A model for forecasting primary fiscal revenue components

4.1 Introduction

The Malta Fiscal Advisory Council (MFAC), as mandated by Article 13 of the Fiscal Responsibility Act (FRA) 2014 (Cap. 534 of the Laws of Malta), is required to endorse and provide an assessment of the extent to which the fiscal and economic policy objectives proposed by the Maltese government are being achieved. In this manner, it contributes to more transparency and clarity about the aims and effectiveness of fiscal policy in Malta. In particular, the MFAC conducts an ex-post assessment of the official fiscal forecasts published by the Ministry for Finance (MFIN) in the Update of Stability Programme (USP) at the end of April each year, and the Draft Budgetary Plan (DBP), by 15 October of each year.

To fulfil similar functions, around one-third of other European independent fiscal institutions (EUIFIs) utilise in-house models for fiscal monitoring and assessment, while approximately a fifth of EUIFIs produce fiscal forecasts at their own initiative, to serve as benchmarks in evaluating the credibility of official fiscal forecast targets.[43] According to the OECD, this forecasting process has helped IFIs to strengthen the analysis of fiscal policy in their countries and contribute to strengthen the governance of public finance at the national level.[44]

The MFAC had, prior to 2023, relied primarily on qualitative assessments of the budgetary forecasts produced by the MFIN. In order to enhance the comprehensiveness of the Council's assessments and to bridge the gap between qualitative and quantitative analyses, in 2023 the MFAC developed a fiscal-revenue forecasting model. This model facilitates a more exhaustive examination of key revenue components and provides deeper insights into fiscal dynamics. Through this model, the Council is generating and publishing its revenue forecasts, and is, in its ex-post assessments, including quantitative-based risks to the MFIN's revenue forecast figures. Such projections aid the Council with endorsing the official forecasts, together with strengthening its position to make well-informed recommendations and effectively evaluate fiscal risks emanating from the revenue side of the budget.

This thematic chapter aims to provide a comprehensive explanation of the basis of the fiscal revenue model and the methodological framework employed by the MFAC to

[43] See European Fiscal Board Annual Report 2023.
[44] See von Trapp, L. et al., *"OECD Review of the Independent Authority for Fiscal Responsibility (AIReF)"*, 2017.

compute historical and forecast revenue elasticity estimates and, eventually, the projections. The Chapter also explains the outputs derived from the model and includes a summary of the two forecast rounds conducted in 2023, highlighting the identified risks relative to the projections of the MFIN. The functionality of the model is then assessed through simulation exercise. Finally, the Chapter concludes by listing the limitations of the modelling framework, whilst summarising the insights and importance of having developed such a revenue forecasting model.

4.2 Modelling framework, data and historical elasticities

The MFAC's fiscal-revenue model follows a unidirectional macro-fiscal approach, wherein macroeconomic inputs exert influence on the pertinent fiscal revenue line items but in turn, fiscal revenue does not affect the macroeconomic variables.

The model focuses on the tax revenue components, namely taxes on production and imports, current taxes on income and wealth, and capital taxes. Besides these tax receipt components, the model also includes social security contributions. Consequently, the model excludes revenue variables such as market output, property income, and other revenue streams that exhibit greater volatility, discretion or lack association with specific macroeconomic proxy bases. The selected revenue categories have historically accounted for over four-fifths of central government revenue. Notably, in 2022, current taxes on income and wealth emerged as the predominant source of governmental income, comprising 39%, followed by taxes on production and imports at 30% and social contributions at 17%.

The model is based on annual data, mitigating disruptive effects of time adjustments and seasonal variations commonly observed in monthly and quarterly fiscal data. The model incorporates information from three primary data sources, all using the ESA 2010 framework. The primary data source comprises annual aggregated data on headline revenue indicators sourced from Eurostat. This data spans from 1995 up till the latest actual annual data available, which in the case of the latest assessment and model compiled by the Council, was 2022.[45,46] However, this dataset lacks a comprehensive disaggregation for all sub-components of the primary revenue

[45] This data is also published by NSO through the release titled *"Quarterly Accounts for General Government"*.
[46] It is to be noted that the analysis in this Chapter centers on the modelling and forecasting conducted for the assessment of the MFIN's October 2023 Draft Budgetary Plan, published in December 2023.

indicators. To facilitate a granular analysis, annual data for sub-components is incorporated by using the NSO's statistical release on tax revenue, which includes a detailed tax list covering the same time frame.[47] The third dataset employed consists of a list of discretionary budgetary measures. This data enables the Council to generate both no-policy change and policy change forecasts. The MFIN provides this dataset to the MFAC, which covers from 2011 onwards, also including the forecast years.

Changes in government revenue are predominantly determined by fluctuations in the tax base and shifts in policy and their responsiveness to such changes. The tax base serves as the foundation for revenue forecasting. The selection of macroeconomic bases for each fiscal revenue component was chosen by relying on both theoretical and empirical associations (see Appendix I to view the proxies chosen for each revenue component).[48]

Elasticities are compiled to gauge the relationship between the tax base and the respective revenue variable. Elasticities measure the response of a revenue variable to a 1 percent change in its allocated macroeconomic driver, under the assumption that government policy (such as tax rates) remains constant. For example, if the elasticity of income tax revenue is 1, then a 1 percent growth in the tax base would yield an increase in income tax receipts of 1 percent. An elasticity which is greater than 1 would indicate that the tax revenue component is very responsive (elastic) to a change in the tax base, whereas an elasticity less than 1 shows less responsiveness to a change in the tax base (inelastic).

The annual elasticities of actual data observations are computed by dividing the growth in a specific revenue component by the growth in the selected tax base. An exception is made for the computation of *'taxes on the income or profits of corporations including household gains'*. In this instance, the computation involves dividing the component's growth by the 5-year average growth of the tax base. This approach is designed to mitigate the inherent volatility of this particular component and to account for any income tax in arrears.

When the yearly elasticities are computed, a historical average spanning from 1996 to 2022 is derived. The most recent 3-year and 5-year elasticity averages are also

[47] The NSO's tax revenue release, used for this analysis, can be found here.
[48] As a rule of thumb Nominal GDP is used as a proxy when variables are not clearly related to other specific variables or where data is unavailable.

computed, both including and excluding the years mostly impacted by the COVID-19 pandemic, namely 2020 and 2021. These calculations are conducted for further analytical purposes, facilitating a more insightful analysis of recent trends in elasticity compared to historical patterns (see Appendix II for the complete list of historical elasticity averages computed).[49]

Generally, when examining the recent 3-year and 5-year averages if excluding COVID-19 years, an overall reduction in elasticities is observed. This suggests a shift towards a more inelastic relationship between the primary revenue components and their respective proxy basis (see Appendix II). Indirect taxes have experienced a notable weakening in the historical (1996-2022) unitary relationship between revenue from indirect taxes and the relationship with various proxies making up the tax base. For instance, the elasticity of '*Value Added Tax (VAT)*' has experienced a decline, with a 5-year average of 0.7 compared to its historical average of 1.1. Meanwhile, the average elasticity of '*excise duties and consumption taxes'* is typically more inelastic and its relationship with the tax base seems to be becoming more stable in the more recent years.

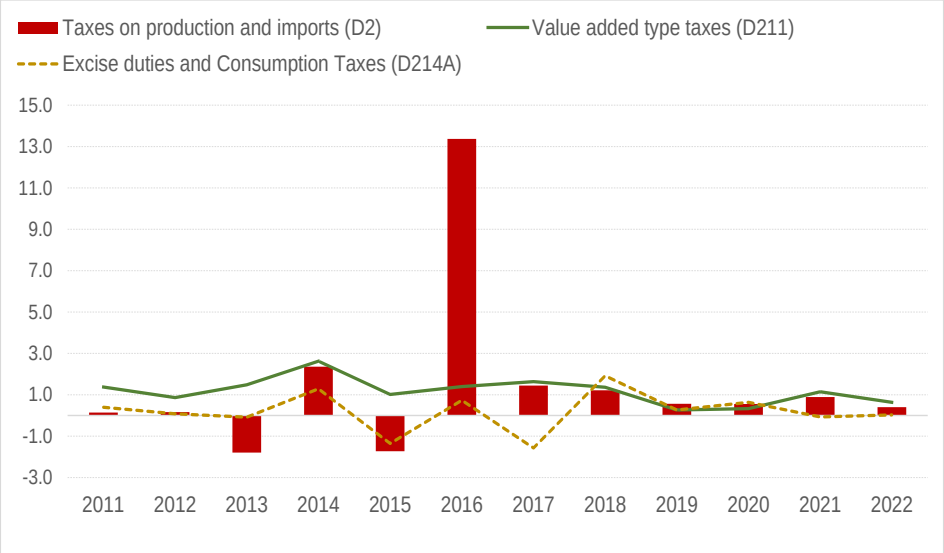
Since 2011, the elasticity for '*current taxes on income and wealth'* has fluctuated between 4.9, recorded in 2020 reflecting the disruptions caused by the pandemic, and 0.5, recorded in 2015. When compared to the historically (27-year) elastic relationship of 1.8 between the headline indicator and the respective macro-proxy variables, there was a notable decline of 1pp in the last 3 years excluding COVID-19, meaning that less taxes are being received compared to the growth in the selected tax base. Particularly the highly volatile sub-component '*taxes on the income or profits of corporations*' which historically had a high elasticity has contributed mostly to this decline in elasticity. Indeed, since 2011 this component has exhibited an average elasticity of 0.5, 1.3pp lower than its historical average. Meanwhile '*taxes on individual or household income*' have exhibited more stability, with an average elasticity of 1.7 since 2011, very close to its historical (27-year) elasticity of 1.8.

[49] It must be noted that tax elasticities could undergo sizeable fluctuations, rendering them potentially unstable in the short term, possibly influencing the 3- and 5-year elasticity averages. These fluctuations are often attributable to changes in the composition of aggregate demand (such as shifts in demand from net exports to private consumption or from low to more heavily taxed consumption goods), and changes in the distribution of income across households that are subject to different marginal tax rates. Consequently, the standard assumptions of exogenous and fixed elasticities might be a source of errors in revenue estimation in the short run (See Leal, T. et al., *"Fiscal forecasting: Lessons from the literature and challenges"*, *European Central Bank Working Paper Series No. 843,* 2007).

It is noted that the elasticity for this tax component is higher during the pandemic years, especially in 2020. This is due to the fact that current taxes on income and wealth declined by more than the corresponding tax base.

'*Net social contributions'* is a revenue component that exhibits more stable elasticity properties. Historically, this revenue stream has demonstrated a close-to-unitary elasticity of 0.9. This has marginally decreased to 0.7 in the recent three and five years excluding COVID-19 years. A notable rise in the elasticity is again noted during 2020 for social contributions, as wage income declined considerably during the pandemic, whilst national insurance contributions continued to be paid.

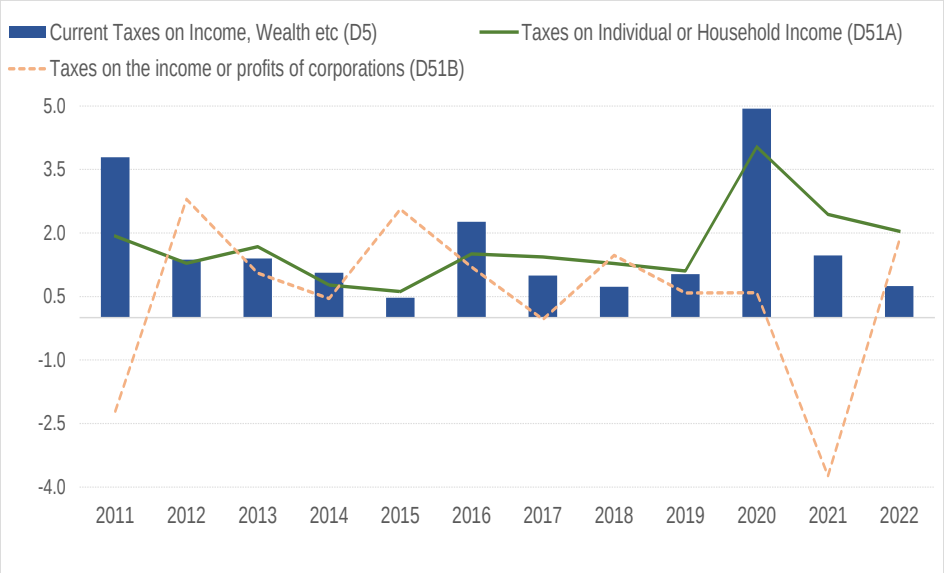
Elasticities of 'Taxes on Production and Imports', 'VAT', and 'Excise Duties and consumption taxes' (2011 – 2022) [50,51,52]



Source: Eurostat & Author's calculations

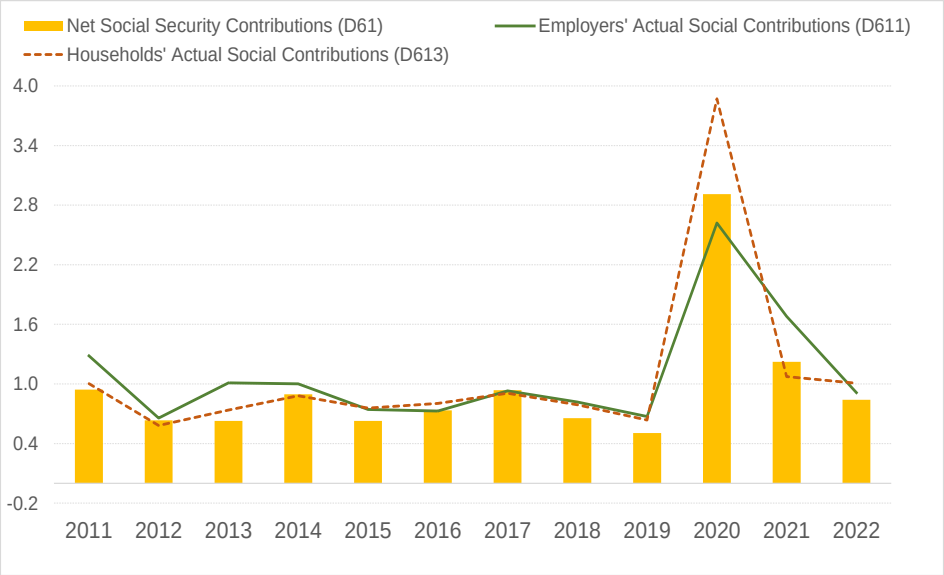
[50] Charts illustrate elasticities based on data from 2011 onwards, aligning with the availability of the discretionary revenue measures dataset from 2011.
[51] In 2016, the elasticity of taxes on production and imports was heavily influenced by a significant variation in the importation of fuel.
[52] In this chart, and the two charts which follow, two sub-components of each main revenue variable were selected for further analysis. However, it is important to note that there are more sub-components than these which contribute to the overall elasticity.

Elasticities of 'Current Taxes on Income and Wealth, etc', 'Taxes on individual or household income' and 'Taxes on the income or profits of corporations' (2011 - 2022)



Source: Eurostat & Author's calculations

Elasticities of 'Net Social Security Contributions', 'Employers' actual social contributions' and 'Household's actual social contributions' (2011 – 2022)



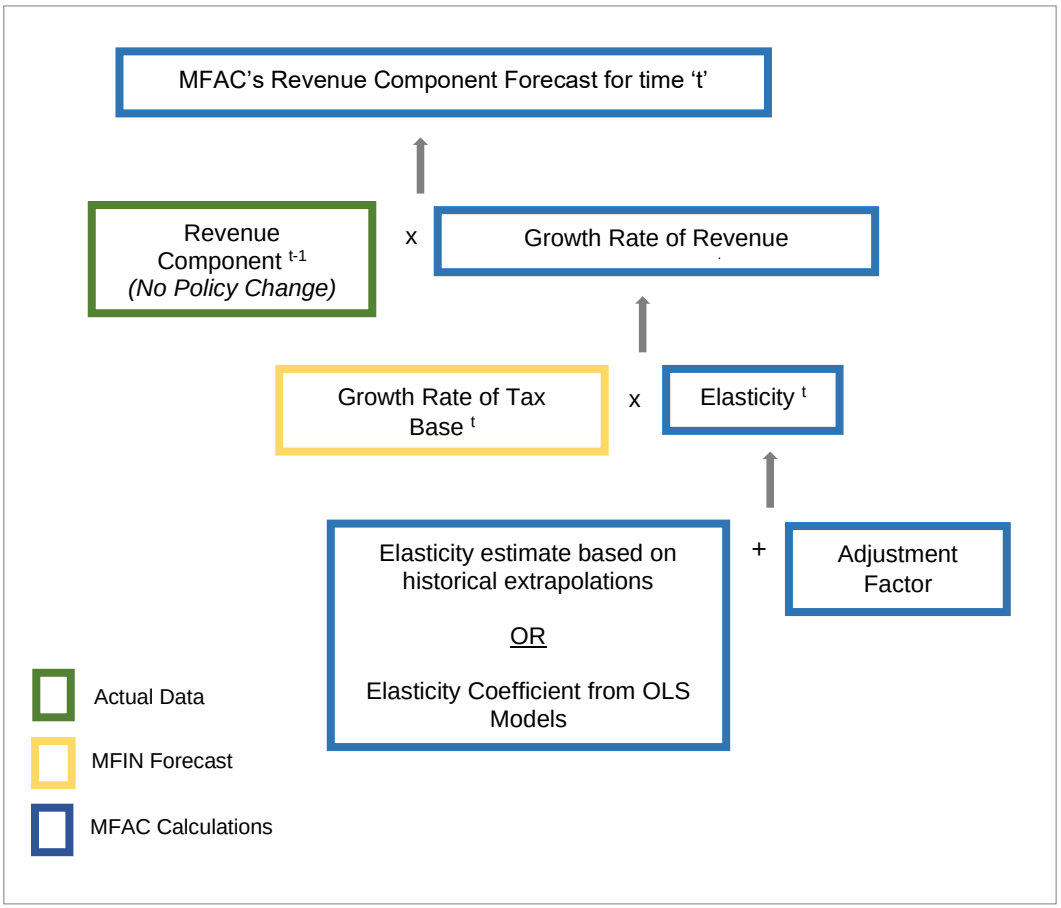
Source: Eurostat & Author's calculations

4.3 Forecasting

This section describes the bottom-up approach used by the Council to derive its forecast for a particular revenue variable (see the figure below). For explanatory purposes, this section shall be explained in terms of a forecast for the year 't'. [53]

The forecasts are formulated under the assumption of unchanged policy, therefore considering only permanent policy measures that are credibly announced and known in sufficient detail while excluding temporary budget measures. By assuming a no-policy change scenario, hence disregarding discretionary measures, empirical estimates can more accurately capture the relationship between the tax base and government revenue.[54] Utilising this no-policy change forecast modelling framework also enables forecasters to quantify the extent of policy adjustment required to achieve budgetary objectives or requirements.[55]

The No-Policy Change Forecast Modelling Framework for year 't'



[53] The same methodology is employed to estimate future periods (t+1 … t+n).
[54] See Conroy, N., *"The Role of Elasticities in Forecasting Irish Government Revenue" Irish Fiscal Advisory Council Working Paper Series No. 14. Dublin,* 2021.
[55] See European Commission "*Report on Public Finances in EMU" Institutional Paper 045*, 2016.

The no-policy change revenue forecasting methodology for year 't' consists of three main stages. The first stage involves determining the forecasted elasticity for that year. This calculation varies depending on the revenue variables, either calculated through historical extrapolations, such as utilising past elasticity averages or maintaining the previous year's elasticity value, or computed via an econometric model. The elasticities of some key revenue contributors are estimated through independent Ordinary Least Squares (OLS) models. More detail on these models is provided in a subsequent section of this Chapter. Following the compilation of these elasticities, expert judgment is applied to the fiscal revenue components by adding adjusting factors to the elasticity coefficients for year 't'.[56] This process enables the Council to apply its expert judgement without compromising the fundamental framework of the model.

In the next stage, the estimated elasticity of the revenue component is multiplied by the forecasted growth of its tax base, to produce the forecast growth rate of the revenue component. This provides a quantitative estimate of expected revenue changes for the specified period. The Council's base model relies on the most recent macroeconomic growth projections for the tax bases provided by the MFIN. By using identical macroeconomic inputs, the framework enables a nuanced comparison between the fiscal revenue forecasts of the MFIN and the MFAC.

In the last stage of the calculation process, the forecasted growth rate of the revenue component is multiplied by the component's preceding year outturn in absolute terms. The final step is then to incorporate the additional discretionary measures (as estimated and used by the MFIN) to the no-policy change forecast. This gives a policy change forecast, which is comparable to the fiscal projections published by the MFIN.

The above delineates the computation process for the base forecast model. Additionally, the MFAC estimates a second model that amalgamates the Council's macroeconomic expert judgment, thereby adjusting the macroeconomic forecast growth rates provided by the MFIN.[57] This expert judgment serves to refine revenue forecasts by incorporating also the MFAC's views on macroeconomic factors. This second model thus generates revenue forecasts which differ from those of the MFIN

[56] An example of such judgement could be, for instance, developments in quarterly data during the current year (which do not feature in the model since this is compiled on annual data) or other pertinent information which the MFAC might know of, that show that the elasticity might differ from past tendencies derived from the model.
[57] Further details regarding this model can be found in Section 4.4 of this Chapter.

due to both differences in elasticities (as in the first MFAC model) as well as differences in the macroeconomic tax bases.

4.3.1 OLS models

For twelve revenue variables, OLS models are used to generate the estimated elasticity coefficient instead of using one that is based on historical extrapolations, as explained in the previous section.[58] These coefficients are consequently employed as the base elasticity for the variables' forecast years. Notably, most models pertain to the '*taxes on production and imports'* revenue component, with eight models developed to estimate its sub-components. These are:

- Value-added type taxes (VAT)
- Taxes on duties on Imports
- Excise duties and consumption taxes
- Taxes on Financial and Capital transactions
- Car Registration taxes
- Taxes on Lotteries, gambling, and betting
- Other taxes on products, except VAT and Import Taxes
- Other taxes on production

Meanwhile, two models were estimated for the *'current taxes on income, wealth etc.'* component: '*taxes on individuals' income'* and '*taxes on the income/profits of corporations'*.

The main elements of the *'net social security contributions'* component*; 'employer's social contributions'* and *'employee's social contributions'*, have exhibited a consistent linear trend in their elasticity figures over time. Consequently, their elasticities were based on historical extrapolations. Conversely the elasticity trend of *'self-employed social contributions'* is rather volatile, necessitating the development of an independent OLS model for better analysis and forecasting accuracy. Additionally, a model was developed to examine the dynamics of capital taxes.

[58] OLS models are used to estimate parameters with statistical techniques that take into account the variability and uncertainty in the data. In such instances this could provide more reliable estimates of elasticities.

All twelve models are based on the simple linear regression (4.1) where y is the revenue sub-component, x represents the macro-proxy variable taken into consideration, β_1 is the intercept and β_2 is the slope coefficient.

$$y = \beta_1 + \beta_2 x \quad \textbf{(4.1)}$$

For the coefficients to represent proportional changes, a logarithmic transformation is applied to both sides of (X.1) which gives:

$$\log y = \beta_1 + \beta_2 \log x \quad \textbf{(4.2)}$$

Here β_2 represents the elasticity between the government revenue variable and the selected macro-proxy variable x. For instance, if β_2 = 0.8, a 1 percent change in the tax base results in a 0.8 percentage change in revenue implying that the component is inelastic. Thus, a double-log model allows for a straightforward interpretation of the elasticity coefficient.

Respecifying the model in logarithmic form also mitigates heteroscedasticity issues. This transformation, as represented by (4.2), tends to lessen these issues, if present, by compressing the scales on which the variables are measured and by reducing the spread of the data. Consequently, it can alleviate the influence of extreme values or outliers in the dataset, which often disproportionately affect statistical estimates and inference in regression analysis.

The regression estimation results for all twelve models are provided in Appendix III. The econometric outputs presented herein provide a comprehensive overview of specific revenue components, forming the foundation for deriving their respective elasticities. These results reflect the best possible outcome in an environment characterized by a relatively small sample size of 28 years, which encompasses multiple time-series breaks, and frequent data outliers. Nonetheless, the estimation process ensures reliable insights into the relationships between variables, contributing to a thorough understanding of the dynamics influencing the revenue components under consideration.

These time series models assume constant variable relationships over time. However, external factors like government policy changes (such as Malta joining the European Union), the 2008 Global Financial Crisis, and the COVID-19 pandemic can disrupt

these relationships. These events introduce outliers and structural breaks in the data, necessitating appropriate adjustments. Failure to address these anomalies risks model misspecification, resulting in poor forecast performance. Thereby, observations significantly influenced by extraordinary events were omitted from the regression analysis of several components that were most impacted by such events. From a statistical standpoint, although incorporating observations from these years increases the goodness of fit (R^2), it lacks economic rationale to include such observations due to their outlier nature. Apart from omissions of outlier data, additive dummy variables are also used to address outliers, particularly for the year/s impacted by the 2008 global financial crisis. Here, the dummy variable takes a value of 1 for the affected observation and 0 elsewhere. Models that have dummy variables are taxes on financial and capital transactions, car registration taxes, other taxes on products, and other taxes on production. The regression formula employed in these cases is as follows:

$$\log y = \beta_1 + \beta_2 \log x + \beta_3 D \quad \textbf{(4.3)}$$

The resultant β_2 coefficient is consequently employed as the base elasticity for the variables' forecast years. An anti-logarithm can also be applied to the equation, giving the impact in absolute terms of a 1-unit change in the tax base.

4.4 Assessments performed using the revenue model

One of the main deliverables of using this modelling framework is to benchmark the revenue forecasts published by the MFIN with those of the MFAC, thus quantifying risks to the various revenue components. Such assessment was first published in the Council's assessment of the Update of Stability Programme (USP) 2023 – 2026 and subsequently in the assessment of the Draft Budgetary Plan (DBP) 2024. Two scenarios of the model were presented in each assessment.[59]

In the first scenario, the model maintains the same macroeconomic growth projections provided by the MFIN but uses the Council's extrapolations or model-driven elasticities to generate the revenue forecast (see Scenario 1). This model is also termed as the 'base model'. Discrepancies observed between the MFIN's forecast and that of the MFAC under this scenario may stem from variations in the tax base chosen to

[59] The forecasts generated by the Council are detailed in Box D of the USP 2023 - 2026 and Box C of the DBP 2024.

represent specific fiscal variables, discrepancies in specific models employed, and the resultant elasticity outcomes, which can also be due to different adjustment values assumptions. It facilitates a better understanding of how baseline risks impact individual fiscal components and ultimately influence the forecast of the fiscal balance.[60]

Meanwhile, the second scenario integrates changes to the macroeconomic projections based on the Council's expert judgment, reflecting macroeconomic risks delineated in the respective reports' macro sections (see Scenario 2). This is done by changing the tax base growth rate figures, from those projected by the MFIN, ultimately leading to further changes in the MFAC's revenue forecasts. Considerations include changes in global economic conditions, domestic policies, emerging trends, and other relevant factors and expectations that may be differently opined relative to the baseline macroeconomic outlook of the MFIN. This approach can be interpreted as the final risk outcome vis-à-vis the various revenue variables, as it includes both the base model's risks and other macroeconomic risks vis-à-vis the MFIN's baseline projections.

Reviewing the risk analyses presented in the two MFAC reports, the Council's overall stance was that of an upside risk for total revenue for 2023. This remained unchanged from the June to December assessments. However, in the base scenario (see Scenario 1) the magnitude of the risk declined following upward revisions to revenue made by the MFIN in the DBP. The main source of this overall upside risk emanated from current taxes on income and wealth. On the other hand, in the base scenario the downside risk identified for taxes on production and imports persisted across both rounds, but the magnitude of this risk was higher in the assessment of the DBP. For 2024 the magnitude of risks for both variables increased in the DBP when compared to the risks identified in the USP. However, this time, the downside risk viewed in the DBP for taxes on production and imports outweighed the upside risk viewed for current taxes on income and wealth, resulting in an overall downside risk to total revenue.

The Council's expert judgment (Scenario 2) reflected more positive macro tax bases, resulting in larger upside risk in both the USP and the DBP. In respect of current taxes on income and wealth, the Council maintained a positive outlook in both assessments. The identified upside risk in the USP was more pronounced in the DBP, and in both

[60] The fiscal model available permits the Council to make counter-factual assessments of macroeconomic and fiscal risks as well as providing a yardstick to compare the Ministry's results, including those of the sensitivity analysis.

rounds, the adjusted macroeconomic projections in scenario 2 yielded an even more positive outcome for direct taxes. Concerning net social contributions, marginal risks were observed across both forecast rounds, with a marginal downside at the time of the USP, shifting to the upside in the DBP, when the macroeconomic tax bases included the MFAC's expert judgment. Upside risks were also viewed in scenario 2 for taxes on production and imports at the time of the USP, which however shifted to negative in the DBP. Nonetheless, in the DBP, the upside risks viewed for both 2023 and 2024 for direct taxes and social contributions more than outweighed the negative risk viewed for taxes on production and imports, which risk was also lower than that of scenario 1.[61]

[61] The complete assessment of forecast performance and a thorough evaluation of identified risks within the latest USP and DBP reports are currently impeded by the unavailability of official annual data for 2023.

Scenario 1: MFAC Projections Assuming the same Macroeconomic Projections from the MFIN (EUR millions) [62]

	USP 2023 - 2026						DBP 2024					
	2023			2024			2023			2024		
	MFAC	MFIN	MFAC-MFIN	MFAC	MFIN	MFAC-MFIN	MFAC	MFIN	MFAC-MFIN	MFAC	MFIN	MFAC-MFIN
Taxes on production and imports	1,923.3	1,924.7	(1.4)	2,022.6	2,035.7	(13.1)	1,928.4	1,981.4	(53.0)	2,041.4	2,161.1	(119.7)
of which VAT	1,295.7	1,300.0	(4.3)	1,369.9	1,376.0	(6.1)	1,298.7	1,315.0	(16.3)	1,382.3	1,450.0	(67.7)
Current taxes on income & wealth	2,508.7	2,463.1	45.6	2,649.0	2,617.2	31.8	2,538.8	2,483.7	55.1	2,713.4	2,636.2	77.2
Net Social Security Contributions	1,053.7	1,059.0	(5.3)	1,112.3	1,128.0	(15.7)	1,053.6	1,046.9	6.7	1,120.8	1,124.4	(3.6)
Risk on Government Revenue			38.9			3.0			8.8			(46.1)

Scenario 2: MFAC Projections incorporating changes in Macroeconomic Projections based on MFAC Expert Judgment (EUR millions)

	USP 2023 - 2026						DBP 2024					
	2023			2024			2023			2024		
	MFAC	MFIN	MFAC-MFIN	MFAC	MFIN	MFAC-MFIN	MFAC	MFIN	MFAC-MFIN	MFAC	MFIN	MFAC-MFIN
Taxes on production and imports	1,943.7	1,924.7	19.0	2,054.4	2,035.7	18.7	1,956.5	1,981.4	(24.9)	2,083.3	2,161.1	(77.8)
of which VAT	1,313.1	1,300.0	13.1	1,397.4	1,376.0	21.4	1,321.4	1,315.0	6.4	1,418.6	1,450.0	(31.4)
Current taxes on income & wealth	2,521.3	2,463.1	58.2	2,646.7	2,617.2	29.5	2,613.2	2,483.7	129.5	2,800.8	2,636.2	164.6
Net Social Security Contributions	1,053.6	1,059.0	(5.4)	1,102.3	1,128.0	(25.7)	1,071.2	1,046.9	24.3	1,139.6	1,124.4	15.2
Risk on Government Revenue			71.8			22.5			128.9			102.0

[62] A positive balance in the tables above reflects an upside risk (green) to the projections by the MFIN, whilst a negative balance indicates a downside risk (red).

4.5 Simulations

This section presents the results of simulations that were performed to examine responses of fiscal variables to tax base changes over forecast years and to assess the extent to which the model captures the associated dynamics. The simulations also help in clarifying the likely magnitudes of responses to changing macroeconomic conditions and serve as a test to check the robustness of the model equations.

The simulations were performed by utilising the base model at the time of the DBP, thus the one taking the government's macroeconomic forecasts as given. They were done by increasing a macroeconomic variable's growth rate in the first year of the forecast (in this case 2023) by one percentage point (1 pp). By keeping everything else constant, the effect of the increase in the growth rate of solely one tax base on revenue variables is singled out. The three simulations shown here are those of a one pp increase in private consumption growth, for compensation of employees and gross operating surplus (see Appendix IV). These three proxy variables were chosen as they capture a large part of the tax bases used in the model for the different fiscal revenue items. It is important to note that, in theory, changes in, for example, private consumption lead to changes in overall GDP, which in most cases, is the tax base of several smaller (in absolute terms) revenue variables. However, for these macroeconomic feedback loops to be captured, a fully integrated model would need to be developed, which is not available at present. These results can therefore be interpreted as a 'floor' to the results which could be inferred from a fully integrated macro-fiscal model. Indeed, the effects of an increase in a particular tax base, for example private consumption, can be wider when incorporating all the macro effects, as the simulations only show the effect on those revenue components which have private consumption as a tax base.

Taking for instance private consumption expenditure, increasing the forecasted growth by 1 pp in 2023 led to a growth rate in taxes of production and imports for the forecast of 2023 that is 0.39 pp higher than in the base model. This difference is attributed to a rise in the VAT growth rate, which is the largest revenue source of indirect taxation, increasing by 0.47 pp, whilst other taxes on production growth rose by 1.54 pp. [63,64]

[63] The magnitude of the different revenue components must be considered when interpreting the resultant growth rates.
[64] The results from the simulations might differ from one forecast round to another based on developments in the data and revised elasticities or forecasting assumptions and techniques.

Increasing compensation of employees has a slightly more than unitary impact on the growth of current taxes on income and wealth in year ‘t’ of the simulation. This is attributed to taxes on individual or household income including household gains, which increases by 1.63 pp, which is in line with the historically elastic properties of this component. The effect on social security contributions is an additional 0.36 pp. Similarly, increasing gross operating surplus by 1 pp has a similar impact on the growth of social security contributions of 0.34 pp. The latter simulation has a limited impact on current taxes on income and wealth due to offsetting effects within its sub-components.

The simulations performed confirm a priori expectations with respect to the impact on the growth of the fiscal variables in response to positive shocks in proxy bases. Apart from the impact in the same year of the simulation, for the most part, a small impact from the simulation is also carried forward onto the next year, in this case, 2024. Such impacts can also be viewed in Appendix IV.

4.6 Conclusion and limitations

The development of the MFAC’s revenue-forecasting model in 2023 allows the Council to conduct more in-depth fiscal policy analysis. This chapter sought to delineate the various stages involved in the preparation of the Council’s forecasts, promoting the transparency of the modelling framework by providing a thorough explanation of the computational methodology and the rationale behind the forecasts.

Despite some limitations, the model allows the Council to generate quantitative forecasts rather than solely relying on qualitative opinions. This constitutes a further improvement in the MFAC’s assessment of fiscal estimates and strengthens its risk assessment capabilities while facilitating scenario analyses thus allowing the Council to gauge the fiscal impact of economic changes and test the sensitivity of specific revenue components to such changes. Along with examining the sensitivity of individual revenue components, the model can be used to observe the variables’ vulnerabilities and resilience to shocks. Additionally, it can aid the Council with undertaking counterfactual assessments, allowing for more rigorous examinations of the potential impact of alternative revenue measures and policy interventions. The Council now has the capability to compare its revenue forecasts with those of other institutions, enhancing the transparency and accountability of the MFAC's fiscal assessments, and thus improving credibility. At the EU level, several fiscal councils

produce forecasts, strengthening their ability to make more meaningful assessments. With the development of these tools, the Council aims to join other independent fiscal institutions which produce and publish their estimates.

Nevertheless, it is acknowledged that the modelling framework has some limitations. The first key constraint in the Council's forecasting process arises from the dependence on the MFIN's macroeconomic growth forecasts acting as a base input to the model. The Council presently relies on expert judgment to make adjustments to the macroeconomic projections provided by the MFIN. The establishment of an independent macroeconomic model would markedly enhance the model's autonomy and self-reliance. To this end, the MFAC has initiated the process towards developing an integrated macro-fiscal model, encompassing feedback effects from the fiscal to the macro side, with the help of the European Commission's DG REFORM and its Technical Support Instrument (TSI) as described in the first Chapter of this Annual Report. Another limitation relates to estimating the total effect of a specific macroeconomic variable on total revenue. The model captures the impact of particular variables if these are selected as a tax base, and is not used to model what the direct and indirect effect of increasing, for instance, nominal GDP, results on total revenue.

Another limitation stems from the variation in the cut-off dates of the data sources and the unavailability of a disaggregated dataset. The NSO's 'Tax Revenue' release has a different cut-off date compared to the other primary datasets, necessitating adjustments to sub-revenue components through historical extrapolations. Additionally, data for a given year is only made available in the subsequent October, resulting in the unavailability of detailed sub-component data, particularly during the publication period of the USP's assessment. Consequently, for this period, other data sources are used to disaggregate tax components, employing historical weights as a basis.

The challenge of working with a small sample size is particularly pronounced in studies conducted in Malta. This difficulty stems from the limited availability of official data, which extends back only to 1995. Consequently, studies, such as this one, contend with a maximum of 28 observations, leading to lower degrees of freedom and compromising the desired asymptotic properties, such as consistency, within the

results. Small sample sizes are especially susceptible to the influence of outliers, and structural economic reforms exacerbating the difficulty of detecting small effects.[65]

Additional limitations pertain to data collection, particularly regarding data availability which extends back to 1995 for all fiscal revenue and macroeconomic components. In cases where such official data was unavailable, data from local publications was extrapolated to supplement the dataset. Another issue is related to the shift from a no-policy change revenue series to an adjusted policy series, whereby the Council relies on discretionary measures forecast data provided by the MFIN. Additionally, this dataset is available only from 2011, impacting calculations for previous years and introducing potential biases linked to economic cycle-related tax policy changes.

Finally, economic modelling is inherently dynamic, demanding ongoing updates to reflect current domestic and global economic trends. From shifts in economic sectors to alterations in governmental policies or advancements in statistical methodologies, a spectrum of changes could possibly require adjustments to the model. In addition, in the future, it is intended to observe forecast versus actual data, to identify forecast errors and potentially improve the model based on such findings. In this context, any notable modifications within this modelling framework will be communicated through forthcoming assessment publications, ensuring stakeholders are informed of the model's potential improvements and adaptability to the evolving economic landscape.

[65] See Gujarati, D.N. *Basic Econometrics*, 4th edition, McGraw-Hill Education, 2003.

Appendix I: Tax Bases of Main Revenue Components

Main Components of Revenue Forecast	Tax Base
Taxes on production and imports	Private Consumption Expenditure + Tourism Earnings + Imports of Industrial + Imports of Fuel + Imports of Consumer Goods
Taxes on products	Private Consumption Expenditure + Tourism Earnings + Total Imports
Value added type taxes (VAT)	Private Consumption Expenditure + Tourism Earnings
Taxes and Duties on Imports excl. VAT	Imports of Goods and Services
Taxes on Products, except VAT & Import Taxes	Nominal GDP
Excise duties and Consumption Taxes	Imports of Capital + Imports of Industrial + Imports of Fuel + Imports of Consumer Goods
Stamp Taxes	Nominal GDP
Taxes on Financial & Capital Transactions	Nominal GDP
Car Registration Taxes	Nominal GDP
Taxes on lotteries, gambling & betting	Nominal GDP
Other	Nominal GDP
Other Taxes on Production	Private Consumption Expenditure
Current Taxes on Income, Wealth, etc.	Compensation of Employees + Gross Operating Surplus
Taxes on Income	Compensation of Employees + Gross Operating Surplus
Taxes on Individual or Household Income including Holding Gains	Compensation of Employees
Taxes on Individual or Household Income	Compensation of Employees
Taxes on individual or Household Holding Gains	Nominal GDP
Taxes on the income or profits of Corporations including Holding Gains	Gross Operating Surplus
Taxes on the income or profits of corporations	Gross Operating Surplus (5 Year Average)
Taxes on holding gains of corporations	Gross Operating Surplus
ITUs	Gross Operating Surplus
Other taxes on income	Nominal GDP
Other current taxes	Nominal GDP
Payments by households for licences - Motor Vehicle Licences	Nominal GDP
Taxes on International Transactions	Nominal GDP
Capital taxes	Nominal GDP
Total tax receipts	Nominal GDP
Net Social Security Contributions	Compensation of Employees
Actual Social Security Contributions	Compensation of Employees
Employers' Actual Pension Contributions	Compensation of Employees
Employer's Social Contribution - Government	Compensation of Employees
Employer's Social Contribution - Private	Compensation of Employees
Penalties on Employers	Compensation of Employees
Households' actual social contributions	Compensation of Employees
Employees' Social Contributions	Compensation of Employees
Self-employed Social Contributions	Gross Operating Surplus
Imputed social contributions	Nominal GDP
Total tax receipts + Social Security Contributions	Nominal GDP

Appendix II: Historical Elasticities

	Historical Average	3-Year Average	5-Year Average	Excl. COVID-19 Years	
				3-Year Average	5-Year Average
Taxes on Production and Imports	1.0	0.6	0.7	0.7	3.4
of which Value Added Taxes	1.1	0.7	0.7	0.8	1.1
Excise duties and Consumption Taxes	-0.4	0.2	0.6	0.7	0.3
Stamp Taxes	3.8	9.1	7.3	4.9	4.3
Taxes on Financial and Capital Transactions	1.5	3.3	2.6	1.0	1.7
Car Registration Taxes	-0.8	0.5	0.4	0.2	0.6
Taxes on lotteries, gambling, and betting	2.0	0.4	0.7	0.7	0.9
Other	0.2	0.3	0.6	1.0	1.9
Other Taxes on Production	3.6	1.0	1.9	2.6	1.7
Current Taxes on Income, Wealth, etc.	1.8	2.4	1.8	0.8	1.2
Taxes on Individual or Household Income including Holding Gains	1.7	2.1	1.7	1.4	1.4
Taxes on the income or profits of Corporations including Holding Gains	1.8	-0.5	-0.1	0.1	0.5
Other current taxes	2.7	0.1	0.4	0.5	0.5
Capital taxes	2.2	2.0	1.9	1.8	1.6
Net Social Security Contributions	0.9	1.7	1.2	0.7	0.7
Actual Social Security Contributions	0.9	1.9	1.4	0.8	0.8
Employers' Actual Pension Contributions	0.9	1.7	1.3	0.8	0.8
Households' actual social contributions	1.0	2.0	1.5	0.8	0.8
Imputed social contributions	1.0	0.0	-0.1	-0.2	0.2

Appendix III: OLS Models Equation [66,67]

				R^2	F	N
	C	Private Consumption Exp. + Tourism Earnings				
Value Added Tax	-5.76	1.40		0.99	1270.38	17
	0.02	0.00				
	C	Imports of Goods & Services				
Taxes & Duties on Imports excl. VAT	-3.42	0.64		0.66	21.68	13
	0.02	0.00				
	C	Imports Industrial Supplies + Capital Goods + Consumer Goods + Fuel				
Excise duties & Consumption Taxes	-0.27	0.66		0.44	7.10	11
	0.90	0.03				
	C	Nominal GDP	D.09			
Taxes on Financial and Capital Trans.	-4.13	0.92	-0.10	0.82	57.20	28
	0.00	0.00	0.67			
	C	Nominal GDP	D.09			
Car Registration Taxes	5.52	-0.20	0.03	0.24	3.93	28
	0.00	0.01	0.87			
	C	Nominal GDP				
Taxes on lotteries, gambling & betting	-1.21	0.57		0.91	87.90	11
	0.06	0.00				
	C	Nominal GDP	D.09			
Other taxes on products, excl. VAT & Import Taxes	-3.98	0.77	-0.20	0.73	33.70	28
	0.00	0.00	0.45			
	C	Private Final Consumption Exp.	D.10			
Other Taxes on Production	-11.84	1.84	1.03	0.97	356.21	28
	0.00	0.00	0.00			
	C	Compensation of Employees				
Taxes on Individual or Household Income	-4.92	1.35		0.99	1805.98	28
	0.00	0.00				
	C	Gross Operating Surplus (5 Yr Av.)				
Taxes on the income or profits of corp.	-0.11	0.67		0.83	101.16	23
	0.84	0.00				
	C	Gross Operating Surplus				
Households' actual social contributions	-0.17	0.47		0.93	298.78	23
	0.44	0.00				
	C	Nominal GDP				
Capital Taxes	-5.76	0.94		0.77	37.50	13
	0.00	0.00				

[66] In this table *C* denotes the intercept, *D* signifies Dummy Variable, R^2 indicates the goodness of fit, *F* denotes the F-statistic, and *N* signifies the number of observations. The statistical significance (P-Value) of each coefficient is indicated underneath the respective coefficient.
[67] The models reflect those used at the time of the DBP. Models are updated each forecast round. The elasticities shown here do not necessarily reflect the final elasticities used for forecasting since adjustment factors may be applied.

Appendix IV: Simulations

Simulating a 1 percentage point increase in the growth of tax base variables in 2023

	Private Consumption		Compensation of employees		Gross Operating Surplus	
	2023	**2024**	**2023**	**2024**	**2023**	**2024**
Taxes on production and imports	0.39	0.01				
Taxes on products	0.33	0.01				
Value added type taxes (VAT)	0.47	0.01				
Other Taxes on Production	1.54	0.00				
Current Taxes on Income, Wealth, etc.			1.04	0.04	0.02	0.01
Taxes on Individual or Household Income including Holding Gains			1.63	0.01		
Taxes on the income or profits of Corporations including Holding Gains					0.07	0.04
Net Social Security Contributions			0.36	0.01	0.34	0.00