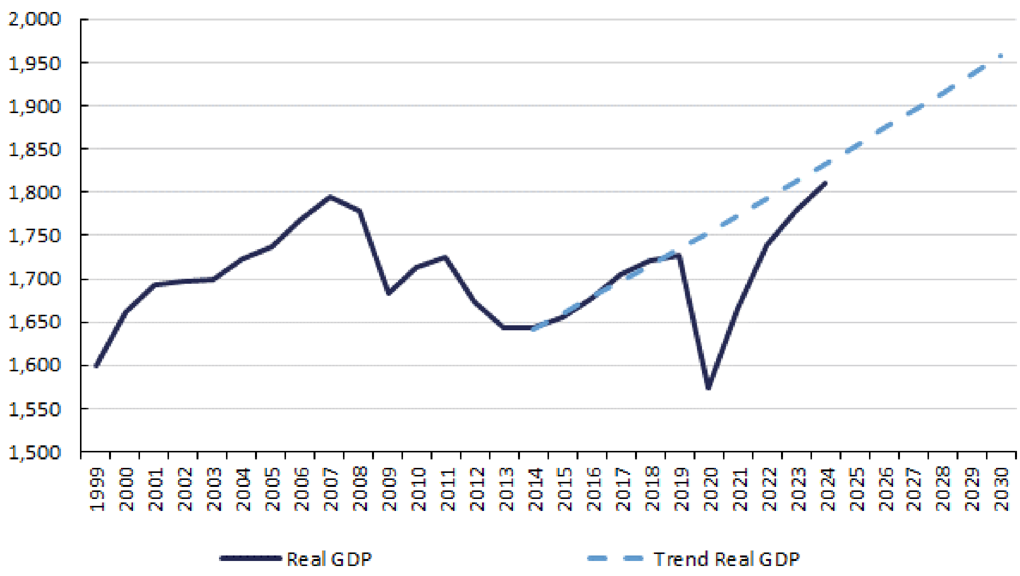
3.2 Scenarios for the debt ratio in the medium term

The PBO scenario for the period 2021-24 illustrated in the previous subsection is the starting point for projections of the debt ratio in a time horizon up to 2030. Alternative simulations based on illustrative scenarios are used to assess the medium-term risks for the dynamics of the debt ratio in a period of high uncertainty. In particular, uncertainties relate to the impact that the pandemic crisis on one hand and the EU recovery initiatives on the other hand could have, in opposite directions, on Italy's trend GDP in the medium term.

More specifically, since commonly-used estimates of potential GDP are considered particularly uncertain because of the impact of the crisis, alternative assumptions on simpler measures of "trend GDP" were used in the scenario analysis. The following three alternative scenarios for trend GDP are thus considered:

1) a "**no-scar**" scenario, in which trend growth is assumed to remain the same as in the period 2014-19, i.e. the years after the financial crisis and preceding the Covid crisis. Such trend growth is equal to around 1.1 per cent (Figure 2); this scenario could be consistent with the assumption that the measures implemented by the government in 2020-21 have been successful to protect Italy's economy from the economic consequences of the pandemic;

Figure 2 – Trend real GDP in the "no scar" scenario
(billions of euros)

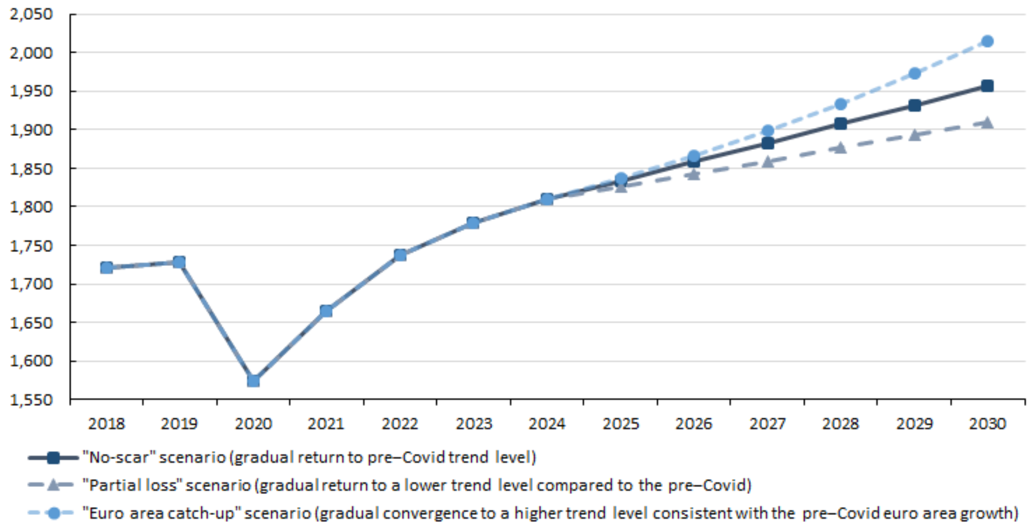


2) a "**partial loss**" scenario, in which the level of trend GDP is assumed below that projected in the "no-scar" scenario by 2.4 percentage points; such a number approximately corresponds to the annual average loss of trend GDP following the 2008-2013 crisis; this less optimistic scenario could be the result of government measures being only partly successful in protecting Italy's economy from the damages of the pandemic, at least in the short term;

3) a "**euro area catch-up**" scenario, in which trend GDP is the same as in the "no-scar" scenario until 2024 after which its growth rate gradually converges to the euro area trend GDP growth preceding the pandemic (i.e. around 1.9 per cent); this more optimistic scenario could be consistent with an effective implementation of the EU recovery initiatives in Italy (in particular Next Generation EU).

The corresponding path for the level of real GDP in each scenario is obtained by considering the additional assumption of the gradual linear closing of the output gap in 6 years, from 2025 to 2030. The implications of the above assumptions for the projections of real GDP levels in the medium term are illustrated in Figure 3. In the "no-scar" scenario, average annual real GDP growth would be projected to around 1.3 per cent in the period 2025-2030, to around 0.9 per cent in the "partial loss" scenario and to 1.8 per cent in the "euro-area catch-up" scenario. In this latter scenario, GDP would be accelerating over time reflecting the delayed assumed effect of reforms and investments on trend growth.

Figure 3 – Real GDP in alternative scenarios
(billions of euros)



As for the other non-fiscal determinants of the debt ratio dynamics, the projection's assumptions are the following: *a)* the gradual convergence of the GDP deflator growth rate to the ECB's inflation rate target of 2 per cent in 6 years, from 2025 to 2030; *b)* the gradual convergence of the short-term interest rate to around 1.8 per cent given by the sum of the ECB's inflation target and the consensus long-term GDP growth rate forecast (+0.5 per cent), adjusted for a "risk premium" of -0.7 per cent (based on historical data[15]); *c)* the gradual convergence of the long-term interest rate to around 3.1 per cent given by the sum of the short-term rate as determined above and a term premium of 1.3 percentage points (based on historical data[16]); d) the stock-flow adjustment amounting, in each year, to the median value recorded between 1999 and 2020 (0.3 per cent of GDP).

As a result of these assumptions, the difference between the average cost of debt and nominal GDP growth (i-g) would remain negative in all three scenarios during the projection period. However, the difference would grow from -5 percentage points estimated for 2021 to -1 projected in 2030 in the “no scar” scenario, to around -0.5 in the “partial loss” scenario and to -2 in the “euro area” scenario.

Finally, starting from 2025, it is assumed that the public finances follow a neutral fiscal stance, i.e. a "no-policy-change assumption". For the "no scar" and "partial loss" scenarios, this assumption implies a constant structural primary balance at the level estimated for 2024. This is approximately equivalent to assume that primary expenditure growth is equal to trend GDP growth and that no discretionary measures on the tax and social contribution side are implemented. For the "euro-area catch-up" scenario, it is assumed that the higher

[15] This risk premium is calculated as the median of the difference between the short-term interest rate and the nominal GDP growth rate from 1999 to 2020.
[16] The term premium is calculated as the median of the difference between long-term interest rate and short-term interest rate from 1999 to 2020.

potential growth compared to the “no scar” scenario translates in an improvement of the structural primary balance without the need of any fiscal restriction.[17]

With these assumptions, the level of the structural primary balance would remain negative in the "no scar" and in the "partial loss" scenarios but would differ between these two alternative scenarios, due to differences in the level of trend GDP. Specifically, in the"no scar" scenario, the structural primary balance would remain at -0.8 per cent in the 2025-2030 period while in the "partial loss" scenario would be equal to -2.1 per cent. In contrast, in the "euro-area catch-up" scenario, the structural primary balance would start negative in 2025 at -0.7 per cent but would gradually improve over the years to be zero in 2028 and end up positive at +0.8 per cent in 2030.

On the basis of these assumptions, the different scenarios for the debt ratio dynamics are illustrated in Figure 4. In the "no scar" scenario, the debt ratio would decrease very slowly after 2025 to reach a value of around 146 per cent at the end of the projection horizon. The ratio would be only around 9 percentage points below the level reached in 2020. In the "partial loss" scenario, the debt ratio would be on an increasing path after 2024, remaining below the 2020 level only by around 1 percentage point at the end of the projection period. Finally, in the "euro area catch-up" scenario the debt ratio would decrease more markedly: it would reach around 138 per cent at the end of the projection period, almost 18 percentage points below the 2020 level but still above the pre-Covid level by around 3½ percentage points.

To interpret these results, notice that the assumption of a neutral fiscal stance starting from 2025 implies an overall nominal deficit as a ratio of GDP that would be between 3.5 and 4 per cent in 2025-30 in the "no scar" scenario whereas it would deteriorate from around 4 per cent in 2024 to around 5.5 in 2030 in the "partial loss" scenario (Figure 5). Therefore, in these two scenarios the overall nominal deficit would remain higher than the 3 per cent threshold established by the Stability and Growth Pact. This is also due to interest payments that would be increasing over time as a result of the assumed "normalisation" of interest rates at issuance in a context of high (and sometime rising) debt. In the case of the "euro-area catch-up" scenario, the deficit would reach a level below the 3 per cent threshold only by 2028 to end up at almost 2 per cent at the end of the projection period.

It is thus interesting, and probably more realistic, to assess debt developments in scenarios where fiscal policy is restrictive rather than neutral. Specifically, it is assumed a structural fiscal restriction of a half a percentage point each year starting from 2025. This assumption implies that in the"no scar" scenario, the structural primary balance would turn into a surplus by 2026 and reach 2.2 per cent at the end of the forecasting period while in the "partial loss" scenario it would reach 0.9 per cent. In the "euro-area catch-

[17] Operationally, these higher structural balances are obtained by applying to the percentage difference of trend GDP between the "euro-area catch-up" and the "no-scar" scenarios the semi-elasticity of the budget with respect to GDP reported in the Appendix.

up" scenario, the fiscal restriction would add to the improvement in the structural primary balance linked to the higher potential growth so that the structural primary balance would go above 3½ per cent by 2030.

Figure 4 – Developments in the debt/GDP ratio in alternative macroeconomic scenarios
(percentages)

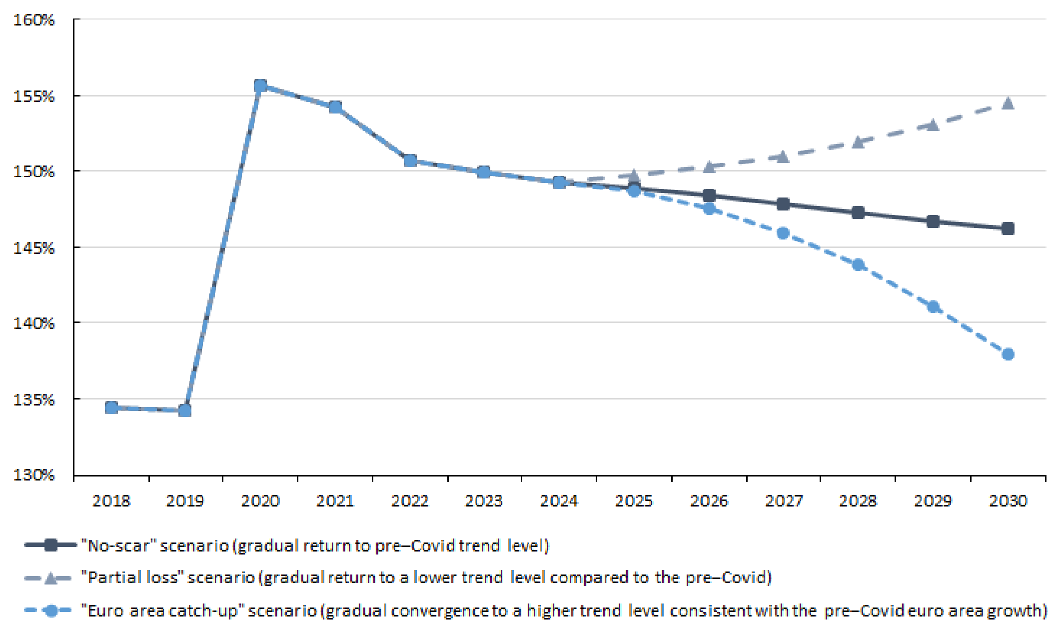
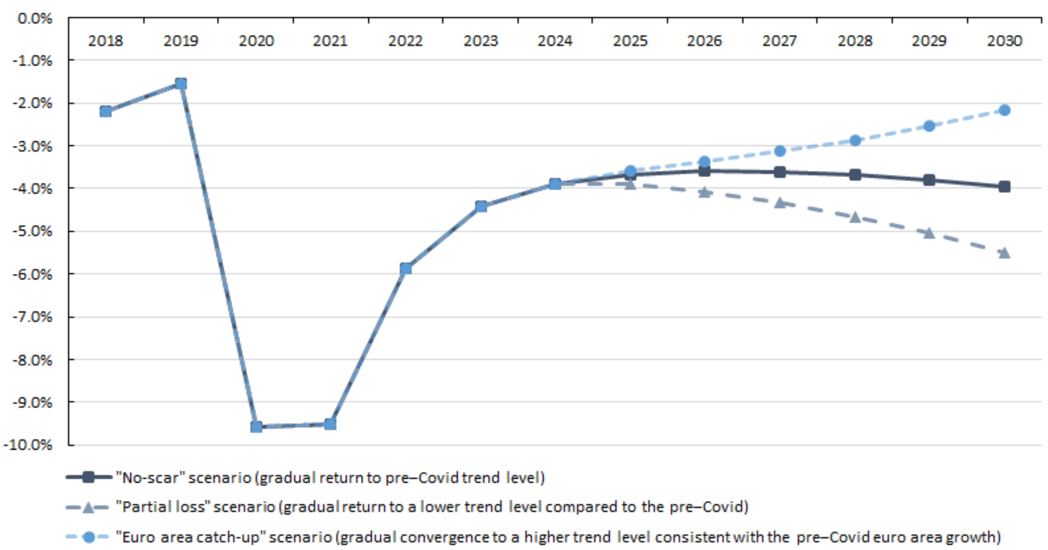


Figure 5 – Overall budget balance in alternative macroeconomic scenarios
(percentages)



In Figure 6, the implications of this fiscal consolidation assumption on the estimated debt projections are illustrated. In all scenarios the dynamics of the debt ratio would be more favourable compared to the neutral fiscal stance assumption, despite the detrimental impact of fiscal consolidation on real GDP growth. In particular, in the "partial loss" scenario the debt ratio would now stabilise at around 149 per cent along the projection horizon, but it will remain still 14 percentage points higher than the pre-Covid level. In the "no-scar" scenario, the decline of the debt ratio would be stronger and at the end of the projection period the ratio would be around 7 percentage points higher than the pre-Covid level. In the "euro-area catch-up" scenario, the structural balance adjustment would lead the debt ratio to reach a level of 132½ per cent by 2030, i.e. slightly below the pre-Covid level as expected by the government in the 2021 EFD Update.

In the interpretation of the results it is important to stress again that the improvement in the dynamics of the debt ratio is lower than expected by considering the structural adjustment per se. Indeed, the latter has an unfavourable impact on the cycle (i.e. on the output gap in the DSA framework described in Section 2) and this results in a detrimental feedback effect on the deficit. The deficit would indeed decline very slowly and would be just below 2 per cent still by the end of the projection period in the "no-scar" and slightly above 3 per cent in the "partial loss" scenario (Figure 7), also because of increasing interest payments. In the more favourable "euro-area catch-up" scenario, the budget would be approximately in balance by the end of the decade.

Figure 6 – Developments in the debt/GDP ratio in scenarios with fiscal adjustment
(percentages)

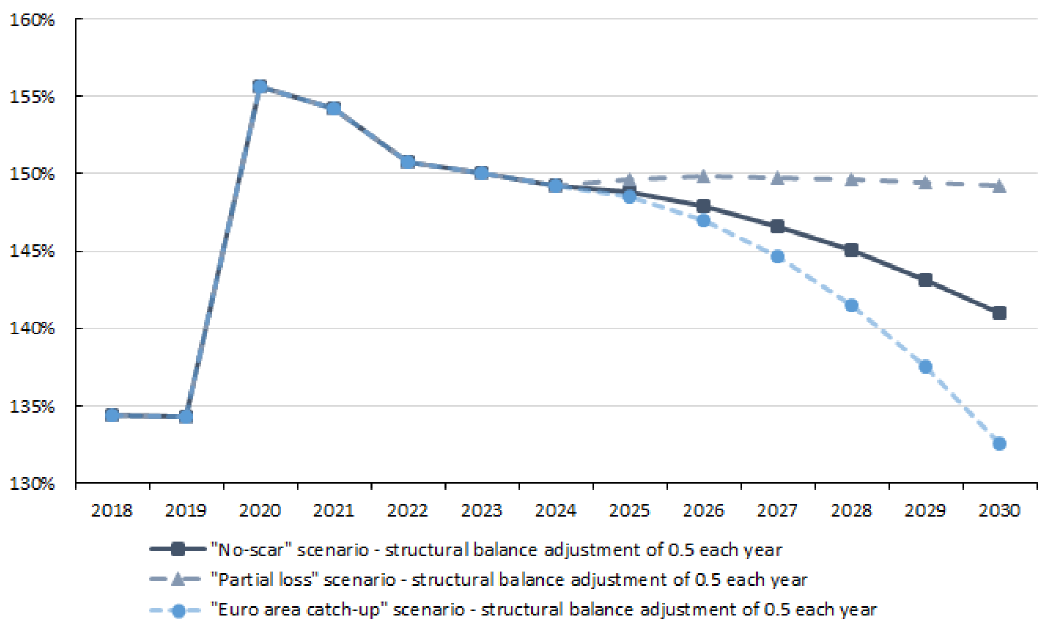
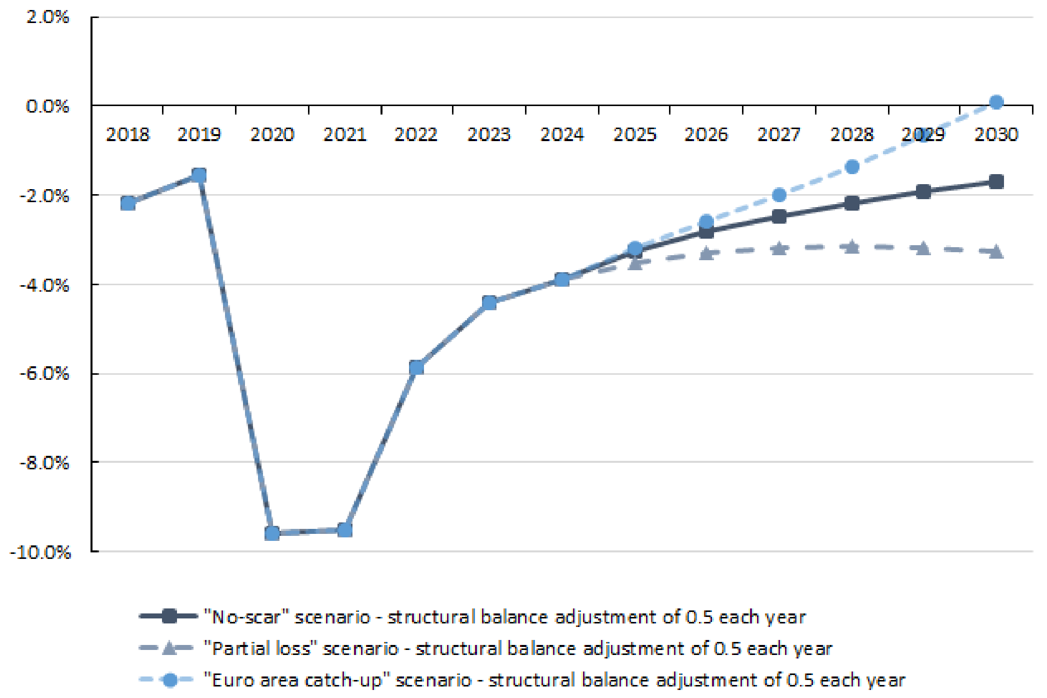


Figure 7 – Overall budget balance in in scenarios with fuscal adjustment *(percentages)*



4 Concluding remarks

The main objective of this paper was to illustrate the main tool used by the PBO to assess public debt dynamics in the short-to-medium term, i.e. the deterministic DSA framework. The main characteristic of this framework is to consider the feedback effects between fiscal consolidations/expansions and the macroeconomic scenarios. Thus, sensitivity analyses are not fully mechanical but take into account, at least partially, the interactions between the fiscal and non-fiscal determinants of public debt dynamics. Moreover, the treatment of interest expenditure considers a relatively wide range of instruments characterising Italy's public debt. This should improve the projections of interest expenditure in the medium term when interest rates are assumed to return closer to historical levels.

This framework was used to carry out illustrative scenarios for Italy's post-Covid public debt ratio in the short-to-medium term. In the 2021-24 period, the debt ratio should decrease, although at a mild rate from 2023, even if nominal GDP growth resulted lower than expected by the government, as forecasted by the PBO. In the period after 2024, with a neutral fiscal stance and assuming that the current low interest rates return to higher historical levels, projections of the debt ratio depend crucially on the assumptions of post-pandemic trend GDP.

If it is assumed that GDP returns to pre-pandemic or higher trend levels, the decline of the debt ratio should continue in the medium term. However, if it is assumed that the pandemic has inflicted a permanent negative "shift" on trend levels, a reverse towards rising public debt dynamics cannot be excluded. Thus, a neutral fiscal stance from 2025 would not suffice to ensure a declining or stable public debt dynamics in a more conservative, but still realistic, scenario. Illustrative projections assuming a significant structural fiscal consolidation from 2025 (half a percentage point each year) could stabilise the debt ratio, albeit at a high level, even with more conservative macroeconomic assumptions.

Finally, this exercise shows that the government objective of returning below pre-Covid levels for the debt ratio by 2030, as stated in the 2021 EFD Update, could be achieved only if Italy's trend growth gradually converges towards the pre-pandemic euro-area average and at the same time a significant and prolonged fiscal consolidation is carried out.

Appendix

Calibration of model's parameters and other assumptions

The values of the parameters in the model described in Eqs. (1)-(21) are calibrated by using estimates from the existing literature.

In Eq. (3), the semi-elasticity of the primary balance ratio to the output gap (α) is assumed equal to 0.544, in line with the European Commission and as estimated by the OECD.[18] In Eq. (8), the structural primary balance ratio is assumed to respond to a price shock through a semi-elasticity equal to 0.15 that is the average estimate for a number of euro area countries as reported in a study by a team of economists from ECB and other central banks.[19]

In Eq. (4), real GDP growth is assumed to respond to the structural primary balance ratio and discretionary budgetary measures according to the multipliers as estimated by the PBO macroeconometric model.[20] The same is true for the response of the GDP deflator to the indirect tax ratio in Eq. (5).

In Eq. (16), it is assumed that the impact of a shock in Italy's inflation rate on euro area inflation is equal to 0.17049, i.e. the weight of Italy's prices on the euro area index in 2020. This is equivalent to assume that there are no additional spillover effects from Italian inflation to that of the other members of the euro area and vice versa.

All the shares of the different types of public debt over the total (i.e. all the γ's) used in Section 2.2 are assumed to be constant over the projection period and equal to their values at the latest observation period[21]. Their value in 2020 is reported in Table A.1.

The short-term interest rate (i^S) is calculated as a weighted average of the interest rates on public debt with maturity equal to 3 months, 6 months and one year, with the weights given by the amounts issued on the last observed year. The long-term interest rate (i^L) is calculated as a weighted average of the interest rates with maturity of 2 years, 3 years, 5 years, 7 years, 10 years, 15 years, 20 years, 30 years and 50 years.

[18] See Mourre et al. (2019), *The Semi-Elasticities Underlying the Cyclically-Adjusted Budget Balance: An Update & Further Analysis*, European Economy Discussion Paper, n. 098, European Commission.

[19] Maria Grazia Attinasi, Vladimir Borgy, Othman Bouabdallah, Cristina Checherita-Westphal, Maximilian Freier, Georgios Palaiodimos, Doris Prammer, Pietro Tommasino and Jochen Zimmer (2016), "The effect of low inflation on public finances", Chapter 10 in Sandro Momigliano (Ed.), "Beyond the austerity dispute: New priorities for fiscal policy", *Bank of Italy.* In the same study, a specific estimate for Italy is also reported (equal to 0.27). However, the analysis in this study was carried out in a period when many indexation mechanisms for public spending were temporarily suspended in Italy as a response to the financial crisis. A preliminary assessment of the inflation elasticity of the primary budget taking into account also the impact of those suspended mechanisms leads to an estimate for Italy that is not dissimilar from that of the euro area average.

[20] For a brief description of the model, see PBO (undated), "Gli strumenti di previsione macroeconomica dell'UPB".

[21] The source of these data is the Bank of Italy, "The public finances: borrowing requirement and debt".

Table A1 – Shares of the different types of public debt over the total

	Shares of Public Debt	Year 2020
γ^{S}	Share of short-term public debt over the total	0.10
$\gamma^{L,M}$	Share of long-term public debt over the total maturing during the year	0.14
$\gamma^{L,NM}$	Share of long-term public debt over the total not maturing during the year, of which:	0.76
$\gamma^{L,NM,F}$	*debt issued at fixed interest rates*	*0.63*
$\gamma^{L,NM,V}$	*debt issued at interest rates indexed to the Euribor rate*	*0.05*
$\gamma^{L,NM,€}$	*debt issued at interest rates linked to the Euro area inflation rate*	*0.06*
$\gamma^{L,NM,I}$	*debt issued at interest rates linked to the Italian inflation rate*	*0.03*

To project interest expenditure, estimates of the different components of the implicit interest rate of long-term public debt not maturing ($i^{L,NM}$) is needed. As stressed before, this is done by solving the system of Eqs. (11)-(20). To this end, initial values for the implicit interest rates $i^{L,NM,F}$, $r^{L,NM,€}$ and $r^{L,NM,I}$ in Eq (13), Eq. (17) and Eq (18), respectively, are needed as well as an initial value for the implicit term premium $prm^{L,NM}$. Such initial value is calculated for the latest observation year (or for the latest year of the macro-fiscal policy scenario). By denoting such year with T, the procedure is the following:

a) Calculate $i_T^{L,NM}$ for the year T by rearranging Eq. (10). Indeed, notice that in such year interest expenditure and the stock of public debt at the end of the period are known. Thus, after some mathematical steps from Eq. (10) the implicit interest rate $i_T^{L,NM}$ can be expressed as:

$$(22)\quad i_T^{L,NM} = \frac{\left[IE_T - \overbrace{i_T^S \cdot \gamma^S \cdot D_T}^{\substack{interest\ expenditure \\ on\ short-term\ debt}} - \overbrace{i_T^L \cdot (\gamma^L \cdot D_T - \gamma^{L,NM} \cdot D_{T-1})}^{\substack{interest\ expenditure \\ on\ newly\ issued\ long-term\ debt}} \right]}{\underbrace{\gamma^{L,NM} \cdot D_{T-1}}_{\substack{long\ term\ debt \\ not\ maturing\ during\ year\ T}}}$$

By dividing the numerator and the denominator of the r.h.s. of the above equation by nominal GDP in year T, the expression for $i_T^{L,NM}$ can be formulated as a ratio of GDP:

$$(23)\quad i_T^{L,NM} = \frac{\left[ie_T - i_T^S \cdot \gamma^S \cdot d_T - i_T^L \cdot \left(\gamma^L \cdot d_T - \gamma^{L,NM} \cdot \frac{d_{T-1}}{(1+g_T)(1+\pi_T)} \right) \right]}{\gamma^{L,NM} \cdot \frac{d_{T-1}}{(1+g_T)(1+\pi_T)}}$$

b) Assume that in year T: a) the nominal implicit interest rate on fixed-term long-term debt $i_T^{L,NM,F}$ is equal to $i_T^{L,NM}$; b) the real implicit interest rates on long-term debt indexed to (euro area or Italian) inflation is equal to $i_T^{L,NM}$ minus the relevant inflation rates; c) the implicit term premium $prm_T^{L,NM}$ is equal to $i_T^{L,NM}$ minus the 6-month EURIBOR. These assumptions are broadly equivalent to assuming no-arbitrage conditions between different types of governments bonds over the years. In formulas, the above assumptions can be expressed as:

$$(24)\quad i_T^{L,NM,F} = i_T^{L,NM}$$

$$(25)\quad r_T^{L,NM,€} = i_T^{L,NM} - \pi_T^{€}$$

$$(26)\quad r_T^{L,NM,I} = i_T^{L,NM} - \pi_T$$

$$(27)\quad prm_T^{L,NM} = i_T^{L,NM} - eur_T$$

c) Plug the above estimates for year T in Eqs. (13), (17)-(18) and (20) to obtain the corresponding estimates for year T+1. To this end, an assumption is also made for the ε's. First, notice that up to year T the ε's can be simply calculated as the difference between the "true" values of the l.h.s. variables from Eqs. (24)-(27) and the estimated ones from Eqs. (13), (17)-(18) and (20). The information contained in the historical values of the ε's up to year T are thus used to provide an estimate of their values in projection years. For $\varepsilon_t^{L,NM,F}$, the annual series spans from 1991 to 2020 and, although short, it allows to carry out some time series inference.[22] A total of five time series models are thus estimated and the average of the corresponding forecasts after year T+1 is used for the projections of $\varepsilon^{L,NM,F}$. For the other ε's, the historical series are too short to allow for any inference. Thus, it is assumed that in projections the values of these *ε's* are the same as the last one observed in year T.[23]

d) Plug the estimates from point c) into Eq. (11) to obtain an estimate of $i^{L,NM}$ for year T+1.

e) Estimate ie_{T+1} from Eq. (21) and d_{T+1} from Eq. (2).

f) Start again from point c) and solve recursively the system of equations to obtain projections for T+2 and the following years.

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[22] A number of unit root tests were performed and rejected the null hypothesis of the presence of a unit root for this variable. The results of these tests and of the estimation of the time series models are available on request.

[23] This is equivalent to assume a random walk for these variables.