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Houses of the Oireachtas

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Parliamentary Budget Office

Analytical Note

The PBO analytical model for public debt sustainability analysis

Jacopo Bedogni & Keith Fitzgerald

Key Findings

1. Significant borrowing by Government has been required to manage the economic and fiscal impact of the COVID-19 pandemic. In this paper, we present a model to facilitate a public debt sustainability analysis. This model enables us to assess the potential implications of the pandemic for medium and long-term debt sustainability, and, more generally, to examine the trajectory of the ratio of Government debt to national income over the next 10 years.
2. Our method is novel among standard deterministic debt sustainability models, in that it allows for a more granular approach to modelling the interest rate effect (i.e. the impact of changes to the interest rate on the debt ratio). This approach further enables us to model and approximate annual interest spending. This work is part of a capacity building exercise, and the first of a set of tools to be used by the PBO in debt sustainability analysis.
3. In the short term, the stock of public debt is set to increase and will likely remain high, representing a key fiscal vulnerability. Notwithstanding this, a broader assessment of the range of factors underpinning public debt sustainability, such as economic growth, inflation, interest rates, and the debt maturity profile, suggests that the debt burden will be on a sustainable path over the next 10 years.
4. Under our baseline scenario, we expect that the debt-to-GDP ratio (debt-to-GNI* ratio) will be on a downward trajectory from 2022, reducing over time to 49% (86.4%) by 2030. In our simulation, this happens without significant fiscal consolidation (i.e. broad-based tax increases or spending cuts), as economic growth is the main driver of debt sustainability over the projection period.
5. Alternative simulations demonstrate that even dramatic increases in the marginal interest rate (assessed in isolation), will not have large detrimental effects on the debt dynamics out to 2030, given the long-term maturity profile of Irish debt and the large share of the debt that is held at fixed rates.
6. Our results suggest that, as we emerge from the COVID-19 crisis, aggressive fiscal consolidation will not be required to ensure that the debt burden is on a sustainable path over the next 10 years, assuming our baseline assumptions hold. However, the winding down of temporary COVID-19 supports once the recovery sets in and a prioritisation of growth enhancing measures, will support the sustainability of the public finances in the long-term.

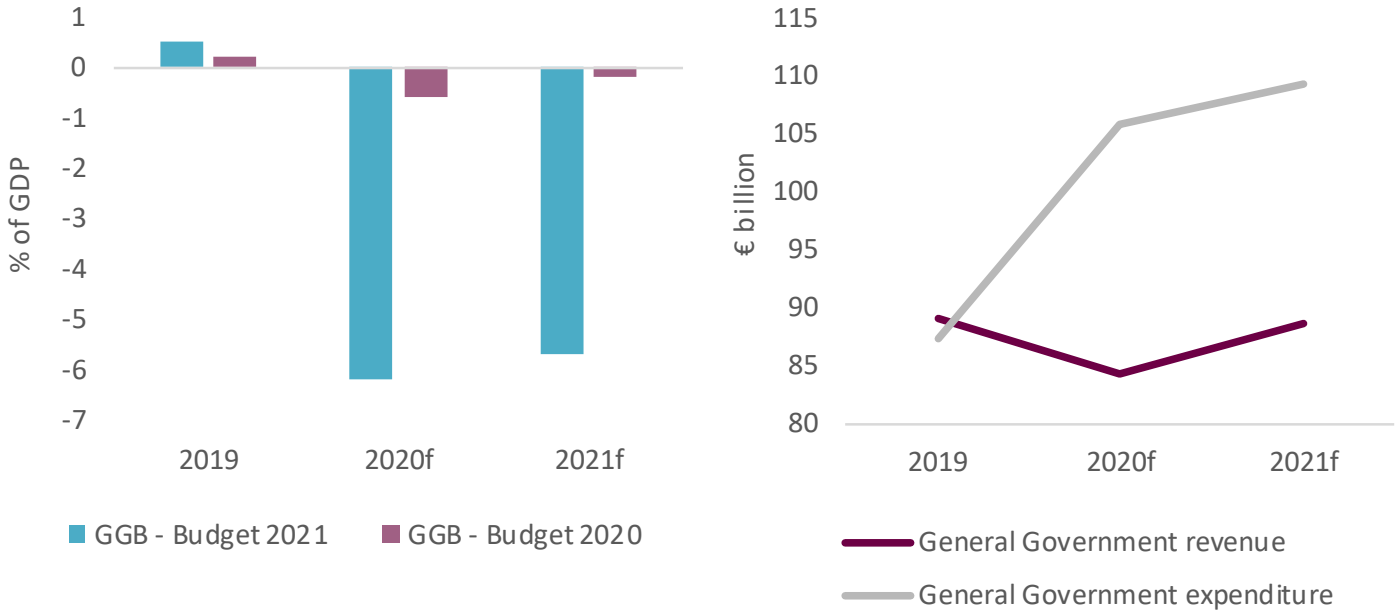
1. Introduction[1]

COVID-19 has had a significant impact on the public finances. Throughout 2020, although tax revenues held up better than expected, the State received substantially less in tax revenue relative to pre-pandemic forecasts. At the same time, there was a need to meet the costs of income supports for individuals and financial supports for businesses in the most impacted sectors.

The closure of several sectors of the economy due to the administrative restrictions introduced to control the spread of the virus, necessitated that fiscal policy be strongly expansionary. To this end, a large budget deficit (of 6.2% of GDP according to official Budget forecasts)[2] was run in 2020, and the Government anticipates a similar deficit (of 5.7% of GDP) for 2021.

In Budget 2021, the Government projected that Ireland's gross debt would reach €239 billion by the end of 2021. This would mark a €35 billion increase in borrowing relative to the end of 2019 and a 9 pp (percentage point) deterioration in the debt-to-GDP ratio (or a 19 pp deterioration in the debt-to-GNI* ratio).

Figure 1a and 1b: Impact of the COVID-19 on the General Government Balance (GGB), Budget 2020 and 2021 (1a) and Budget 2021 (1b)



Source: Department of Finance

This additional borrowing is occurring in the context of an extraordinarily accommodative interest rate environment, supported in large part by the European Central Bank's (ECB's) emergency bond-buying programme (the Pandemic Emergency Purchase Programme). Furthermore, while some economic 'scarring' effects are likely to persist, the shock to revenue and spending is temporary, with revenue and spending growth likely returning to pre-pandemic trends over time, as vaccines are rolled out and the economy begins to re-open.

1 The authors are grateful to the NTMA for the provision of underlying data and expert advice.
2 Budget 2021 - Economic and Fiscal Outlook, Government of Ireland, October 2021. A more recent estimate of the general government deficit at end-2020 (of €19 billion, or circa 5.5 per cent of GDP) was presented in the Fiscal Monitor publication for December 2020.

This additional debt burden (while necessary to meet the immediate costs of the pandemic), must be considered from a debt sustainability perspective. In assessing the issue of debt sustainability, it is instructive to explore the main factors that drive the evolution of the debt burden over time.

This is the first in a series of technical publications by the PBO, dealing with the issue of public debt sustainability and its key drivers. In this paper, we present the deterministic model used by the PBO to project and analyse future public debt trajectories. This is part of a capacity building exercise, and the first of a set of tools to be used by the PBO in debt sustainability analysis (for example, future work will expand on this deterministic model to include a stochastic framework).

This model allows us to explore how various factors impact on the dynamics of the public debt to national income ratio (a key indicator of debt sustainability). For example, the model helps us to understand how an increase in the budget deficit and/or lower economic growth rates can increase the debt burden, or how factors such as inflation and a longer maturity profile impact on the debt to national income ratio.

A key feature of our model is that, leveraging data provided by the National Treasury Management Agency (NTMA), it considers the maturity profile of individual tranches of the national debt, as well as the specific interest rate attached to individual components of the debt portfolio. This approach allows for a more explicit analysis of how an interest rate shock affects the trajectory of the debt ratio, or how the primary balance in a particular year impacts on the evolution of the debt burden thereafter. It also facilitates an analysis of how compositional changes in the national debt affect sustainability. Furthermore, it allows us to model and approximate the path of interest spending over the coming years.

Our analysis finds that, while the outstanding stock of public debt is set to increase and will likely remain high in the medium term, a broader assessment of the set of factors underpinning debt sustainability indicates that the debt burden will be on a sustainable path out to 2030. Under our baseline scenario, the debt-to-GDP ratio (debt-to-GNI* ratio) will be on a downward trajectory from 2022, and will reduce over time, to 49% (86.4%) by 2030. In our simulation, this happens without significant fiscal consolidation, as economic growth is the main driver of sustainability over the projection period. Alternative simulations also show that even dramatic increases to the marginal interest rate (assessed in isolation), will not have large detrimental effects on the debt dynamics out to 2030, given the long-term maturity profile of Irish debt and the large share of the debt that is held at fixed rates.

2. Broader context to public debt in Ireland

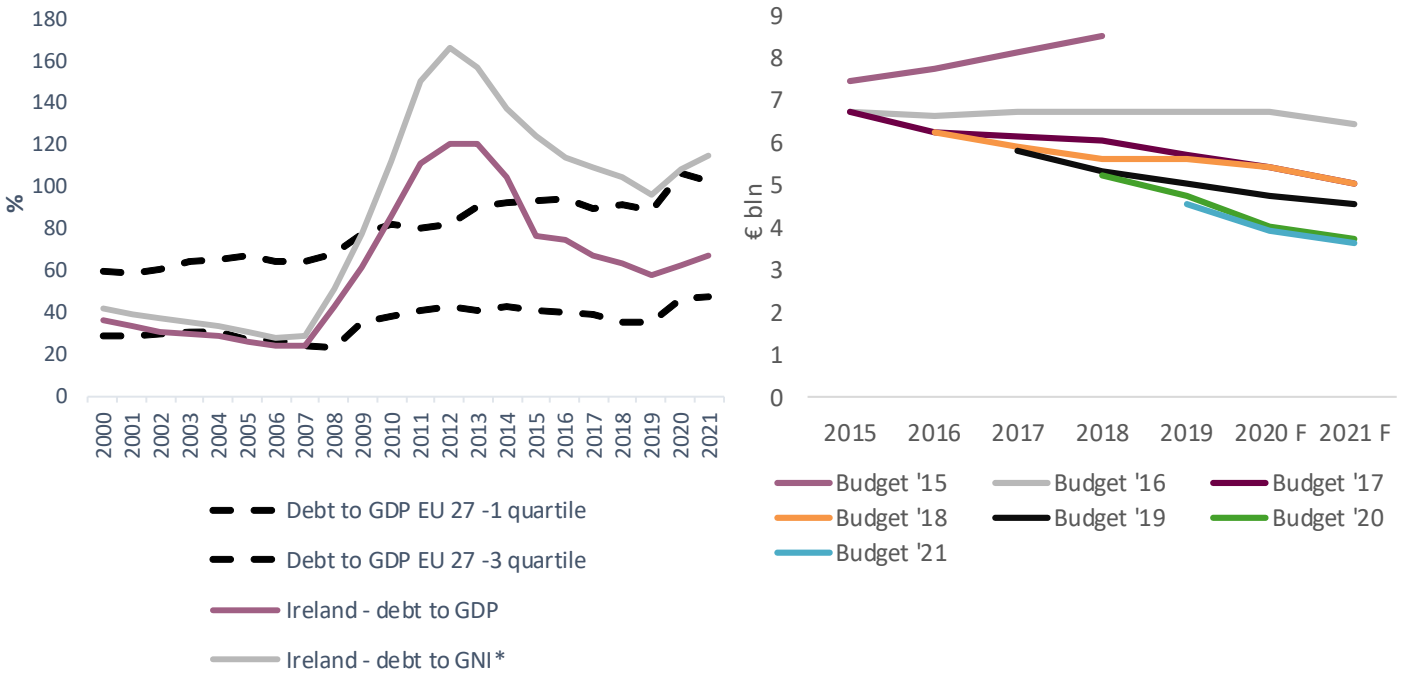
In the last 20 years, public debt has undergone significant changes. Following a period of unprecedented economic growth, prior to the onset of the economic and fiscal crisis of 2008, Ireland's General Government Debt-to-GDP ratio fell significantly below the EU's Stability and Growth Pact threshold of 60% (i.e. a threshold which is considered a prudent debt burden within the European fiscal framework). As the crisis unfolded, the debt ratio peaked at 120% in 2012 (a significant increase on the 24% figure for 2007).

The debt burden improved as the recovery set in, with the debt ratio reducing to 57% by 2019. However, this progress halted with the onset of the COVID-19 pandemic, with the debt ratio set to increase both in 2020 and 2021.

The debt burden is higher still when gross debt is measured as a percentage of Modified Gross National Income (or GNI*).[3] Using GNI*, public debt in Ireland is comparatively higher than the interquartile range of EU Member States (see Figure 2a).[4] In other words, Ireland's debt burden is higher than a typical EU country and rising, at least in the short-term, due to the COVID-19 pandemic (sovereign debt burdens are increasing more generally, as economies grapple with the macroeconomic and fiscal implications of the pandemic). A similar picture emerges when debt is measured as a percentage of General Government Revenue (at 229% in 2019).

However, the debt burden cannot be fully understood in a vacuum and should be analysed in the broader context of macroeconomic and fiscal sustainability, in consideration of factors such as economic growth, inflation, interest rate dynamics, and the debt maturity profile. For example, it must be noted that the risk of a shock to interest rates is mitigated in part by the large share of Irish debt that is held at fixed rates. In addition, the estimated weighted average maturity (WAM) of the medium and long-term (MLT) debt portfolio is over 11 years,[5] and debt financing conditions remain favourable. Interest payments on the national debt have consistently been lower than expected in recent years (Figure 2b), reflecting the very favourable interest rate environment brought by ECB policies involving the purchases of Euro-Area Member States' sovereign debt.

Figure 2a and 2b: Ireland's debt burden internationally (2a); favourable debt financing conditions - budgetary forecasts for interest expenditure over time (2b)

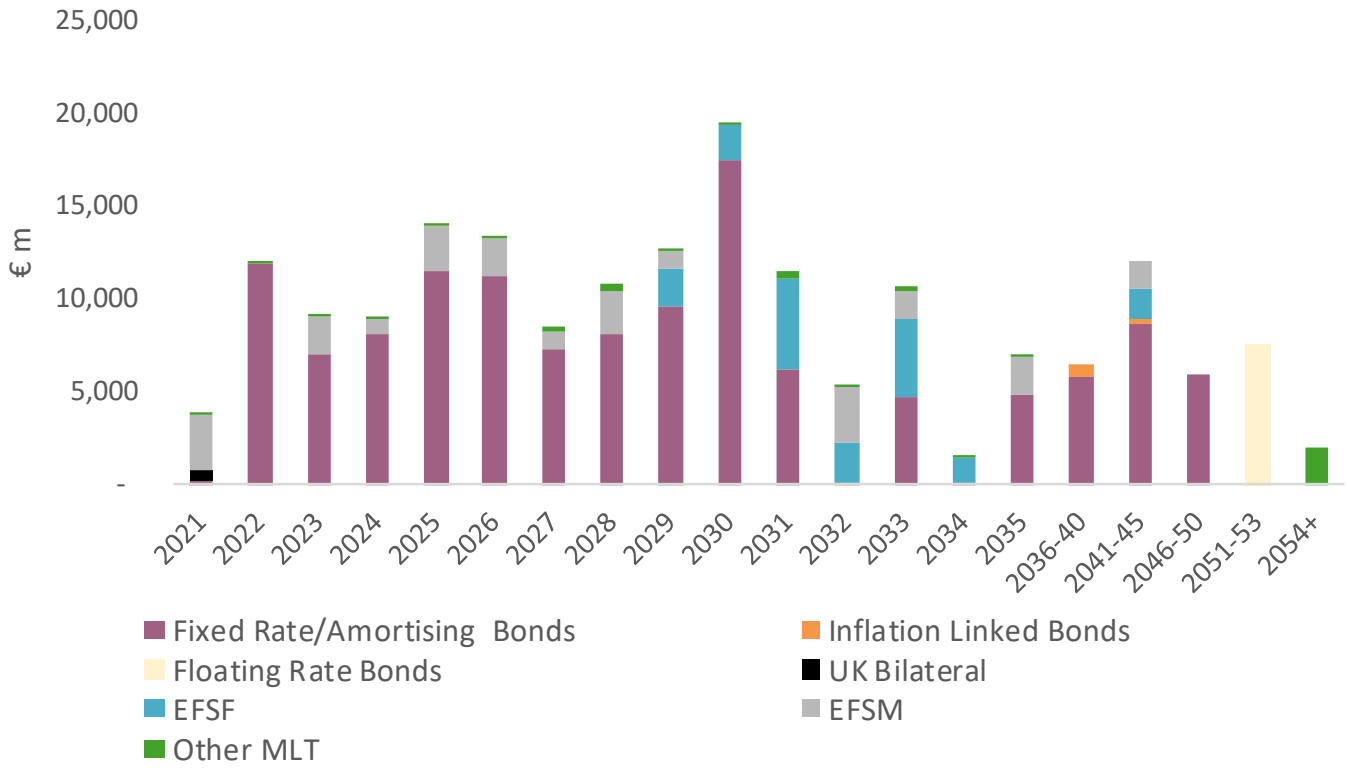


Source: Authors' analysis of Ameco data, and Department of Finance's Economic and Fiscal Outlook (various years). Figures for 2020 and 2021 are forecasts.

Note: Debt here is measured in gross terms, that is, it ignores offsetting items such as cash balances and financial assets.

3 GNI* is a measure of Irish economic activity that strips out the impact of certain globalised activities (e.g. intellectual property imports and aircraft leasing) that make a more limited contribution to the domestic economy.
4 Notwithstanding the issues inherent in the use of GDP to measure growth in the Irish context, GNI* is itself an imperfect metric for use in estimating the debt burden. For one, the activity excluded from GNI* (yet captured by GDP) is taxable, and should not reasonably be excluded in assessing debt sustainability.
5 *Annual Report on Public Debt in Ireland 2020*, Department of Finance, January 2021.

Figure 3: Maturity profile of MLT Debt Portfolio (at end-December 2020)



Source: NTMA

Figure 3 illustrates that, as of end-2020, a sizeable portion of the MLT debt (approximately 38%) is set to mature beyond 2030, which necessitates an analysis of the issues underpinning long-term growth prospects (e.g. demographic trends, productivity, and labour supply). However, the majority of MLT debt (approximately 62%) is set to mature within the next 10 years. In this paper, we focus on debt trajectories out to 2030. We examine both a baseline scenario, and an alternative scenario with less accommodative financing conditions (i.e. reflecting increases in the marginal interest rate).

We outline the general framework of our simulations, and the underlying model, in the following section.

3. Developing a granular deterministic debt model

Since our focus is on debt sustainability, we model the dynamics of Ireland's MLT debt, as distinct from the totality of General Government Debt (GGD).[6] Our approach is novel among standard deterministic debt sustainability models, in that we separately consider the individual components of the MLT debt stock (rather than a single aggregated stock of debt), as captured by an interest rate and maturity profile.[7] This approach, for example, allows for a more explicit analysis of how a shock to the marginal[8] (rather than the effective) interest rate in a particular year affects the trajectory of the debt ratio, or how the primary balance for a given year impacts on the evolution of the debt burden thereafter.

6 GGD is the total gross consolidated debt of the State, of which the Gross National Debt (as managed by the NTMA) is overwhelmingly a principal component.
7 A detailed interest model including maturity dates and interest rates on Irish debt securities was also presented by Casey and Purdue (2021), which also introduced a stochastic framework for debt sustainability analysis.
8 We use the average annual rate on a 10-year Irish government bond (as estimated).

The general framework of our model is based on the standard debt accumulation equation, which offers an accounting framework for assessing the dynamics of public debt, year-on-year:

$$D_{t+1} = (1 + i_{t+1})D_t - PB_{t+1} + F_{t+1} \quad \textbf{(1)}$$

Where the stock of debt next year (D_{t+1}), is driven by the outstanding stock of debt in the current year (D_t), interest spending on this stock of debt next year ($i_{t+1}D_t$), the primary balance next year (PB_{t+1}), and the stock-flow adjustment (F_{t+1}) i.e. the change in government debt that is not explained by the change in the government deficit/ surplus.

The debt ratio is the outstanding stock of debt for a given year divided by national income (i.e. GDP). In our model, we consider the debt ratio as the sum of: the individual outstanding debt tranches (each with an interest rate and maturity profile), the interest spending on each debt tranche, the primary balance, and the stock-flow adjustment (all over GDP), such that:

$$d_{t+1} = \sum_{a=1}^{A} d_t^a(1 + i_{t+1}^a) - pb_{t+1} + f_{t+1} \quad \textbf{(2)}$$

Where, d_t^a refers to the stock of tranche *a* debt, with *A* total tranches of debt. For each year, any primary deficit and the interest expenditure from the preceding year (the new borrowing requirement) enters the stock of debt, and is treated as another debt tranche and assigned the prevailing marginal interest rate.[9] We are interested in modelling the evolution of the debt burden over time. To that end, we are interested in:

$$\Delta d_{t+1} = d_{t+1} - d_t \quad \textbf{(3)}$$

Equation (3) can be expressed in a way that enables us to identify and separately estimate three distinct drivers of the debt dynamics, year-on-year:

$$\Delta d_{t+1} = \sum_{a=1}^{A} \left\{ d_t^a \left(\frac{i_{t+1}^a}{1+g_{t+1}} \right) - d_t^a \left(\frac{gr_{t+1}}{1+g_{t+1}} \right) - d_t^a \left[\frac{\pi_{t+1}(1+gr_{t+1})}{1+g_{t+1}} \right] \right\} - pb_{t+1} + f_{t+1} \quad \textbf{(4)}$$

Where (in addition to previously defined terms), *g* is the nominal growth rate of GDP, *gr* is the real growth rate of GDP, π is the rate of inflation (in terms of the change in the GDP deflator), *pb* is the primary balance over GDP, and f_t captures the stock-flow adjustment over GDP.

In equation (4) above, we can identify three key factors that drive the dynamics of the debt-to-GDP ratio, year-on-year. Together, these three factors capture the "snowball" effect, that is, the combined impact of interest spending, the inflation rate, and GDP growth, on the debt dynamics. A key driver of the snowball effect is the interest rate-real growth rate differential (discussed below). These factors are usually aggregated together, however we isolate and analyse each driver individually.

The first of these factors, is the **interest rate effect**:

$$\sum_{a=1}^{A} d_t^a \left(\frac{i_{t+1}^a}{1+g_{t+1}} \right),$$

9 In our model, a primary surplus (i.e. pb > 0) is used to offset interest expenditure and thereby reduce the borrowing requirement for a given year. After this, any excess is used to reduce the next maturing tranche of the debt stock.

This captures the implications for the sustainability of public debt of an increase in the rate of interest paid on the outstanding stock of debt.

Holding other factors constant, a rise in interest rates increases the debt ratio and has negative implications for public debt sustainability, as it becomes more expensive to service the debt. We adopt a granular approach to modelling the interest rate effect, in that we account for the breakdown of the different interest rates applied to individual components of the debt over the maturity profile of the outstanding stock of debt.

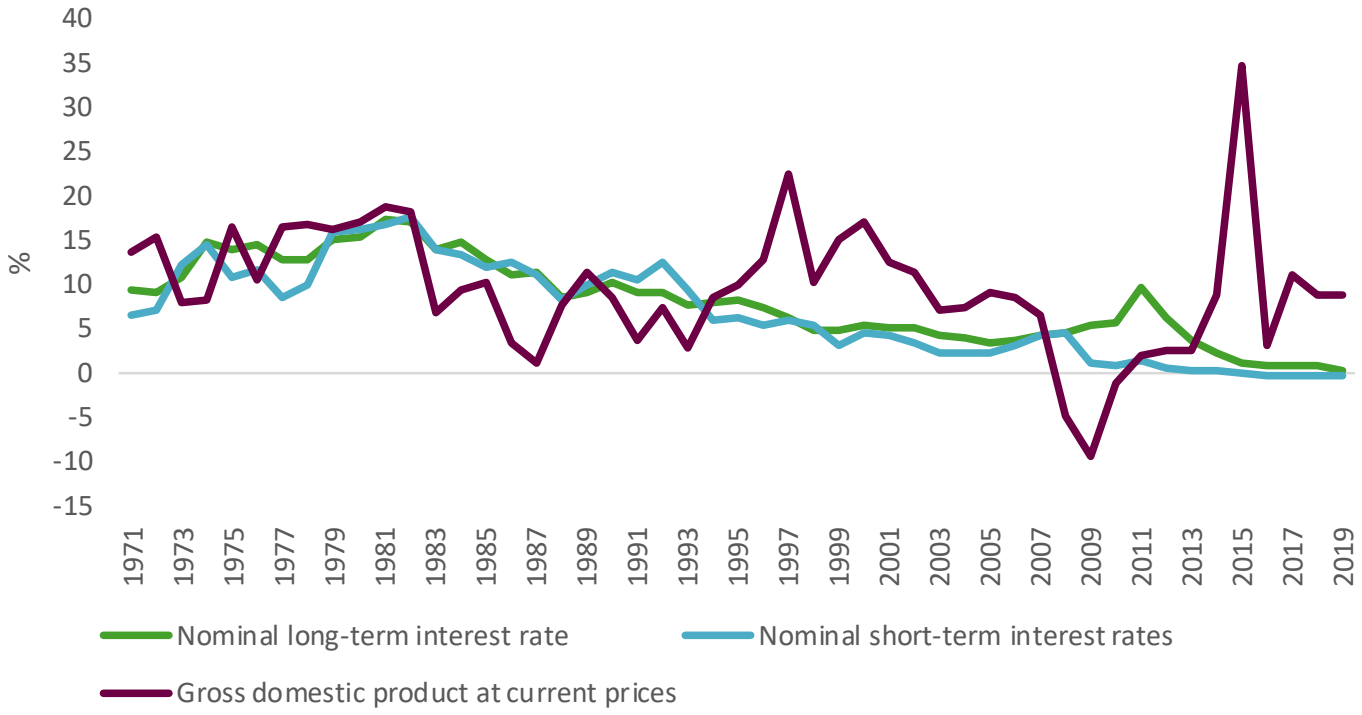
Secondly, is the **real GDP growth effect**:

$$\sum_{a=1}^{A} d_t^a \left(\frac{gr_{t+1}}{1+g_{t+1}} \right),$$

This reflects the public debt repayment capacity, capturing the positive impact of higher economic activity on debt sustainability.

More specifically, the interest rate-growth differential (i – g) is a key determinant of the sustainability of public debt (and the driver behind the "snowball effect" on the debt ratio). Holding other factors constant, a prolonged period of low interest rates causing a persistent negative interest rate-real growth rate differential (i < g), would contribute to a reduction in the debt burden over time.

Figure 4: long-term trends for the interest rate (i) and economic growth (g)



Source: Authors' analysis of Ameco data

As can be observed in Figure 4, interest rates in Ireland have generally been on a downward trajectory over the latest number of decades. Indeed, recent literature (see Blanchard (2019))[10] has explored the tendency for growth rates to exceed interest rates on public debt in advanced economies over the last ten years (particularly since the Global Financial Crisis).

10 Blanchard, O. (2019), "Public Debt and Low Interest Rates", *American Economic Review*, Vol. 109 (4).

Secondly, the **inflation effect** is represented by:

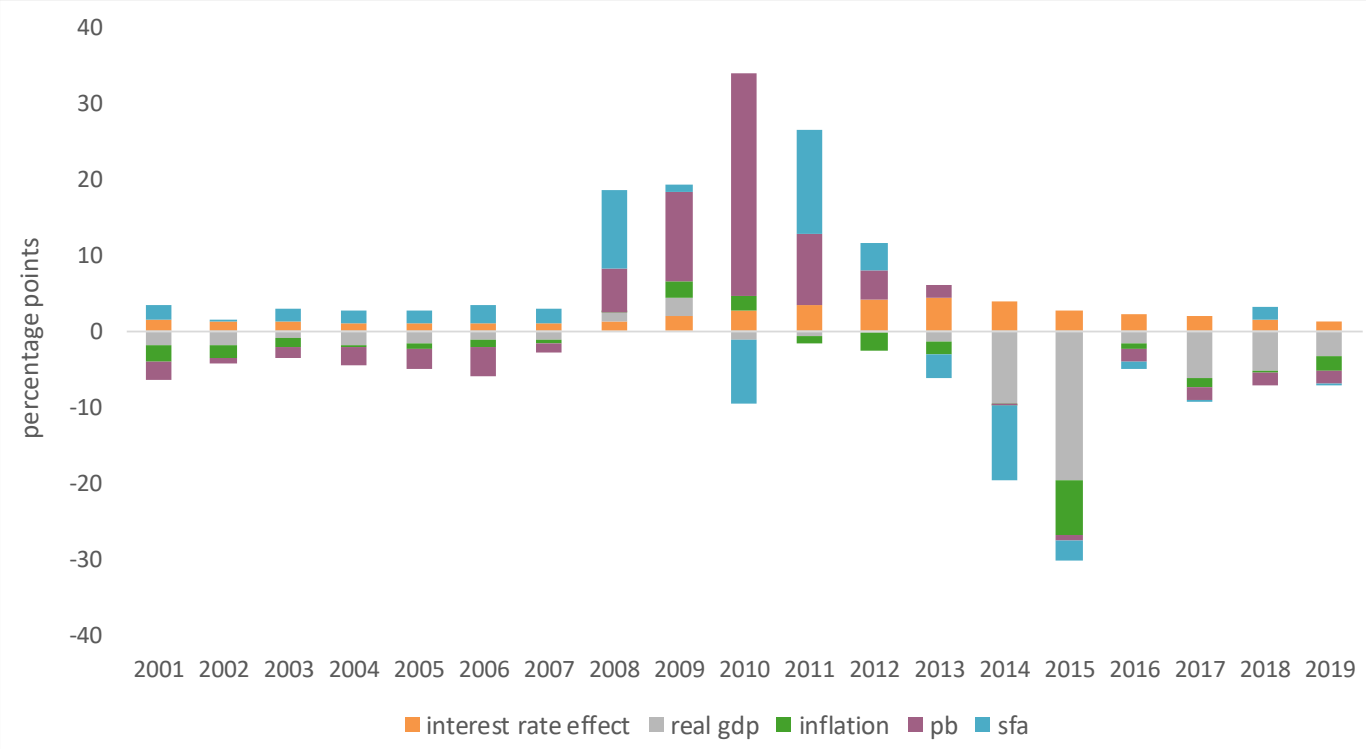
$$\sum_{a=1}^{A} d_t^a \left[\frac{\pi_t(1+gr_{t+1})}{1+g_{t+1}}\right],$$

This captures the extent to which inflation erodes the real value of the stock of outstanding debt, easing the public debt burden. This depends on the level of inflation as well as the maturity profile of outstanding debt.

Box 1: Debt dynamics over 2001 – 2019, factor breakdown

Using historical data, we show a breakdown of the impact of these key drivers on the debt-to-GDP ratio over 2001 to 2019. Overall, the debt dynamics were positive prior to 2008, with improvements driven by budget surpluses, inflation and real GDP growth. A large deterioration in the public finances occurred over 2008 to 2013, relating to successive primary deficits, bank recapitalisations (captured by the Stock Flow Adjustment (SFA term)), and the increased cost of borrowing (captured by the interest rate effect). From that point onwards, exceptional economic growth (albeit standard measures of economic activity were distorted in 2015 due to the on-shoring of intangible assets by foreign owned multinationals) has been the key factor in reducing the debt burden up until the onset of the COVID-19 pandemic in 2020. Primary surpluses from 2015 onwards were also a factor.

Figure 5: Key drivers of the debt dynamics over 2001-2019



Source: Authors

4. Debt Projections

As stated earlier, our objective is to create public debt projections – stylised trajectories of Ireland's Government debt – out to 2030. Specifically, we model the dynamics of approximately €180 billion in MLT debt outstanding in 2020 (as of end-December 2020; this is 82% of General Government Debt). In deriving the stock of General Government Debt, the remaining €37 billion, consisting mostly of short-term debt and State Savings schemes (retail) is held constant over the projection period.[11]

We present deterministic debt projections, that is, we project a single debt trajectory based on a defined set of assumptions regarding the way that certain macroeconomic and fiscal variables evolve over time. As a starting point, we construct a baseline scenario underpinned by a given set of assumptions for key macroeconomic and fiscal variables (these are detailed in Table 1). We then compare our public debt projections under these assumptions to debt projections based on an alternative set of assumptions. We outline the baseline and alternative scenarios below.

4.1 Baseline Scenario

Our baseline scenario models an Irish economy emerging from the worst of the COVID-19 pandemic in 2021, with a more pronounced recovery taking hold in 2022. This is consistent with the effective rollout of a mass vaccination campaign and the easing of administrative restrictions throughout 2021. Over the short term, this scenario considers real GDP growth of 4.5% in 2021, rising to 5.6% in 2022. In terms of the primary balance, we model a deficit of €15.7 billion for 2021, falling to €5.3 billion in 2022.

Over the medium-to-long term (from 2025 onwards), and in line with the standard approach used by forecasting bodies, we assume a return of key variables to their equilibrium values. **GDP growth** converges to its estimated potential growth rate, at 2.3%, and inflation converges to the 2% ECB target rate. Benign financing conditions are assumed to hold, in line with the extraordinary support provided by the ECB's monetary policy stance. We model a very gradual normalisation in marginal **interest rates** out to 2030 (as outlined previously, the marginal interest rate refers specifically to the average annual market interest rate on a 10-year Irish government bond).

We derive the **primary balance** from a bottom-up assessment of revenue forecasts (based on revenue elasticities) and expenditure projections. We model a fiscal scenario where revenue grows in line with GDP, and public spending growth follows pre-pandemic trends from 2021 to 2025, and increases in line with revenue growth from 2026 to 2030. We adjust for some of the exceptional supports provided during the pandemic, which are assumed to be temporary in nature. Specifically, we assume the removal of a proportion of pandemic-related social protection spending over 2021 and 2022, in line with the economic recovery, with all of this temporary social protection spending removed from 2023. With these underpinning assumptions, we model a primary deficit averaging €3 billion *per annum* over 2023 to 2030.

For each tranche of the MLT debt that is set to mature in a given year, we assume that this debt is rolled-over (or re-financed) for an additional 10 years, at the prevailing marginal rate (as estimated).[12]

11 We exclude a small portion of the debt from our model (approximately €1.3 billion or 0.5% of General Government Debt), largely consisting of amortising loans and inflation-indexed bonds.

12 This also applies in respect of maturing EFSM loans. Specifically, our model considers that these loans, are re-financed by Government in financial markets. While EFSM loans may be refinanced by the EFSM on request, as yet, no formal decision has been taken. While prevailing rates for Irish government debt are significantly lower than at the time that EFSM funding was availed of, EFSM borrowing on behalf of the State would likely result in lower rates. Our model allows for an analysis of the impact of changes to EFSM loan structures should these become policy.

A majority of Ireland's MLT debt is held at fixed rates. However, €7.5 billion of outstanding debt in 2020 was held in floating rate notes (FRNs). These FRNs account for just 4% of the total MLT debt (the NTMA has been cancelling, at pace, outstanding FRNs in recent years).[13] These rates are determined by a fixed margin plus the EURIBOR[14] 6-month rate. We use forward rates as a proxy for forecasts of the EURIBOR over the projection period.

€3 billion in EFSF funding (currently at a fixed rate) will transition to a pooled rate from 2022. In line with this, from 2022, we apply the current EFSF pooled lending rate of 1.16% to the relevant tranches of debt.[15]

Finally, the stock-flow adjustment (SFA) is set to zero over the projection period.

Table 1 details our projections of key macroeconomic and fiscal variables under this baseline scenario.

Table 1: Baseline scenario – projections of key macroeconomic and fiscal variables

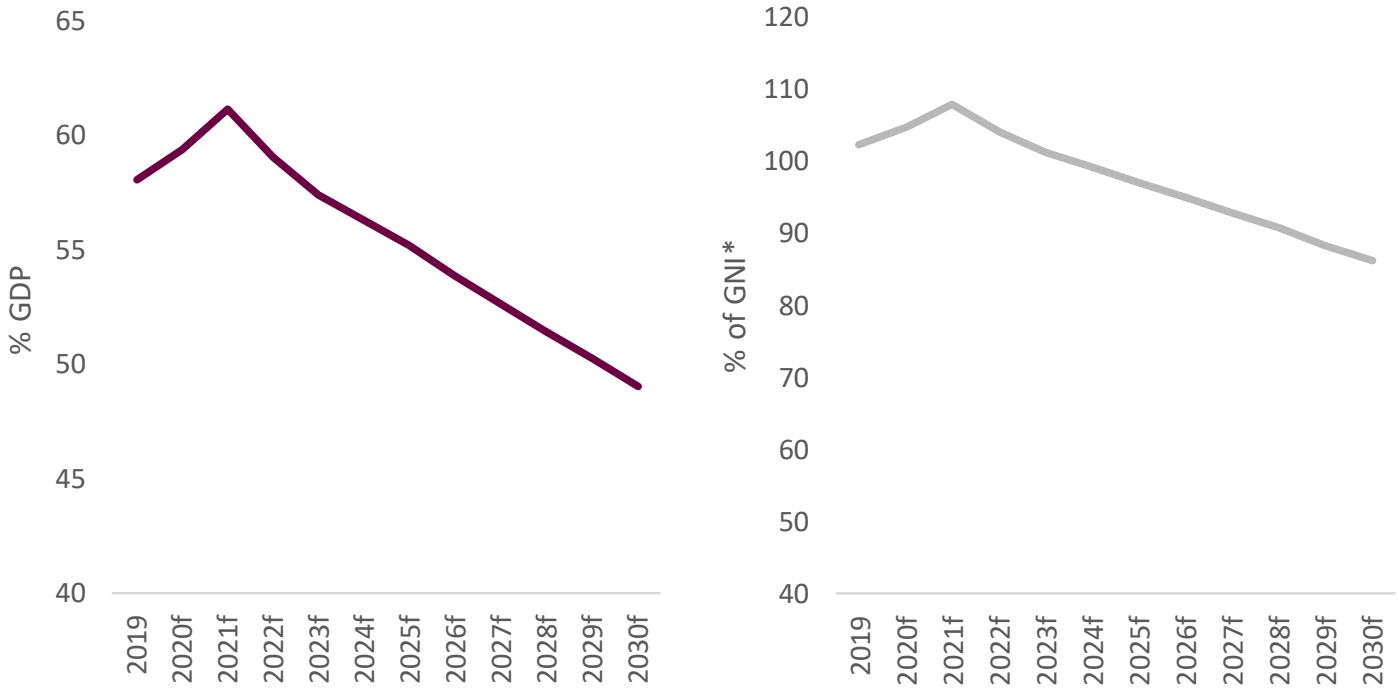
Year	Nominal GDP Growth (%)	Real GDP Growth (%)	GDP Deflator (%)	Market Interest Rate (%)	Primary Balance (€ bn)
2020	3.0	3.4	-0.5	0.1	-17.4
2021	5.5	4.5	1.0	0.0	-15.7
2022	7.2	5.6	1.6	0.1	-5.3
2023	5.1	3.3	1.8	0.2	-2.4
2024	4.4	2.5	1.9	0.5	-3.4
2025-2030 rate per annum	4.3	2.3	2.0	0.8	-3.2*

Source: Authors, and CSO for GDP figures in 2020.
Notes: *average over the projection period.

Figure 6a shows the estimated trajectory of the debt-to-GDP ratio under our baseline scenario. As shown, we project an increase in the debt-to-GDP ratio for 2021 of 3.1pp (vs 2019), to 61.2%. The primary deficit is the main driver of the deterioration in the debt dynamics from 2020 to 2021 (by 4 pp, see Figure 7).

13 It is worth noting that these FRNs are held by the Central Bank of Ireland, and as such, interest payments made on this debt is returned to the Exchequer in the form of Central Bank Surplus Income.
14 The EURIBOR is a reference rate that reflects the average interest rate at which banks in the Eurozone offer short-term lending in the inter-bank market.
15 Lending Rates, European Stability Mechanism, accessed 18th February 2021.

Figure 6a and 6b: Projected trajectory of the debt-to-GDP (6a) and debt-to-GNI* (6b) ratio under the baseline scenario, 2020 - 2030



Source: Authors

Given that we assume no significant fiscal policy changes (apart from the removal of temporary social protection supports outlined previously), our baseline scenario estimates that primary deficits are run until the end of the projection period (in 2030) and have an adverse impact on the debt-ratio during this time. The modest projected increase in marginal interest rates also has a negative impact on the debt dynamics, although to a lesser extent.

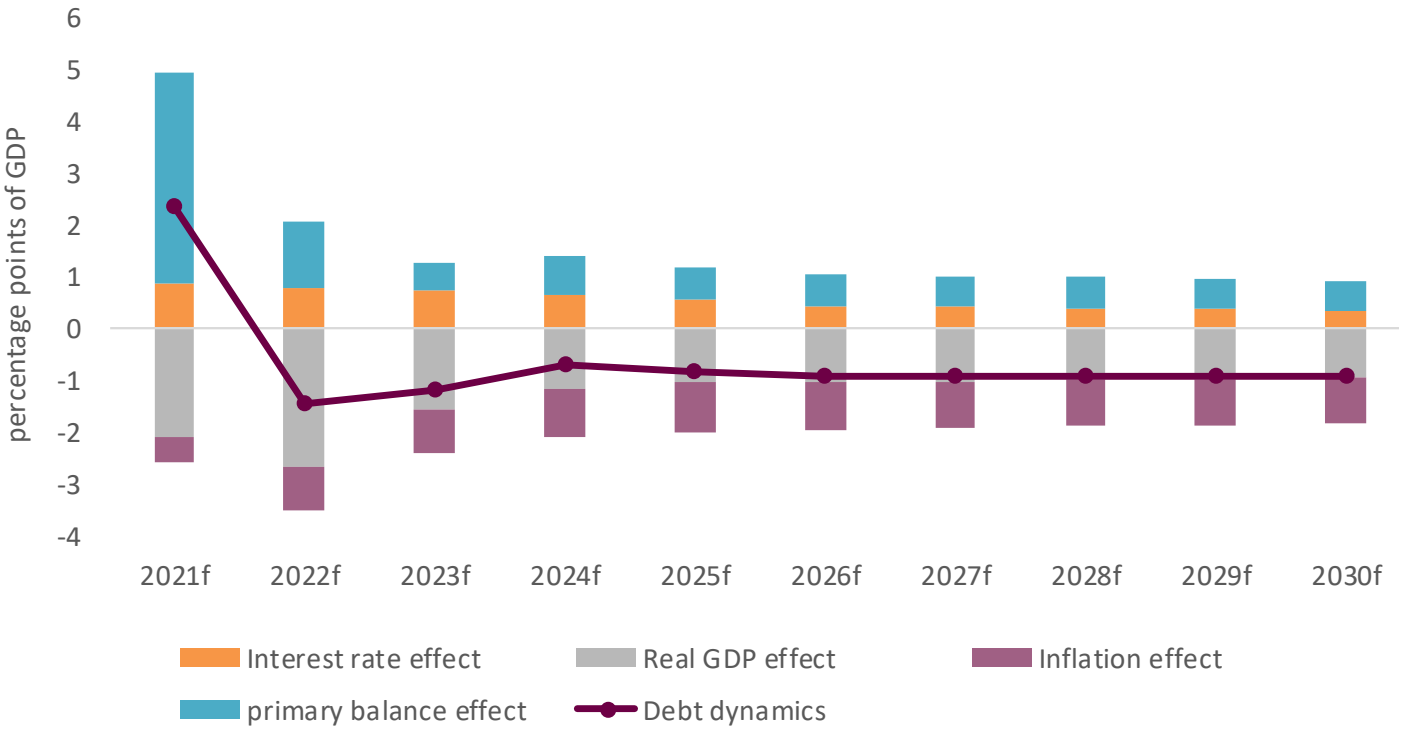
Nonetheless, real GDP growth and inflation have an off-setting impact on these primary balance and interest rate effects. Real GDP growth improves the debt dynamics by 2.1pp in 2021 and 2.7pp in 2022, reflecting the impact of the economic recovery following the end of the pandemic period (assumed in 2021/2022).

Under our baseline scenario, taking account of these three effects, the debt-to-GDP ratio reduces to 49% by 2030. This suggests that, if our baseline assumptions hold, the debt burden will be on a sustainable path for the next 10 years without significant fiscal consolidation. Economic growth is the main driver of debt sustainability over the projection period.

We further investigate the debt dynamics when public debt is expressed as a percentage of GNI*. A technical assumption is made regarding forecasts of GNI*, and we assume growth in line with GDP.[16] The main difference in the results, is a higher level for the debt ratio, while the overall dynamics are unchanged. Under our baseline scenario, the debt-to-GNI* ratio peaks at 107.8% in 2021. From that point on, the debt ratio declines over time, and reaches 86.4% in 2030.

16 The estimated elasticity between the two variables prior to a structural break in 2015 is approximately 1.

Figure 7: Composition of the debt-to-GDP ratio dynamics - baseline scenario



Source: Authors.
Note: Negative numbers imply a reduction in the debt-to-GDP ratio.

4.2 Alternative Scenario: Shocks to the Marginal Interest Rate

In an alternative scenario, we model the impact on the dynamics of the debt ratio, of a shock to marginal interest rates (assessed in isolation). As outlined previously, we model the impact of adverse changes in marginal (rather than effective) rates, using the annual average rate on a 10-year Irish government bond. This is a hypothetical exercise, that is intended only to explore the exposure of the public finances and the debt position to interest rate risk.

This scenario could arise post-COVID-19 once the ECB's emergency bond-buying programme ends. Further, should inflationary pressures mount in response to the extraordinary fiscal and monetary support provided in respect of the pandemic, this could prompt a tightening of monetary policy and a rise in market interest rates. In addition, high levels of public indebtedness could raise concerns among investors of fiscal and debt sustainability, particularly in the long-term. For example, a failure by policy-makers to unwind temporary fiscal supports, greater than anticipated long-term health-care costs, and less favourable demographic trends, could all place upward pressure on rates over time, as these sustainability issues are priced into the rates charged on new or re-financed debt.

More specifically, any deterioration in debt financing conditions would impact the debt burden in three key-ways:

- The portion of outstanding debt that is set to mature in the year(s) during which adverse financing conditions prevail, would need to be rolled-over at higher (more expensive) rates;
- Any new debt issued to cover primary deficits during this time would need to be borrowed at higher, more costly, rates; and,

- The portion of outstanding debt held at variable rates (insignificant in the Irish case) would become more expensive to service.

As a precursor to this scenario analysis, it is important to note that we model the impact of interest rate shocks in isolation. That is, we assume that these shocks do not occur within a broader context of macroeconomic and fiscal distress.

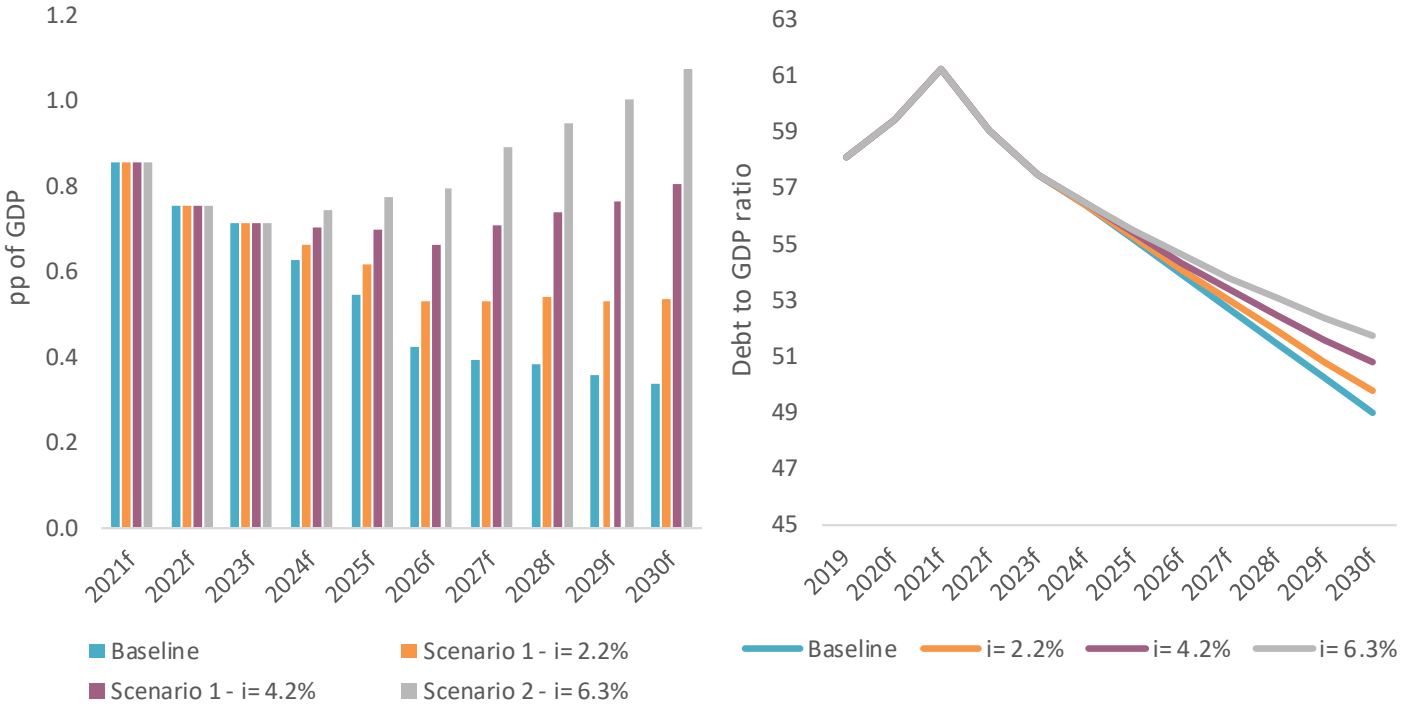
We model three interest rate shocks that are assumed to impact on marginal rates:

- An increase of 200 basis points in 2023 (i.e. i = 2.2%);
- An increase of 400 basis points in 2023 (i.e. i = 4.2%, corresponding to the average effective interest rate over 1996-2019);
- An increase of 610 basis points (i.e. i = 6.3%, the highest effective interest rate observed over 1996-2019). This is an extreme case scenario, that allows us to examine the impact on the debt ratio of a very large shock to the market interest rate.

For all these simulated shocks, the new rates are assumed to hold until the end of the projection period (in 2030).

The results are displayed in Figures 8a and 8b, and show how an increase in borrowing costs have a negative impact on the debt dynamics as, holding all other factors constant, they increase the 'interest rate effect' captured by the model. For example, while the interest rate is projected to increase the debt ratio by 0.34 pp in 2030 under the baseline scenario, this impact increases to 0.54 pp in the less severe interest rate shock scenario, and to 1.07 pp in the most severe scenario. However, the main finding from these simulations is that even dramatic increases to the marginal interest rate appear not to have large detrimental effects on the overall debt dynamics to 2030.

Figure 8a and 8b: Estimated impact of the interest rate on the debt-to-GDP ratio under different interest rate scenarios - pp (8a); Projected trajectory of the debt-to-GDP ratio - % (8b)



Source: Authors

More specifically, while the reduction in the debt ratio is slower than in the baseline scenario, the debt ratio remains on a downward trajectory. This can be explained by the long maturity profile of Irish debt, which has benefitted from the NTMA's strategy of 'locking-in' low interest rates and lengthening the average debt maturity. As a result, Ireland's average interest rate reacts slowly to higher marginal rates. With that, even in severe interest rate shock scenarios, the growth dynamics assumed mean that the usual "i-g" snowball effect remains in Ireland's favour.

There are some important caveats to this hypothetical scenario analysis, that are worth noting. While we model the impact of a shock to the interest rates attached to Irish government debt in isolation, it is possible that this shock could occur in a context of broader macroeconomic and fiscal distress. This means that, an increase in interest rates as modelled here, could be accompanied by larger primary deficits and low (or negative) growth, worsening the debt dynamics.

Furthermore, we assume that programme loans maturing in the projection period (i.e. EFSM) are re-financed *via* government borrowings from financial markets rather than *via* a loan extension. For loans maturing during the period of the interest rate shock, it is likely that EFSM refinancing would result in significantly lower rates.[17] If this option was availed of, this would improve the debt dynamics relative to what we have modelled in this scenario. In addition, while our central assumption is that maturing debt is rolled over for a period of 10 years, this is likely to be shortened in times of crisis, when rates are higher.[18]

Finally, as we are modelling the impact of a deterioration in domestic borrowing conditions on debt sustainability, we assume that there is no significant increase in the 6-month EURIBOR rate (i.e. the rate used to determine the interest paid on the floating rate tranches of government debt, an insignificant portion of overall MLT debt) during the period of the rate shock. This is a reasonable assumption in the context of a domestic shock.[19]

17 As outlined previously, while EFSM loans may be extended or refinanced by the EFSM on request, as yet no formal decision has been taken to extend the maturity of programme loans. However, any changes to the structure of EFSM loans could be captured by our model.

18 This could also be captured by our model.

19 For context, the EURIBOR 6-month rate peaked during the European sovereign debt crisis in 2008, reaching 5.4%. However, even this relatively high rate (should it materialise again) would not have a notable impact on the debt dynamics, given the relatively low portion of connected debt (just 4% of the medium and long-term debt).

5. Concluding Remarks

Due to the fiscal stimuli adopted in response to the COVID-19 pandemic, Irish Government debt has risen and is set to rise further. To assess the possible implications for issues of sustainability in the medium to long-term, we have presented a model for public debt analysis, which features, for example, a more granular modelling of the interest rate effect (leveraging data provided by the NTMA at the level of the individual debt instrument).

As explained, this approach allows for a more explicit analysis of how an interest rate shock affects the trajectory of the debt ratio, or how the primary balance in a particular year impacts on the evolution of the debt burden thereafter. It also facilitates an analysis of how compositional changes in the national debt affect sustainability. Furthermore, this model allows us to examine the possible path of interest spending over time.

While the stock of public debt is high, particularly when assessed in respect of other metrics such as GNI* or total revenue, long-term debt sustainability is a concept which takes into consideration a broader set of factors, such as economic growth, inflation, interest rate dynamics, and the debt maturity profile.

In this paper, we constructed a baseline scenario underpinned by a given set of assumptions for key macroeconomic and fiscal variables. Under this baseline scenario, we find that the debt-to-GDP ratio (debt-to-GNI* ratio) is on a downward trajectory from 2022, and reduces over time, to 49% (86.4%) by 2030. This suggests that, if our baseline assumptions hold, the debt burden will be on a sustainable path for the next 10 years, as economic growth will be the main driver of debt sustainability over the projection period.

We also model an alternative scenario simulating several shocks to market interest rates. In this case, simulations demonstrate that increases in marginal interest rates (assessed in isolation) are unlikely to have large detrimental effects on the debt dynamics out to 2030, as a result of the long-term maturity profile of Irish debt and the large share of the debt that is held at fixed rates.

However, it must be noted that a high stock of public debt represents a key vulnerability, particularly if a joined macroeconomic and fiscal shock was to materialise. In general, a high level of indebtedness increases the exposure of the Exchequer and limits the room for movement to respond to future crises. This vulnerability can be exacerbated by long-term issues, including an ageing population, and concerns around productivity and weaker than expected growth prospects. While our results suggest that aggressive fiscal consolidation is not a requirement to ensure the debt burden is on a sustainable path over the next 10 years (assuming our baseline assumptions hold), the winding down of temporary COVID-19 related supports, and a prioritisation of growth enhancing measures will help to safeguard against long-term sustainability risks. Key to this is an approach to fiscal policy that ensures the optimal use of public funds and facilitates beneficial structural reforms.

Subsequent publications will focus on some of these issues in the context of scenario and sensitivity analyses. This will enable us to test the resilience of the debt burden to a range of shocks, including pure macroeconomic ones (such as a shock to economic growth) or combined macro-fiscal shocks (as is the case when changes are simulated for both the interest rate, the growth rate and/or the primary balance). It will also be possible to illustrate the “room for movement” for various parameters, addressing

questions such as: for a given growth rate, how much of a shock to interest rates, or a deterioration in the primary balance, can the State withstand over a five-year period, before the debt burden becomes unsustainable? Or similarly, for given rates, how much of a GDP shock can be withstood? It would also be possible to assess the extent to which the primary balance responds to public debt levels and current economic conditions, by modelling Fiscal Reaction Function scenarios; and to model the 'feedback loop' between the primary balance and growth.

Finally, this paper has explored deterministic debt projections. As outlined, this is part of a capacity building exercise, and the first of a set of tools to be used by the PBO in debt sustainability analysis. Future work will explore a probabilistic approach, whereby, the results are a probabilistic distribution of debt projections resulting from several macro-fiscal shocks to the baseline scenario.