

Strengthening the Capacity of Independent Fiscal Institutions

Deliverable 1A. Review of existing analytical tools, methodologies

Technical Support Instrument

Supporting reforms in 27 Member States



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LIST OF ABBREVIATIONS

API	Application Programming Interface
CE	Cambridge Econometrics
CPB	Centraal Planbureau
DG ECFIN	Directorate-General for Economic and Financial Affairs
DG REFORM	Directorate-General for Structural Reform Support
DNB	De Nederlandsche Bank
DSA	Debt Sustainability Analysis
DSGE	Dynamic Stochastic General Equilibrium
EAGLE	Euro Area and Global Economy Model
ECB	European Central Bank
ECON	Economic and Monetary Affairs
EMU	Economic and Monetary Union
ESA	European System of Accounts
FPB	Federal Planning Bureau
FSA	Fiscal Sustainability Analysis
GDP	Gross Domestic Product
GFCF	Gross Fixed Capital Formation
GVA	Gross Value Added
HFISC	Hellenic Fiscal Council
HICP	Harmonised Index of Consumer Prices
IFI	Independent Fiscal Institutions
IMF	International Monetary Fund
LTFS	Long-Term Fiscal Sustainability
MFAC	Maltese Fiscal Advisory Council
MOF	Ministries of Finance
MS	Member State
MTFS	Medium-Term Fiscal Strategy
NAO LT	National Audit Office of Lithuania
NGFS	Network for Greening the Financial System
NiGEM	National Institute of Economic and Social Research
NSO	National Statistics Office
OBR	Office for Budget Responsibility
OECD	Organisation for Economic Co-operation and Development
PM	Project Manager
QAM	Quality Assurance Manager
QPM	Quality Project Manager
RFS / ToR	Request for Service / Terms of reference
RRF	Recovery and Resilience Facility
SC	Steering Committee
SGP	Stability and Growth Pact
VAR	Vector autoregression

1. INTRODUCTION

The objective of Pillar 1 is to support the development of new tailored macroeconomic and fiscal models and/or the upgrading of existing ones in the beneficiary Independent Fiscal Institutions (IFIs). The scope of this deliverable concerns the following three IFIs under Pillar 1:

- Hellenic Fiscal Council (HFISC)
- Budget Monitoring Department of the National Audit Office of Lithuania (NAO LT)
- Malta Fiscal Advisory Council (MFAC)

This report, Deliverable 1A, reviews existing analytical tools and methodologies, both those employed by the beneficiary IFIs, but also those used by IFIs and other institutions in Europe and the scientific community in general. The aim of this review is twofold.

First, the review of tools and methodologies in general yields a broad overview of possible approaches including advantages and disadvantages of the respective tools and methodologies. This overview a) supports the analysis of the tools and methodologies employed by beneficiary IFIs, and b) structures the selection of new or augmented tools and methodologies for the beneficiary IFIs to be implemented as part of this project. Specifically, the new or augmented tools and methodologies should reflect European or international best practices to the extent possible, while fitting the local institutional context, including absorptive capacity.

Second, the review of analytical tools and methodologies currently employed by beneficiary IFIs is a necessary step in the development of a needs assessment and an associated workplan to address those needs. As part of the project, the project team needs to understand the as-is situation in every beneficiary Member State (MS) as well as the desired to-be situation, so that a workplan can be developed to bridge the gap between as-is and to-be. The to-be situation should be inspired by international good (or best) practice.

This review proceeds in three steps. Chapter 2 reviews the current setup in each beneficiary IFI, including the merits and shortcomings of their existing approach(es). From discussions held during this scoping phase, Chapter 2 also highlights IFI-specific features relevant to upcoming implementation. Chapter 3 goes on to present the requirements of the IFIs, desired input and output model variables, user types and use cases, and highlights commonalities shared across the beneficiary IFIs. . Together, these two chapters yield an overview of current practices and needs of the beneficiary IFIs to support the development of the workplan.

Chapter 4 reviews macro-fiscal modelling and forecasting practices in Europe and the US, both at IFIs, central banks and at other institutions. This includes an overview of a selection of existing models of potential relevance to the beneficiary IFIs, before highlighting commonly used approaches in the literature. This yields an overview of good practices in macro-fiscal modelling and forecasting. The intention at this stage is not to firmly specify the models to be built, but instead to highlight the various design considerations that will then be tackled during the next phase, when we will work with the IFIs to build the models, drawing on this selection of models.

Chapter 5 then sets out the proposed approach to the new or updated tool/methodology. This focuses on principles that underpin our development approach and the timetable to begin the process. Further details would be agreed with the IFIs as the work progresses.

2. BENEFICIARY IFIs

This chapter briefly describes the situation in each of the IFIs and goes on to summarise their current setups as it relates to the proposed model development and capacity building.

2.1. HFISC

2.1.1. Background

HFISC was established in 2015 and is responsible for assessing and monitoring the government's budgetary policies. The organisation is of medium size compared to other IFIs within the EU, with a staff of around 15. HFISC has a broad mandate, consisting of the following elements, with those in **bold** the most relevant to the requirements for a new macroeconomic-fiscal forecasting model:

- **Endorse macroeconomic forecasts**
- **Endorse budgetary forecasts and compliance with fiscal rules**
- Assess the methodology used by the Ministry of Finance
- Publish twice a year a report on the macroeconomic and fiscal stance of the Greek economy
- Perform policy costings

In order to perform this mandate, HFISC produces a macroeconomic forecast about three times a year. These relate to the endorsement of the government budget and macroeconomic forecasts, and HFISC's two semi-annual reports. HFISC produces additional forecasts if warranted; for example, in response to the Covid crisis. In principle (i.e. it is within HFISC's mandate), a forecast could also consist of a basic policy costing, although these are not currently produced.

2.1.2. Approach

HFISC has developed economic models to support its assessment of the economic forecasts of the Ministry of Finance. This endorsement process consists of several elements:

- HFISC contacts the Ministry of Finance about the background to the new macroeconomic or budgetary forecasts. This results in additional information being shared about changes in data and modelling criteria (e.g. elasticities and assumptions).
- When the forecast concerns a macroeconomic forecast, HFISC compares the GDP forecast of the Ministry of Finance to forecasts of other organisations, such as the EC, the IMF and the Bank of Greece. In addition, HFISC constructs a GDP forecast based on a set of economic models (see below). Together, these models provide a range for the GDP forecast. Subsequently, HFISC assesses whether the forecast of the Ministry of Finance is in line with this range and the forecasts of other institutions.
- When the forecast concerns a budgetary projection, HFISC compares the fiscal forecasts of the Ministry of Finance only with the forecasts of other organisations. Projections of the EC, IMF and Bank of Greece are among the forecasts used.

- Next to a comparison of the forecasts themselves, HFISC assesses the assumptions underlying the forecast. In this regard, HFISC assesses specifically the assumptions that have led to a change in the macroeconomic or fiscal forecast. This could, for example, be a change in expected economic growth in other EU countries or changes in interest rates, trade and/or inflation. HFISC takes this assessment on board when deciding on the endorsement.
- In addition, HFISC considers which risks are most relevant to the GDP and fiscal forecasts. To do so, HFISC makes an assessment of the macroeconomic environment and pinpoints the most important risks. Examples include increases in inflation and trade restrictions.
- Finally, HFISC decides whether to endorse each forecast, qualifying endorsements with an explanation of the most critical assumptions and most important risks. All (non)-endorsements are published.

To define a range for the macroeconomic forecast, HFISC uses a variety of models that produce GDP forecasts. To do so, HFISC has developed its own macroeconomic forecasting models. At present, HFISC makes use of three econometric models, each of which covers aggregate macroeconomic variables only e.g. countrywide GDP without a sectoral decomposition. The models are reduced form in nature, and do not have an underlying structural component to them. The implication is that these models are focused more on predicting the short term, rather than the long term; nor do they expressly capture policy effects that may be relevant, for example, in budgetary assessments. The three models are:

1. a Mixed-Data Sampling (MIDAS) model
2. a Dynamic Factor Model (DFM)
3. a Vector Error Correction Model (VECM)

The MIDAS approach consists of a single reduced-form equation, which can be re-estimated and updated at a higher frequency than the outcome variable measured. It differs from the DFM and the VECM by using data that are measured with mixed frequency, and thus combines monthly data with quarterly data. The primary benefit of this modelling method is that one does not have to align the data frequencies to the lowest common frequency. For instance, if real GDP is the outcome variable and is only available on a quarterly basis, but underlying indicators (the explanatory variables) are measured on a monthly basis, then one does not have to transform the monthly measurements into quarterly ones. This means that forecasts for real GDP can be updated any time that one of the higher-frequency explanatory variables receives an update. If the highest frequency of the explanatory variables is monthly, while real GDP is measured quarterly, then the MIDAS approach can provide three new forecasts of real GDP each quarter, as each month of data becomes available. The specification of the MIDAS model by HFISC sets real GDP as the outcome variable. Much like the two other models, the MIDAS approach does not have a structural foundation. It is a strictly reduced-form approach. As such, it does not include any economically founded explanation for why the exogenous variables should influence the outcome variable. The approach depends on the choice of hyperparameters, which are difficult to support on the basis of economic thought and theory.

The DFM explores the option to combine a large set of macroeconomic time series by factor analysis. It thereby aims to capture the majority of the dynamics and information from within such time series without letting the dimensions of the model grow out of proportion. The model has one dependent variable: real GDP. In approach, the model uses lagged GDP and 95 explanatory variables. These are categorised into three bins: “Survey Balances” (data originating from surveys, such as consumer/producer confidence), “Real Variables” (such as the number of

newly built structures or number of visiting tourists) and “Nominal Variables” (such as interest rates and stock market indices). This model can easily be re-estimated and updated with the release of new quarterly data. Though the model is simple in its use and captures a large number of variables, it lacks several key features to act as a forecasting tool under various policy scenarios. Despite the large number of series combined by the factor analyses, there are certain economically relevant variables that are possibly underrepresented, such as the influence of fiscal policy.

The VECM makes use of core economic series to establish long-term relationships in the data-generating process. A core feature of such models is that short-term impulses can have lasting, long-term effects, which is in contrast to standard VAR models in which any and all shocks only have temporary effects. The VECM includes a wide variety of series, namely the HICP, GDP growth, the 10-year interest rate, energy prices, the capital account and trade indicators. With the release of new data each quarter, the VECM can be re-estimated. As VECMs rely on cointegrating relationships, it is important with each re-estimation to consider whether the new data makes or breaks any new relationships. To test its out-of-sample performance, the authors estimated the VECM on data over 2000Q1-2014Q4 and then made forecasts of the next eight quarters, varying the model specification. While the paper generates eight quarters of out-of-sample projections, it is also capable of generating longer-term forecasts. The model lacks a structural, economic explanation for why the chosen mix of variables fits together. In addition, the model does not include certain policy-relevant variables that capture the effects of, for example, fiscal or monetary policy. As such, it is not capable of generating forecasts under changing policy environments.

Modelling is currently carried out using a combination of EViews, R and Microsoft Excel.

2.1.3. Assessment

HFISC has in place an endorsement process for assessing the short-term macroeconomic forecasts. It is based on a set of macroeconomic models that are capable of predicting GDP in the short term. In addition, HFISC also assesses information from other organisations as well as the underlying assumptions and risks relating to the forecasts.

With regard to the fiscal forecasts, HFISC uses the available information in its endorsements, but is dependent on other institutions to carry out any comparisons. HFISC does not currently have a model to make a fiscal forecast. As the current models do not explicitly model government income (e.g. taxes) and expenditure (e.g. social security), they are not capable of making a budgetary forecast. HFISC has the mandate to assess fiscal projections and monitor compliance with fiscal rules. In order to do so in a forward-looking manner, HFISC needs to be able to make projections of the government budget. The models HFISC currently applies do not have this capability. To be able to make fiscal projections, a model should include components of GDP and incorporate an explicit government sector.

At present, the models do not include fiscal spending as an explicit component in generating GDP forecasts and can therefore not estimate the effect of public expenditures on GDP. Fiscal expenditures form a major portion of a country's overall spending and are thus a major component of GDP. In the current models, government spending is not one of the explanatory variables determining GDP. As such, the models are currently not sufficient for generating forecasts conditional on forthcoming fiscal policy plans, as changes in the planning of governmental budgets have no influence on the forecasts generated by the current models.

In addition, HFISC lacks the ability to produce longer-term macroeconomic forecasts. To extend the projections to four years (and beyond), the model needs more structural components, to be able to generate an economically plausible longer-term projection (this is not guaranteed by the existing models). Moreover, the current models do not yet have the capacity to accurately generate the necessary information for performing debt sustainability analyses. Note that this is not an inherent limitation of reduced-form models, and that the explicit inclusion of fiscal policy is possible within the existing forecasting methods. The models in their present form are quite parsimonious, with ample room for further expansion.

Overall, the models developed by HFISC are empirical in nature and do not rely on economic theory as a foundation. This approach has several benefits and drawbacks worth highlighting. The primary benefit is that reduced-form models impose fewer assumptions on how economic systems work. Instead, they let the data speak for themselves, without any priors limiting which patterns may emerge. Consequently, it is possible to develop extensive models featuring a wide variety of series, with the ability to accurately capture past dynamics. The primary drawbacks of fully empirical models is that they are only as good as the data. If there are major gaps in the data, the available time-series are limited, or if there are major structural breaks along the way, a model's forecasting capabilities are likely severely hampered. Forecasting based on historical data is only effective if the future behaves similarly to the past. Empirical models are particularly vulnerable to the Lucas Critique.

Structural models, in contrast, narrow the focus to a more select set of information. The precise relation between elements of this narrower information set is explicitly spelled out. The downside of this approach is that it does not make use of all the available variation in the data, potentially leaving out highly informative data series. The historical empirical fit can therefore be worse than that of purely empirical models. The benefit is that, if the underlying economic theory is solid, a structural model can perform out-of-sample forecasting effectively even in the presence of structural breaks or shocks. By modelling the underlying economic fundamentals, macroeconometric models with a structural basis are less susceptible to the issues brought up by the Lucas Critique. This out-of-sample performance and (partial) immunity to the Lucas Critique depend on the accuracy of the economic theory. It is therefore not a given that structural models outperform empirical ones. Against this background, a new model for HFISC would expand the IFI's capabilities by:

1. Providing the ability to produce macroeconomic forecasts with a longer time horizon ($t+4$ to $t+7$ years) for comparison with the Ministry of Finance's projections.
2. Establishing an integrated approach to macroeconomic-fiscal forecasting, enabling HFISC to analyse two-way feedbacks between macroeconomic and fiscal variables.
3. Offering a wider range of forecasts, that includes not only GDP, but also its main components.
4. Improve HFISC's ability to make accurate short-term forecasts, possibly based on its existing models.

All in all, such a model would improve HFISC's ability to support macroeconomic and fiscal analysis under European economic governance reform.

The remaining sections below on HFISC briefly present other constraints and considerations for the model, with a fuller proposal for model requirements and a review of practices in other institutions detailed in the following two chapters.

2.1.4. Requirements

A brief summary of HFISC's requirements and, where relevant, our proposed approach, is listed in the table below.

Task		Approach (proposed)	Comments
Data	Public Sources	National: • Elstat • Bank of Greece International: • Eurostat • European Central Bank	Some data sources can be accessed via an API, which automates the data gathering process and reduces the manual labour required to perform updates
	Sectors	Key sectors: • Government (revenue and expenditure)	Modelling the government budgetary stance is important
Software	Model	MATLAB, EViews or R	HFISC has existing capability in in EViews and MATLAB
	Data collection and handling	R or Python	-
	Version control	Git (proposed)	Is the standard for version control
Forecast	Frequency	Short term: Quarterly	Short-term forecasts should be quarterly
	Forecast period	Medium term: Quarterly or annual	
	Forecast updates	Minimum: t+4 years	Medium-term forecasts can be either quarterly or annual (to be reviewed)

2.2. NAO LT

2.2.1. Background

Established on 1 January 2015, the Budget Monitoring Department is a key division within the National Audit Office of Lithuania (NAO LT).¹ The department implements the functions required of an IFI and, as of March 2024, consists of five economists, an assistant economist and the head of the department; along with an advisory panel of three local experts.

NAO LT has four principal functions, of which two (in **bold** below) are relevant to the current requirement for a new macroeconomic-fiscal forecasting model:

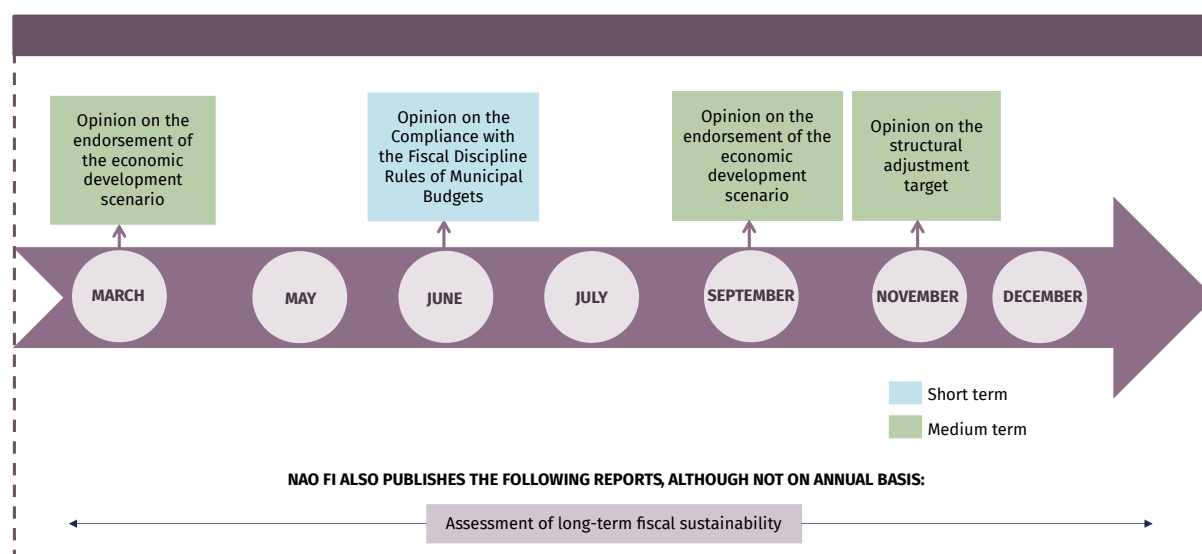
- 1. Assessment and endorsement of macroeconomic forecasts**
- Promoting fiscal transparency
- 3. Evaluation of compliance with fiscal discipline rules**
- Role in establishment of exceptional circumstances (in such circumstances, this may then necessitate more frequent activities under the above, such as more frequent assessments of Ministry of Finance forecasts)

The figure below sets out NAO LT's calendar of submissions to the Seimas (Lithuanian parliament). Ordinarily, in its work to assess and endorse macroeconomic forecasts (Point 1 above), NAO LT assesses and endorses two forecasts (economic development scenarios) produced by the Ministry of Finance each year, in March and September. However, under exceptional circumstances (a situation that was in effect in Lithuania in 2024), two further

¹ NAO LT: Budget Monitoring
<https://www.valstybeskontrole.lt/EN/BudgetMonitoring>

forecasts may be produced and assessed. Under such exceptional circumstances, the economic development scenario must be published and endorsed at least once per quarter.

Calendar of opinions to be submitted to the Seimas



Source: Adapted from <https://www.valstybeskontrole.lt/EN/BudgetMonitoring>

2.2.2. Approach

To assess the Ministry of Finance forecasts, NAO LT conducts forecast comparisons using a variety of methods:^{2, 3, 4}

- Of real GDP growth in the short term (up to one year ahead, as well as estimates for the current year), using NAO LT's own projections as well as those of other institutions. This analysis also considers the evolution of these projections over time, as new information becomes available. By considering the dispersion of forecasts over time and where the Ministry of Finance's own forecast is located in that range, NAO LT can also judge the degree of (relative) caution in the Ministry's forecast each time.
- Against NAO LT's own forecasts (annual to $t+3$ years, as well as estimates for the current year) of a wider range of macroeconomic indicators, five of which form the basis for an endorsement decision, concerning headline GDP and key fiscal determinants:⁵
 - GDP in constant prices (i.e. real GDP)
 - GDP in current prices (nominal GDP)
 - household consumption expenditure (a component of GDP by the expenditure approach, in real terms)

² See, for example, NAO LT's March 2024 'Opinion on the endorsement of the Economic Development Scenario': <https://www.valstybeskontrole.lt/EN/Product/24226/opinion-on-the-endorsement-of-the-economic-development-scenario>

³ NAO LT Description of evaluation and endorsement of the EDS of the NAO FI: https://www.valstybeskontrole.lt/TVS/Content/Biudzeto_stebesena/ERS_vertinimo_ir_tvirtinimo_aprasas.pdf

⁴ Brief details are also provided in Annex 2 of National Audit Office of Lithuania (2023a) 'Opinion on the endorsement of the economic development scenario', September 2023, 19/09/2023 <https://www.valstybeskontrole.lt/EN/Product/24198/opinion-on-the-endorsement-of-the-economic-development-scenario>

⁵ NAO LT Macroeconomic forecasts: <https://www.valstybeskontrole.lt/EN/post/17687>

- employment (number of employed persons, by the Labour Force Survey methodology)
- average monthly gross earnings

This is the part of the exercise that is of most immediate relevance to the requirement for a new macroeconomic model.

Other macroeconomic indicators are also projected (see the following table for variables published as part of NAO LT's endorsement opinions on the economic development scenario). While these other indicators do not form the direct basis for forecast endorsement, the wider list constitutes a more complete set of indicators with which to assemble and judge the overall coherence of the macroeconomic forecast. This wider set of variables is thus important to underpin a credible forecast, even if just a subset is scrutinised from the perspective of final forecast assessment and endorsement.

Group	Indicator
Key macroeconomic indicators	Change in GDP at constant prices, %
	GDP at constant prices, EUR million
	Change in GDP at current prices, %
	GDP at current prices, EUR million
	Change in labour productivity, %
Components of GDP at constant prices, rate of change, %	Household consumption expenditure
	General government consumption expenditure
	Gross fixed capital formation
	Exports of goods and services
	Imports of goods and services
Price indicators, rate of change, %	GDP deflator
	Household consumption expenditure deflator
	Government consumption expenditure deflator
	Gross fixed capital formation deflator
	Export (goods and services) deflator
	Import (goods and services) deflator
	Harmonised index of consumer prices (annual average)
Labour market indicators	Number of employed persons (according to the Labour Force Survey methodology), thousand
	Change in the number of employed persons, %
	Unemployment rate (according to the Labour Force Survey methodology), %
	Average monthly gross earnings, EUR
	Change in average monthly gross earnings, %
	Wage bill, million EUR
	Change in the wage bill, %
Changes in potential GDP and the output gap	Change in potential GDP, %
	Output gap (% of potential GDP)

Notes: Variables listed are taken from Annex 1 of the September 2024 NAO LT opinion.

Rows shaded in blue denote variables that form the basis for forecast endorsement.

Source: NAO LT (2024) 'Opinion on the Endorsement of the Economic Development Scenario', 19/09/2024

<https://www.valstybeskontrole.lt/EN/Product/24275/opinion-on-the-endorsement-of-the-economic-development-scenario>

Currently, NAO LT's forecast is not generated by a single integrated model. Instead, the various components of the forecast are developed separately (typically by different members of the NAO LT team). The principal assumptions that underpin the forecast are: EU GDP growth; global GDP growth (excluding the EU); GDP growth in the economies that make up Lithuania's main export markets (compiled from IMF and European Commission sources); the Brent crude oil price; and the US dollar-euro exchange rate. As will be explained later, by this process, any consequent fiscal forecasts do not feed back into the macroeconomic view, motivating the interest under this current project in an integrated macroeconomic-fiscal model.

The modelling approach makes use of various small models and tools that have been judged by the OECD (2019) to be fit for the purpose of short-to-medium-term macroeconomic analysis. For forecasting, NAO LT employs econometric models of indicators regressed on macroeconomic components, whether using multivariate regression methods or vector autoregression (VAR) techniques. The chain-linking method estimates GDP and its components at constant prices, with assumptions about trade, export markets, oil prices, and exchange rates. Potential GDP is estimated using a Cobb-Douglas production function with assumptions about convergence to aggregate EU-15 levels, long-term unemployment, and other factors.

The models currently in use tend to rely on more time-series approaches (statistical methods to fit the data based on past trends) rather than more structural economic approaches (employing more explicit economic theory to tie the projections together; which is, instead, handled by the later collective adjustment step). Modelling is currently carried out using a combination of EViews, R and Microsoft Excel.

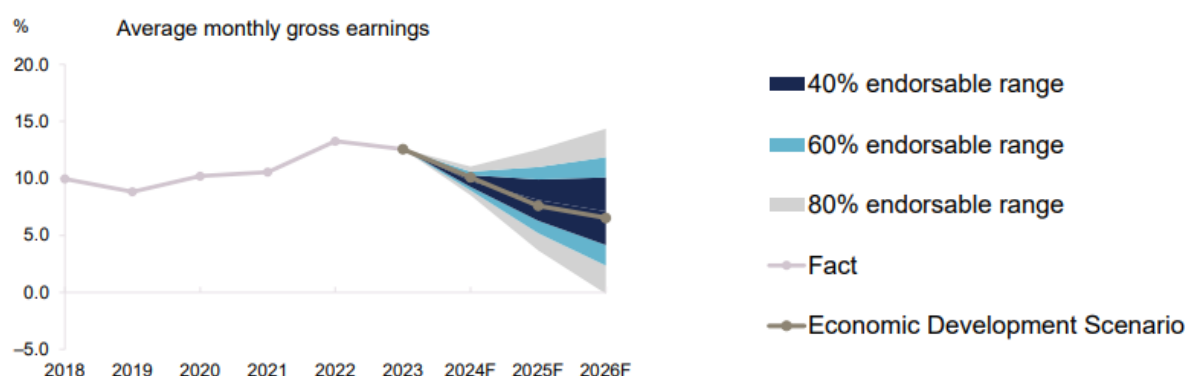
A process of collective adjustment and expert judgment then follows, to bring the various (sub)forecasts into alignment. This adjustment process is what leads to a coherent macroeconomic picture from which the five key variables are extracted for examination as part of the endorsement process.

Having developed its own forecast, NAO LT compares the projections to those supplied by the Ministry of Finance under the latest economic development scenario. As NAO LT itself notes, these projections may differ from those of the Ministry of Finance. This could be due to either (mild) differences in data or assumptions by vintage; or because of explicable differences in information/assumptions arising from differing forecast timetables/vintages. Endorsement of the economic development scenario is still possible in such circumstances, as stated by NAO LT (2023a, Page 2):

Estimates of the NAO FI and the MoF may differ. The Economic Development Scenario is endorsed if the differences between the projections of the indicators to be approved in the assessment of the NAO are not significant, or if the Ministry of Finance provides supporting information as to why their projections are plausible, or any other relevant information that was not available to the NAO FI when preparing its projections.

This comparison involves constructing ranges (uncertainty bands / a fan chart) around the NAO LT projections for each of the five core variables of interest, as below (excerpted from the latest September 2024 opinion). The OECD (2019) review of NAO LT found the IFI to be unusual in producing a large number of charts of this type while also noting that such an approach could usefully be extended to cover sensitivity analysis of key parameters in the forecast.

Excerpt from economic development scenario endorsement ranges estimate by the NAO FI



Notes: Grey dotted line over the forecast period indicates NAO LT's own forecast. Endorsable ranges / fan charts are constructed from separate historical forecast errors around this range.

Source: NAO LT (2024) 'Opinion on the Endorsement of the Economic Development Scenario', 19/09/2024
<https://www.valstybeskontrole.lt/EN/Product/24275/opinion-on-the-endorsement-of-the-economic-development-scenario>

As in the latest (September 2024) opinion, the uncertainty bands show ranges of values at the 40%, 60% and 80% confidence intervals. These confidence intervals are constructed by cumulating historical (pre-Covid) forecast errors from the Bank of Lithuania.⁶ That is, the uncertainty bands do not as yet arise statistically from NAO LT's own forecasts. NAO LT has not to date carried out any rigorous evaluation of its own forecasts, with the IFI's relative youth (it was established in 2015) and the subsequent disruptions of, among others, Covid and the war in Ukraine, likely limiting the number of forecasts that can reasonably be assessed in this manner. Nevertheless, and resources permitting, a forecast evaluation exercise at some point in the future remains worthwhile.

The uncertainty bands also allow for a discretionary adjustment for asymmetry if warranted e.g. if there is a case for placing more weight on one direction (positive/negative) over the other, although such adjustments are more reliant on expert judgment.

Given the NAO LT forecast and its accompanying uncertainty bands, NAO LT then assesses whether the Ministry of Finance forecasts are in the vicinity of NAO LT's own projections. As noted in NAO LT's reports, the two forecasts may not precisely align for reasons of data and assumptions. Moreover, there could be cases in which the Ministry of Finance forecast incorporates other data not available to NAO LT at the time of forecast production. Subject to these considerations, NAO LT can then judge whether the Ministry of Finance forecast can be endorsed.

Until September 2023, NAO LT produced forecasts purely as an internal exercise to support its assessment and subsequent endorsement of Ministry of Finance forecasts. Since September 2023, NAO LT has published its forecasts alongside its opinion documents.⁷ This is in keeping with the OECD's (2019) earlier recommendations.

⁶ One practical complication of this approach is that the time horizon for the Bank of Lithuania forecasts is shorter than those required by NAO LT.

⁷ NAO LT Macroeconomic forecasts:
<https://www.valstybeskontrole.lt/EN/post/17687>

As well as the regular macroeconomic forecasts described above (2-4 times each year), NAO LT also produces fiscal forecasts, principally as part of its annual opinion on the structural adjustment target.^{8,9} These projections follow from a prior (i.e. given) macroeconomic forecast, largely as a matter of accounting, and building on standard IMF debt sustainability analysis (DSA) tools.¹⁰

Fiscal forecasts are crucial for assessing Draft Budget reliability and adherence to fiscal discipline rules. NAO LT typically bases its opinion each year on the structural adjustment target on a single hypothetical scenario. Further analysis may be carried out on an *ad hoc* basis, as was the case in 2023 (NAO LT 2023b) when the IFI produced two forecasts: a no-policy-change scenario and a hypothetical scenario, based on detailed economic classifications and recent data:

1. The no-policy-change scenario, embedding announced/confirmed policies only, which usually only covers the upcoming fiscal year
2. The hypothetical scenario, an indicative projection only, which models policies of comparable magnitude to those previously implemented (e.g. with respect to minimum wages etc)

Revenue forecasts rely on macroeconomic indicators and elasticities, adjusted for discretionary measures. Results are combined for net lending/net borrowing indicators, calculated on an accrual basis according to ESA 2010 categories.¹¹

In the case of longer-term analysis, including of fiscal risks, medium-term projections use 30-year anchors, assuming convergence in productivity to the EU-15 in aggregate, long-term unemployment targets, and more. These factors encompass economic, social, and demographic indicators.¹²

2.2.3. Assessment

In line with the OECD (2019) review, NAO LT's forecast methods are considered appropriate for its core purposes, to stimulate an informed discussion about the plausibility of government forecasts/estimates. It remains the case that NAO LT is relatively young as an IFI, and with a relatively small team. At roughly the same size now as at the time of the review, the methods employed are at a level that could continue to be sustained over the long term.

The main (and justified) interest in a macroeconomic model is as a more formal aid to efficient macroeconomic forecasting and analysis. Such a model would support NAO LT in the development of (and confirming the original TSI request for):

1. Coherent macroeconomic forecasts from the outset, by employing a formal framework that already links the various macroeconomic aggregates into a coherent whole. This

⁸ See, for example, National Audit Office of Lithuania (2023b) 'Opinion on the structural adjustment target', 27/10/2023 <https://www.valstybeskontrole.lt/EN/Product/24199/opinion-on-the-structural-adjustment-target>

⁹ NAO LT Description of evaluation and endorsement of the EDS of the NAO FI: https://www.valstybeskontrole.lt/TVS/Content/Biudzeto_stebesena/ERS_vertinimo_ir_tvirtinimo_aprasas.pdf

¹⁰ Additional inputs concern, for example, the expected structure of future government debt etc.

¹¹ NAO LT Fiscal forecasts: <https://www.valstybeskontrole.lt/EN/post/17688>

¹² NAO LT Description of evaluation and endorsement of the EDS of the NAO FI: https://www.valstybeskontrole.lt/TVS/Content/Biudzeto_stebesena/ERS_vertinimo_ir_tvirtinimo_aprasas.pdf

would create a single focal point for the team to develop its macroeconomic view, with an account of wider economic effects and feedbacks that, right now, must instead be expressly considered by the team.

2. Integrated macroeconomic-fiscal forecasts, given the points previously about how these are currently dealt with in a one-directional manner.

Any new model thus represents a potential source of efficiency on the one hand (by allowing the team to focus attention on other aspects of the forecasting process and/or freeing time) and an augmentation of the existing forecasting setup by introducing linkages that are not currently captured in the existing approach.

Further needs of a new model, arising from the assessment concern:

1. A likely need to extend the forecast horizon further into the future, beyond the current three years, as part of EU economic governance reform. A formal framework will assist in the production of such a forecast, as more *ad hoc* methods become increasingly labour-intensive (from a need to consider more complex and/or longer chains of causation). Here, a more formal framework underpinned by a more explicit economic logic will be beneficial.¹³
2. Growing interest in the ability to conduct scenario analysis, which is prohibitively costly under the current setup (effectively amounting to a new forecast exercise for each scenario) but which would be relatively inexpensive with a formal model: Once the forecast is complete, adjusting scenario inputs should automatically lead to new macroeconomic outcomes.
3. The potential to conduct more rigorous uncertainty analysis (in particular, the construction of the fan charts shown above) by generating ranges of values from the model itself, rather than the current practice of cumulating forecast errors from a separate source (Bank of Lithuania forecasts) and applying them to the current forecasts.

In these respects, the rationale for an integrated macroeconomic-fiscal model seems reasonable, as a tool to both speed and augment NAO LT's forecasting capability. Earlier discussions about expert judgment are also noted and the ability to intervene in the model's inputs/responses will be an important feature of a forecasting tool. The remaining sections below on NAO LT briefly present considerations for the model, with a fuller proposal for model requirements and a review of practices in other institutions detailed in the following two chapters.

2.2.4. Requirements

A brief summary of NAO LT's requirements and, where relevant, our proposed approach, is listed in the table below. Fuller details are discussed in broader terms in Chapters 3 (on considerations and model approaches) and 5 (model development and workplan).

Task		Approach (proposed)	Comments
Data	Public Sources	National: - Statistics Lithuania - Central Bank of Lithuania International:	Some variables may need to be obtained from other sources but on a one-off / <i>ad hoc</i> basis only

¹³ Here, the OECD's (2019) recommendation of improving policy costings would also be beneficial, to more rigorously ground what is currently NAO LT's hypothetical scenario in its fiscal analysis, although this earlier assessment did also appreciate the high effort involved in doing so.

Task		Approach (proposed)	Comments
Features	Sectors	• Eurostat • European Central Bank • DG ECFIN • IMF • OECD • World Bank	
		Key sectors: • Construction • Services • Manufacturing • Agriculture	The sectors listed are considered key, with the aim to establish an agreed (and more complete, as needed) list during implementation
Software	Model	EViews (Version 12 standard/enterprise)	NAO LT has existing capability in EViews
	Data collection and handling	and R	NAO LT has existing capability in R and considers R suitable for this application
	Version control	Git (proposed)	NAO LT has no existing capability in version control
Forecast	Frequency	Short term: Quarterly Medium term: Quarterly or annual	Short-term forecasts should be quarterly Medium-term forecasts can be either quarterly or annual (to be reviewed)
	Forecast period	Minimum: t+4 years If possible: t+7 years	Forecast performance to be reviewed on an ongoing basis
	Forecast updates	Minimum: Two times a year Exceptionally: At least once per quarter	More frequent forecasts may be needed in exceptional circumstances

2.3. MFAC

2.3.1. Background

MFAC, established in 2015, is composed of a team of five economists, as of 2023. Among its statutory responsibilities is an obligation to assess and endorse (if appropriate) the extent to which the Maltese government's proposed economic and fiscal policy objectives are being achieved. In doing so, MFAC has a key role in the transparency and clarity of fiscal policy in Malta. MFAC's responsibilities in this regard concern its assessments of official forecasts by the Ministry for Finance. Here, specifically, MFAC assesses the forecasts published in the Ministry's:

- Update of Stability Programme (at the end of April each year), which concerns macroeconomic and fiscal forecasts out to t+3 years (a four-year period, with year t also requiring estimation, owing to lags in data publication)
- Draft Budgetary Plan (no later than 15 October each year), for the fiscal year ahead, consisting of estimates for year t and a forecast for year t+1

Both plans are also submitted to the European Commission. MFAC's legal obligations concern ex ante assessment and endorsement of the macroeconomic forecasts, and ex post assessment of the fiscal forecasts.

In addition to the above, MFAC also carries out assessments each year of the Ministry for Finance's annual and half-yearly reports, which detail macroeconomic/fiscal outcomes and any significant in-year deviations/departures since the corresponding Draft Budgetary Plan.

MFAC's own annual report and statement of accounts each year details both its activities through the year but also contains chapters on *ad hoc* work carried out over that same period. Those chapters might, for example, present new empirical analysis of aspects of the Maltese

economy. Notably, in the case of the report for 2023 (MFAC, 2024a), there is a chapter describing MFAC's new fiscal-revenue model, which was deployed in MFAC's assessments of the Update of Stability Programme for 2023-26 (MFAC, 2023a) and Draft Budgetary Plan for 2024 (MFAC, 2023b).

The IFI has also published an evaluation of the macroeconomic forecasting performance of the Ministry for Finance (Davison et al., 2024). The report uses statistics such as root mean square error and Theil's U statistics to test for forecast accuracy. The report also uses OLS to test for biasedness of forecasts.

From 2025, following European economic governance reform, the Update of Stability Programme assessment will be replaced by an Annual Progress Report. The focus of the new report will be on evaluating progress towards targets under Malta's Medium-Term Fiscal-Structural Plan for 2025-28. The Plan was published and submitted to the European Commission in September 2024 and sets out (nominal) growth targets for net primary expenditure over the period (Government of Malta Ministry for Finance, 2024).

2.3.2. Approach

The Ministry for Finance's forecasts are produced using its own model, the Short-Term Quarterly Economic Forecasting Model (STEMM).¹⁴ MFAC assesses and endorses these projections by:

- Scrutinising the (plausibility of the) assumptions that underpin the projections
- Carrying out various comparative forecast exercises to judge the forecast outcomes themselves
- Considering potential sources of upside and downside risk, to gauge the extent to which the forecast might be prone to under- or over-estimating future outcomes

By these methods, MFAC then decides whether the forecast lies within a range that can be considered endorsable, with some accompanying comment on the potential direction of any risks. For example, in its most recent letter of endorsement (14 October 2024), of the Draft Budgetary Plan for 2025, MFAC endorsed the forecast for 2024 and 2025 while considering the balance of risks to be on the upside, and especially so for 2024. This judgment was made in part on the basis that economic growth in the first half of 2024 had been strong and above the Ministry's forecast for the year as a whole. The slower growth in 2024H2 implied by the Ministry's forecast was considered on the conservative side in the light of other (soft) indicators available to MFAC at the time of its own assessment. Similar reasoning applies to other aspects of the forecasts but also in its overall coherence; for example, as in MFAC's assessment that the Ministry's forecast for 2024 implies negative labour productivity growth for the second half of the year (MFAC, 2024a).¹⁵

MFAC's assessment of the Ministry for Finance forecasts considers both inputs (assumptions) and outputs (the forecasts themselves). The typical approach is to first assess the macroeconomic forecast before considering the fiscal implications. The legal obligation is that the macroeconomic forecasts require MFAC's endorsement before being sent to the European Commission.

¹⁴ This model was developed by Cambridge Econometrics and is now independently operated and maintained by the Ministry for Finance.

¹⁵ The full assessment has since been published by MFAC (2024c).

Given the importance of external factors to a small open economy such as Malta's, the assumptions that underpin the macroeconomics forecasts are crucial, with MFAC ensuring the sources are authoritative and reputable, and considering the nature of any changes in these assumptions relative to the previous forecast e.g. updates to reflect more recent turmoil in the global economy and any expectations of adjustment or recovery. Expert judgment on the part of the Ministry for Finance also plays an important role. As appropriate, MFAC's assessment also provides commentary on assumptions-related decisions e.g. the expectation of higher import prices in the face of policy interventions intended to reduce emissions from shipping.

In assessing the forecasts themselves, MFAC takes a wide-ranging view, analysing individual components of the Ministry's projections, including:

- GDP and its breakdown by the expenditure approach, to identify the sources of demand growth, whether one-off or sustained
 - particular attention is paid to external drivers influencing trade (imports/exports of goods services) and tourism, with the balance between domestic and external drivers of economic activity of particular interest
- The size and composition of the (estimated) output gap: Depending on how GDP compares to potential output, the extent to which any output gaps might close is then assessed over the forecast period
- Income (wages/compensation, including on a per-employee basis) and the labour market (employment and unemployment)
- Inflation
- The role of government policies e.g. recent energy subsidies for households and businesses to help absorb the effects of global price shocks

MFAC's analysis is disaggregated as appropriate e.g. in the assessment of output, trade, employment etc at a sectoral level.

The assessment considers how forecast trends compare to recent history (and the treatment of more volatile components such as gross fixed capital formation) as well as the relationship to the various assumptions that underpin (drivers of) the forecast and mediating model-based outcomes (e.g. the influence of wages, inflation, interest rates and unemployment). This is with a view to rationalising both continuations of and/or any departures from trend.

The (low/limited) level of disaggregation in a model such as STEMM means that MFAC will frequently examine more detailed data (e.g. on the detailed breakdown of household consumption and inflation; and imports/exports) to better understand recent developments and whether likely trends in the various components support or contradict the aggregate forecast made by the Ministry.

MFAC will also conduct forecast comparisons, considering how the latest Ministry forecasts compare to:

- The Ministry's previous forecast, including an assessment of changes in the data and assumptions that might explain any differences in outlook.

- Forecasts produced by other institutions (in particular; the European Commission, the Central Bank of Malta, IMF and various credit-rating agencies), to judge the Ministry's outlook relative to others'.¹⁶

Such forecast comparisons note, for example, which components of GDP are expected to drive future growth and whether these patterns differ between forecasts due to varying combinations of data revisions and assumptions. Equally, MFAC also reports where forecasts agree in their quantitative and/or qualitative features.

On the fiscal forecasts, MFAC looks closely at both the fiscal and structural balance, as well as gross debt; including as ratios to GDP. The underlying components of revenue and expenditure are also considered.

MFAC's assessment approach is thus quite holistic, involving a close examination of forecast drivers and outcomes. MFAC does not, however, produce a complete macroeconomic forecast of its own to serve as a benchmark to compare with the Ministry for Finance forecast. Any additional analysis (beyond the descriptive assessment described above) employs a mix of:

- Smaller *ad hoc* tools e.g. ARIMA models of inflation, to help assess whether the Ministry for Finance forecasts lie within plausible bounds (here, appropriate confidence intervals from the ARIMA projections).
- A recently developed fiscal revenue model with which to assess the Ministry for Finance's forecasts but also produce MFAC's own indicative projections

On the latter, in 2023, MFAC began using small-scale quantitative models and simulations to forecast fiscal revenue under a no-policy-change scenario. Estimations used demand-side unidirectional models without feedback loops. Elasticities were estimated using macroeconomic outputs of the government through extrapolation of historical trends, averaging, or econometric estimation. Simulation results examined the response of fiscal variables to a 1 pp increase in each isolated macroeconomic variable's growth rate (see Chapter 4 in MFAC, 2024a). This new fiscal revenue model is now applied to consider two scenarios to support fiscal forecast assessment:

1. A scenario that makes use of the Ministry for Finance macroeconomic forecasts (providing information on the various tax bases from which revenues are collected), using the MFAC model to generate its own estimates of revenues by component.
2. A scenario in which the Ministry for Finance forecasts have been adjusted to reflect MFAC's own macroeconomic view, informed by its assessment of upside and downside risks (see below). Again, the model produces a set of revenue estimates based on the macroeconomic assumptions.

In applying the model in this way, MFAC generates two sets of alternative revenue projections. Both make use of MFAC's own estimates as to how revenues relate to macroeconomic conditions (the parameters of the model itself) while varying in the input assumptions (whether the Ministry's own projections, or the version adjusted by MFAC, based on expert judgment and risk-sensitivity analysis). In this part of the analysis, MFAC thus generates its own benchmark

¹⁶ As with similar exercises carried out by NAO LT (see previous section), that there are differences across forecasts is to be entirely expected, given differences in forecast production timetables (affecting vintages of data and decisions about assumptions), methods and expert judgment. Nevertheless, as MFAC makes clear, such exercises remain useful because they can still serve as useful forecast benchmarks, *in light of* such differences.

results for comparison, with a view to understanding whether the relative position of the Ministry forecasts suggests optimism or pessimism as part of the overall risk assessment.

Because the Ministry for Finance's forecasts are model-based (using STEMM, as mentioned previously), it is possible to generate scenarios to compare against the main projection. Scenarios include alternative paths for global economic growth, interest and exchange rates, inflation and tourism. MFAC is thus able to review the macroeconomic and fiscal outcomes of these scenarios to help inform its risk assessment by considering the range of results (including as fan charts based on the Ministry for Finance results) and, for example, the possibility of contractions in GDP. Budget balances follow from the macroeconomic outcomes and can be assessed in a similar manner.

Other aspects of MFAC's risk assessment consider whether trends in the forecast might be considered cautious (or not); or subject to uncertainties that might suggest that any deviations in the outturn from the forecast might be in a particular direction, whether above or below, as an assessment of upside versus downside risks.

As examples, from MFAC's (2023a) assessment of the Update of the Stability Programme over 2023-26, the Ministry for Finance projections for:

- Household consumption expenditure were judged to be cautious given expected labour market developments, demographics and income trends, pointing to an upside risk in the sense that such conditions could drive expenditure to be higher than forecast (while accepting that continued high inflation might counteract such an outcome).
- Investment may be subject to more in the way of downside risk because MFAC felt that the Ministry's forecast decline in investment still implied a profile that differed markedly from (was higher than) historical experience.
- The output gap highlights a persistently negative gap despite above-target inflation, which may highlight some inconsistency between expected economic growth (possibly underestimated) and the future evolution of potential output (possibly overestimated).

Upside or downside risks associated with the fiscal forecast follow from such analyses as well as the fiscal revenue model described previously. MFAC also comments on whether previously assessed upside or downside risks came to pass.

2.3.3. Assessment

As set out above, MFAC does not currently produce its own (complete) forecast as a comparator to the Ministry of Finance's projections. Instead, MFAC's approach to assessing and endorsing Ministry forecasts focuses mainly on assessing the assumptions and outputs of the forecast to judge the plausibility of the projections and also consider whether the balance of uncertainties points to upside or downside risks. This approach applies to both the Ministry macroeconomic forecast and consequent fiscal forecast.

MFAC complements this descriptive approach most notably in assessing the revenue side of the fiscal forecast with its own model. This model embeds a set of estimated tax elasticities, taking a macroeconomic forecast (projections of the relevant tax bases) as an input to generate revenue projections. This gives MFAC its own revenue forecasts which, so far, have consisted of two projections: one based on the original Ministry for Finance forecast, and another in which the forecast has been adjusted to incorporate MFAC expert judgment. Elsewhere, MFAC applies

more *ad hoc* techniques like ARIMA models to consider the potential range of outcomes in certain variables, and whether the Ministry projections lie within those bounds.

A new model would expand MFAC's capabilities, by:

1. Conferring the ability to produce a complete macroeconomic-fiscal forecast for comparison with the Ministry of Finance's projections, alongside MFAC's existing approaches to forecast comparison (including examination of assumptions, patterns of forecast revisions and assessments of forecasts produced by other institutions).
2. Establishing an integrated approach to macroeconomic-fiscal forecasting, extending MFAC's existing tools (e.g. the fiscal revenue model and *ad hoc* short-term assessment techniques), and with two-way feedback between components (rather than the one-way linkage from macroeconomic to fiscal projections currently in place).
3. Offering a more formal (and potentially quantitative) approach to uncertainty by allowing for fan charts or scenario analysis to judge the potential range of macroeconomic and fiscal outcomes. This could usefully support MFAC's assessment of upside and downside risks, although there will always be a need for expert judgment in this regard, both to produce and assess forecasts.
4. Creating a focal point (the model itself) for the above, rather than having to assemble forecast for the different components of a forecast and then carrying out an exercise to bring those components together, reconciling them into a coherent forecast. In the current situation ('as is'), the effort associated with such an exercise would grow in proportion to the comprehensiveness of the forecast. As with the NAO LT assessment, a model to develop forecasts would yield a variety of efficiency gains.

The forecast horizon of a formal model would also be more easily extended beyond the t+3 years that MFAC currently assesses. This would improve MFAC's ability to support macroeconomic and fiscal analysis under European economic governance reform. The remaining sections below on MFAC briefly present considerations for the model, with a fuller proposal for model requirements and a review of practices in other institutions detailed in the following two chapters.

2.3.4. Requirements

A brief summary of MFAC's requirements and, where relevant, our proposed approach, is listed in the table below. Fuller details are discussed in broader terms in Chapters 3 (on considerations and model approaches) and 5 (model development and workplan).

Task	Approach (proposed)	Comments
Data	National: • National Statistics Office Malta • Central Bank of Malta International: • Eurostat • European Central Bank • DG ECFIN • IMF • World Bank	Some variables may need to be obtained from other sources but on a one-off / <i>ad hoc</i> basis
	Public Sources • National Statistics Office Malta • Central Bank of Malta	
Other sources	National: • National Statistics Office Malta	MFAC has a memorandum of understanding with NSO Malta for more detailed statistics (e.g. Balance of Payments) than are published on the NSO's website

Task		Approach (proposed)	Comments
Features	Sectors	Key industries: - Tourism - Financial services - Manufacturing (particularly pharmaceuticals and electronics) - Digital gaming	The sectors listed are considered key, with the aim to establish an agreed (and more complete, as needed) list during implementation
			Prominence of financial services may warrant closer examination of need for a financial sector in the model
Software	Model	EViews (Version 13)	MFAC has existing capability in EViews
		Python	MFAC has no existing capability in Python
	Data collection and handling		CE can recommend training resources and provide support to assist in deployment and with project-specific application (i.e. within reason)
		Git (proposed)	MFAC has no existing capability in version control
	Version control		CE can provide relevant training once the preferred software is confirmed
Forecast	Frequency	Quarterly or annual	Preferred frequency to be confirmed in the early stages of implementation (the concern is that the advantages of larger quarterly samples may be offset by noise in the quarterly data)
	Forecast period	Minimum: t+4 years If possible: t+7 years	Forecast performance to be reviewed on an ongoing basis
	Forecast updates	Minimum: Two times a year Potentially: Four times a year	More frequent forecasts may be useful for internal use

2.4. Discussion

The assessment above highlights each IFI's current approach to forecast assessment and endorsement. In all cases, the IFIs have access to quantitative tools but these tools are, in general:

- Short term in their outlook, making use of more time-series techniques to extrapolate from historical data, rather than approaches that more explicitly draw on economic theory / economic-structural features. This limits the tools' use to forecast horizons a few years out, which is suitable for budgetary analysis, but European economic governance reform suggests that longer forecast periods will be of increasing interest going forward.
 - Deeper reliance on time-series rather than structural methods also means that deep policy assessment (costing, impacts) may receive somewhat less attention in the current approaches (and, indeed, may be difficult to separate from the data/projections).
- Applied selectively, depending on the variable(s) of interest, rather than as part of a wider-ranging modelling exercise to produce an alternative benchmark for comparison. Related to the point above about limited use of structural approaches, this then requires effort (which may be labour-intensive) to bring the various forecasts together into a coherent whole.

As such, the existing suites of quantitative tools form one part of the IFIs' capabilities to review country forecasts and must be combined with other analysis to inform the final assessment. The country-by-country assessment above lays out the various ways in which an integrated model would support IFIs in their work, with clear commonality in various benefits. These benefits

include reasons of efficiency and expanded analytical capability through the ability to conduct deeper sensitivity analysis and scenario analysis.

It is important to acknowledge that a model does not obviate these approaches, because there will always be a need for specialist input and scrutiny to ensure a thorough assessment. Instead, a formal model will help to automate aspects of forecast production so that the IFI teams can focus more on areas that warrant such input e.g. forecast checking and adjustment, rather than raw forecast production.

From an economic standpoint, the structural features of the respective countries are also of note. Both Lithuania and Malta are small open economies with the following implications:

- Developments in the rest of the world are highly consequential for macroeconomic and fiscal outcomes. This is clear in both cases in the identification of key assumptions when assessing the forecasts of the finance ministries. Careful attention is paid to external factors such as economic activity in the rest of the world (with a focus on key trade partners), global commodity prices (usually oil) and exchange rates. To be effective, any new macroeconomic model should embed an appropriately comprehensive account of these effects and/or provide the means for alternative views (including expert judgment) to be incorporated into the forecasts.
- Economic developments in the countries have been quite rapid, spurred by growing access and exposure to the global economy. This is evident in the (interrelated) data on both the domestic (e.g. evolutions in income and household consumption) and external (notably in the rapid growth in exports of various services in the countries) sectors. This may pose empirical challenges in parameterising models (in particular, by econometric methods) of fast-developing economies, especially in light of the further points below.
 - The developments of such economies is also frequently quite specific in terms of the way their structures have evolved over time. As examples, re-exports of goods (the passage of goods through a country, registering as both imports and exports) are significant to Lithuania given its geographical circumstances; while, among the various services exports that have grown rapidly in both countries, Malta is notable for its tourism and gaming sectors.
 - Careful consideration of these subcomponents may continue to be important in a more formal macroeconomic treatment, because it is these subcomponents that are likely to drive the overall forecast. A forecast may be rationalized in terms of movements in these key sectors.
- The span of the necessary data may be limited, further complicating statistical inference when attempting to explain rapid economic development with relatively few data points. For example, many macroeconomic time series for Lithuania and Malta start in either the mid-to-late 1990s or early 2000s.¹⁷ This affords (in the best case) 25-30 annual observations or perhaps some 100 quarterly observations, albeit spanning a period of change (as above) but also a variety of crises that introduce additional volatility to the data.
- By virtue of their size, countries covered by this pillar may also be challenged in producing economic statistics required for an appropriate macroeconomic model. Examples in the case of quarterly data for Lithuania and Malta include the absence of readily available time series of:

¹⁷ This consideration fuels, in large part, considerations as to the trade-off between higher-frequency quarterly data (which offer more observations at the cost of higher noise) and annual data (potentially less prone to data quality issues but at the expense of fewer observations).

- household disposable income, which would have to be constructed/estimated from (proxies of) its underlying components¹⁸
- various disaggregated exports in real terms, with current-price data available from trade statistics, but not necessarily reconciled with the corresponding national accounts concepts¹⁹

The possible need to construct further series from the data also poses a further challenge because, while such series may have explanatory power in an econometric sense (because they serve to improve the fit of any estimated equations), for modelling purposes these same series must also be projected into the future. This highlights a further trade-off between finding variables that help explain the historical dynamics of the economies while also ensuring that variables for applying the model in forecasting can be projected either exogenously (it is possible to make credible assumptions about their future movements) or endogenously (as among the variables generated by the model itself). There are similar challenges if considering certain classes of model (e.g. semi-structural approaches) which may rely on variables that are not directly observed, like certain concepts of (say, permanent) income.

The above will need to be assessed on a case-by-case basis but may lead to cross-IFI solutions e.g. in the handling of household disposable income. Where such learnings can be deployed across multiple models/IFIs, we will ensure the setup and management of the later phases supports it.

Overall, we also expect there to remain a critical need for expert judgment (as there already is in the IFIs' assessment procedures) in the production of model-based forecasts. This is important given the continued evolving state of the MSs' economies and the continued likelihood of ongoing shocks and uncertainties. The expert is thus crucial to the development of credible forecasts because the model(s) may not be able to anticipate such events themselves, whether due to the challenges of populating databases and parameterising the models; or because such events cannot be reasonably picked up by a mechanical modelling approach (parameterised as they are on historical data).

¹⁸ There are nevertheless various options for constructing such data, which we will explore with the IFIs during the next phase of work.

¹⁹ Again, there are options for either modelling the current-price data or attempting to build real-terms versions; and for handling what are, effectively, statistical discrepancies.

3. REQUIREMENTS

3.1. Overview

The beneficiary IFIs' requirements are similar, reflecting the requirements of the EU economic governance framework (see, for example, European Commission, 2024; and Höflmayr, 2024). Specifically, the IFIs each wish to develop an integrated macroeconomic-fiscal model for short- to medium-term forecasting, to assess forecasts produced by their countries' respective ministries of finance. In addition, the forecasts should support the evaluation of compliance with fiscal discipline rules and establishment of exceptional circumstances. From a combination of document review and consultation, the IFIs' requirements are to:

- a. Produce macroeconomic and fiscal projections
- b. Allow for scenario analysis of different policies
- c. Assess the impact of different external assumptions on macroeconomic and fiscal forecasts
- d. Produce their own macroeconomic and risk scenarios and quantitatively assess the risk scenarios produced by the ministries of finance

To do this effectively, the models must be tailored to the specific requirements and economic circumstances (e.g. key data, sectors etc) of each MS.

This chapter lays out an initial set of features, considerations, and variables that will need to be reflected in the final model(s).

3.2. Model Requirements

The model outputs must be sufficient to evaluate the beneficiary countries' economic performance, their compliance with fiscal discipline rules, and establish any exceptional circumstances.²⁰ The draft list of output variables below has been compiled based on existing IFI publications and other publication requirements, as well as consultation with the IFIs.²¹ While not a final list, the table represents in broad terms the intended scope of the final model(s).

For publication, IFIs generally report variables at annual frequency although this does not necessarily mean that any new model(s) should also be at annual frequency. As discussed elsewhere in this report, quarterly frequency may present other advantages to IFIs, whether to better understand their short-term projections or to improve sample sizes for statistical (econometric) analysis.

²⁰ NAO LT Fiscal discipline rules:

<https://www.valstybeskontrole.lt/EN/Post/17749>

EU New economic governance framework:

https://economy-finance.ec.europa.eu/economic-and-fiscal-governance/new-economic-governance-framework_en

²¹ NAO LT Budget monitoring:

<https://www.valstybeskontrole.lt/EN/BudgetMonitoring>

MFAC Data:

<https://mfac.org.mt/data/>

Strengthening the Capacity of Independent Fiscal Institutions (IFI) | Review of existing analytical tools, methodologies (Deliverable 1A)

Output Variables	Unit	Purpose
GDP, constant price	Levels (€m) / Rate of change (%)	Standard macroeconomic variable for forecasting
GDP, current price	Levels (€m) / Rate of change (%)	Standard macroeconomic variable for forecasting
Household consumption	Rate of change (%)	Components of real GDP
Government expenditure	Rate of change (%)	Components of real GDP
Investment	Rate of change (%)	Components of real GDP
Exports of goods and services	Rate of change (%)	Components of real GDP
Imports of goods and services	Rate of change (%)	Components of real GDP
GDP and its components deflator	Price index (euro)	Evaluates inflation target
Consumer Price Index	Price index	Evaluates inflation target
Retail Price Index	Price index	Evaluates inflation target: goods and services
Housing Prices	Rate of change (%)	Evaluates inflation target: housing
GVA	Rate of change (%)	Calculates employment
Active population	Thousand persons	Calculates unemployment rate
Employment	Thousand persons	Calculates unemployment and productivity
Employment	Rate of change (%)	Calculates unemployment and productivity
Employment rate	Percentage (%)	Evaluates labour market
Unemployment rate	Percentage (%)	Evaluates labour market and unemployment costs
Labour productivity	Rate of change (%)	Often influences gross earnings
Average monthly gross earnings	EUR	Evaluates wage bill and inflation target
Average monthly gross earnings	Rate of change (%)	Evaluates wage bill and inflation target
Potential GDP	Rate of change (%)	Calculates output gap
Output gap	Relative to potential GDP (%)	Evaluates surplus general government rule
Government Revenue	Relative to GDP (%)	Evaluates surplus general government rule Breakdown by ESA 2010 classification
Government Expenditure	Relative to GDP (%)	Evaluates surplus general government rule Breakdown by ESA 2010 classification
Structural balance	Relative to GDP (%)	Evaluates surplus general government rule
Net Lending (+) / Borrowing (-)	Relative to GDP (%)	Evaluates sustainability of public debt
Debt	Relative to GDP (%)	Evaluates sustainability of public debt

Assumptions and exogenous variables are inputs to the model, with the following considered as key (rather than exhaustive).

Input Variables	Unit	Purpose
Real effective exchange rate	USD/EUR	Affects cost of imports and price competitiveness of exports
World prices	EUR	Affects cost of imports and price competitiveness of exports
Oil prices (Brent)	USD/barrel	Affects cost of imported goods
World GDP (without EU)	Rate of change (%)	Affects export demands
GDP of main export markets	Rate of change (%)	Affects export demands
EU GDP	Rate of change (%)	Evaluates exceptional circumstances to the general government expenditure growth limiting rule.
ECB Interest Rate	Percentage (%)	Affects investment and interest payables
3-month interbank interest rate	Percentage (%)	Affects dwelling investment
Population	Thousand persons	Calculates active population

Input Variables	Unit	Purpose
Working-age population	Thousand persons	Affects labour force
Population projection	Thousand persons	Affects labour force

3.3. Data requirements

From an initial data scoping exercise, most if not all national variables are available from the countries' respective National Statistics Offices (NSOs) or central bank:

- For Greece, HFISC already uses an extensive dataset to make GDP forecasts, especially in the case of the MIDAS model. Hence, data needed to enhance HFISC's modelling capabilities are at least to a large extent already available.
- In the case of Lithuania, NAO LT already publishes and makes use of the variables listed in the previous table (at annual frequency), as part of its existing forecasting exercises, albeit without the use of a single integrated model. As described in the previous chapter, the various assumptions / input variables either feature directly in quantitative analysis or inform the projections, with further adjustment made on a collective basis to arrive at the final coherent forecast.
- For Malta, other than its own projections of government revenue (using its fiscal revenue model), MFAC does not publish its own forecasts. The main inputs to the fiscal revenue model are projections (either derived from the Ministry for Finance forecasts, or adjusted versions of those same forecasts according to MFAC expert judgment) of the relevant tax bases. Selected series (e.g. inflation) may inform more *ad hoc* (e.g. ARIMA) models but are used more as a way to consider the range of potential outcomes, rather than forming a forecast in themselves.

In all three cases, the statistics providers operate Application Programming Interfaces (APIs) for their data, enabling programmatic access which we will make use of when implementing the data pipelines for the models.

External (international) variables will be sourced from Eurostat (e.g. EU GDP) or the ECB (interest rates) in the first instance. Both of these organisations also operate APIs for convenient and automated data access.

In the case of assumptions, these will be sourced from the above as required (e.g. for population projections), from other stakeholders (e.g. relevant ministries in the countries) or other sources as needed (e.g. as might be the case if looking to draw on DG ECFIN Ameco projections in the short term for consistency).

Other sources as needed could extend to the IMF (especially the World Economic Outlook) and World Bank.

There may still be a requirement for other variables as model development progresses but, outside of the above, we expect these to only be needed in exceptional circumstances.

3.4. User Types and Use Cases

This section sets out three primary user categories that embody the roles and needs of different users in the IFIs. In beneficiary IFIs with small teams, a team member may well fulfil multiple user profiles. Some external users may also fulfil certain user profiles, too. For example, key non-IFI

participants could include members of government ministries who might either supply information to feed into a forecast or act as stakeholders with an interest or role in validating the projections.

User Types	Description and Role
Model Developers	• Have a deep understanding of the model's components, mechanisms and functionalities. • Equipped to maintain, develop and make changes to the model over time.
Model Users	• Have a practical understanding of the model's components, mechanisms and functionalities. • Able to update the model with latest data. • Equipped to interpret questions posed by end users and develop model assumptions. • Operate the model to generate insights accordingly.
End Users	• Are consumers of the model's outputs. • Able to provide assumptions to model users based on understanding of macroeconomic-fiscal development. • Equipped to review, check, comment on model results at various points.

The subsequent example use cases depict the workflow of typical activities carried out by beneficiary IFIs, emphasising the specific roles of the user types involved. Chapter 2 goes on to map these types to staff in the IFIs, who will constitute the working groups for the implementation phase.

3.4.1. Forecast Updates

Forecast updates will be led primarily by the team of model users. The updated baseline forecast is used to assess forecasts produced by the respective ministries of finance and endorse their published statements. In addition, the forecast supports evaluation of the surplus general government rule and sustainability of public debt. The typical workflow is as follows:

1. Decide data cutoff date
2. Update database with latest historical data
3. Develop assumptions simultaneously with inputs from end users, some of whom may not be IFI staff e.g. stakeholders/experts in the respective ministries of finance
4. Produce the forecast based on the updated data and assumptions
5. Review the forecast and check key output variables with inputs from end users (again, potentially including non-IFI staff)
6. Repeat Steps 3-5 to adjust assumptions and refine the forecast as needed, whether through validation with experts and other stakeholders or in reconciling results with other models/tools
7. Publish outputs from the forecast and endorse other publications

IFI staff have experience of the above to varying degrees and the focus of the work will be to develop the models and supporting tools in ways that support the above process, rather than expressly looking to redesign the workflow.

In consultation with the IFIs, the minimum requirements for regular forecasts are:

- HFISC: At least three forecasts a year (spring, autumn, winter) and the option to produce further forecasts as needed. Forecasts should be of quarterly frequency.
- NAO LT: Macroeconomic forecasts are updated two times a year (in exceptional circumstances, four times a year). Forecasts should be at quarterly frequency in the short

term, but there is openness to switching to annual frequency as the time horizon extends into the medium term.

- MFAC: At least two forecasts each year for publication but with the option to produce further forecasts, even if only internal. MFAC is more open to annual forecasts, even in the short term and our workplan provides for some initial investigation into the relative merits of quarterly versus annual frequency before making a final decision (see Chapter 5).²²

In all cases, the process of producing a forecast should be sufficiently automated and efficient to take place within a 2-3 week period.

Following the new EU economic governance framework, the IFIs require models capable of forecasting out to t+4 years at a minimum, but with the possibility that some analysis might be required as far out as t+7 years. These forecast horizons relate to the new requirement for Member States to produce national medium-term fiscal structural plans of 4-5 years in duration, which must then be endorsed by the Council of the EU (Council of the EU and the European Council, 2024a and 2024b).²³ These plans must articulate a multi-year path for public net expenditure that also sets out the investments and reforms to be undertaken in response to country-specific recommendations under the European Semester. Member States may ask for an extension of these plans, to up to seven years, subject to committing to certain reforms and investments.

These horizons of four and seven years also correspond to the periods covered by European Commission-produced reference trajectories for Member States whose government deficit and debt exceed their reference values. The four-year fiscal adjustment period is the standard period over which the reference trajectories will set out a path towards either a plausibly downward trajectory or to keep government debt below 60% of GDP (Council of the EU and the European Council, 2024b). Again, Member States can request a longer adjustment period of up to seven years, subject to committing to certain reforms and investments.

As detailed in Chapter 5, we will look to develop a working model that can be run out to at least t+7 at an early stage, to be able to review the models' ability to project into the medium/long term.

3.4.2. Policy Impact Analysis and Scenario Analysis

Policy impact analysis and scenario analysis helps assess the impact of different policies and assumptions on macroeconomic and fiscal forecasts. As raised in discussions with the IFIs the ability to examine sensitivities, if not carry out uncertainty analysis, was also of potential interest and should be explored as the work progresses.

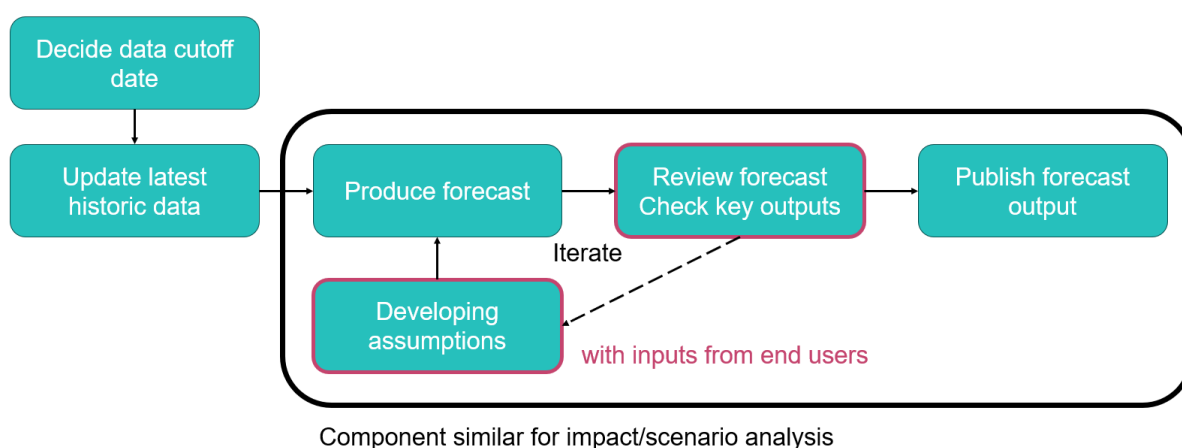
The workflow is similar to that of the quarterly forecast update and as follows:

1. Identify the research question in consultation with end users
2. Develop scenario assumptions and publish model output following Steps 3-6 described under quarterly forecast update

²² Particularly in the MFAC case, the tension lies in the extent to which quarterly data provide a larger sample size but also more noise with respect to statistical inference while annual data risk the opposite, of smaller sample size but less noise.

²³ The length of these plans is determined by national legislation.

Forecast update primarily led by **team of model users**



3.4.3. Model Updates and/or Extensions

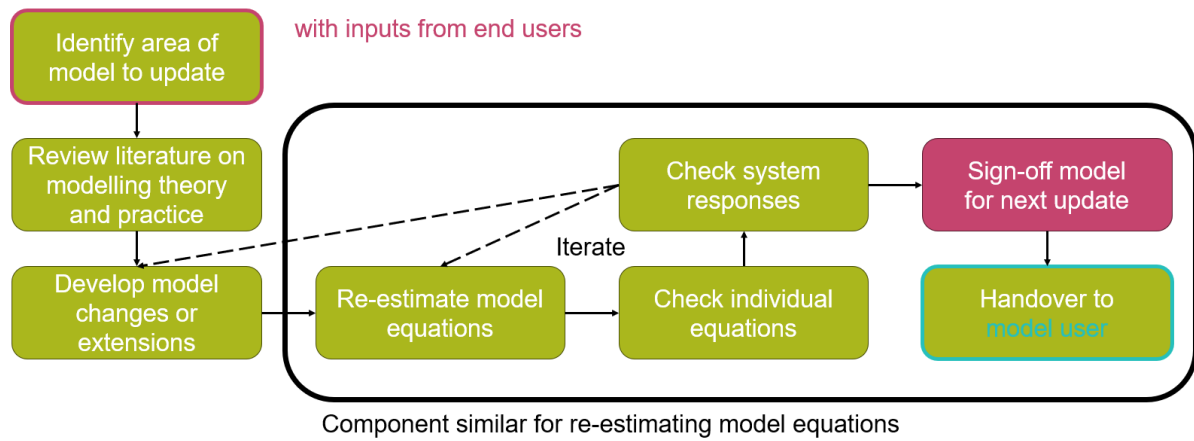
Model updates and/or extensions will be led primarily by the team of model developers. This is a recurrent process to improve the model capacity, ensuring it remains relevant and accurate in its predictions. The typical workflow is as follows:

1. Identify area of model to extend or update informed by feedback from model users and end users
2. Review economic literature on relevant theory and modelling practice
3. Develop updates and/or extensions to the model
4. Re-estimate model equations
5. Check individual estimated equations
6. Check system responses and key outputs through simulations
7. Repeat Steps 3-6 to test and adjust the model
8. Sign-off model by end users
9. Handover model to model users for the next forecast update

3.4.4. Re-estimation of Model Equations

Re-estimation of model equations recalibrates the model, particularly in the face of systemic changes to the economy. It involves a similar approach to the previous section (Model Updates), with model developers conducting Steps 4-9 as described above. The need for re-estimation should be determined in consultation with model users and end users, usually prior to a forecast update. Depending on the application, it may not be necessary or desirable to re-estimate the entire model every time. For some applications, users may prefer to continue to operate the model on existing and tested/known parameters.

Model update primarily led by team of model developers



4. MODELLING PRACTICES IN OTHER INSTITUTIONS

This chapter provides a summary of existing modelling approaches, beginning with a broad overview of model types, with NAO LT and MFAC having a similar interest in the development of large-scale macroeconomic models similar to those in use in many other IFIs. These models contrast especially to more ‘structural’ models, which are more deeply rooted in economic theory. Such structural models are relatively more common in central banks than in IFIs. After providing this overview, the chapter briefly summarises the five models that have been reviewed in this first phase, before discussing the approach to each ‘block’ of a typical economic model. In doing so, the chapter lays out various considerations that will be explored further in the next phase (implementation) of the project.

4.1. Overview

IFIs, central banks and ministries of finance across Europe and the US make use of formal macroeconomic models for forecasting and scenario analysis. These models can be divided into three broad categories, each of which places different emphasis on economic theory and data:

1. Dynamic Stochastic General Equilibrium (DSGE) models, which most closely follow mainstream theory and are most explicitly rooted in the microeconomic behaviour of agents
2. Large-scale macroeconomic models, which allow theory to dictate the general form of the model with greater allowance for the data to then inform the final structure and parameters
3. Semi-structural econometric models, which lie somewhere between the first two, being founded on microeconomic theory while allowing for a greater role for data than a DSGE model

Note that the distinction between the last two is somewhat fine in the sense that they can share many features, with the appeal to theory in certain cases (to derive alternative equations and variables) tending to mark semi-structural models.

As mentioned previously, of the above, both IFIs’ preference (largely aligning with practices in other IFIs) is for a large-scale macroeconomic model for forecasting and scenario analysis. These ongoing discussions have narrowed the model review somewhat, to focus on the kinds of models that might be relevant to meet this requirement and IFIs’ current capabilities.²⁴

Note that the semi-structural approach is increasing in popularity (e.g. at the ECB) but, as discussed later, such models are also more complex, which may not be desirable at the current time. Insofar as macroeconomic models are in continual development and usually quite modular, a large-scale macroeconomic model does not preclude the incorporation of more semi-structural features in the future.

²⁴ In practice, this has ruled out DSGE models at an early stage and shifted attention more to country models rather than the multi-country models previously suggested. Nevertheless, the final models reviewed represent a reasonable selection given the circumstances of the IFIs concerned.

4.1.1. Dynamic Stochastic General Equilibrium (DSGE)

Dynamic Stochastic General Equilibrium (DSGE) models delineate the economy as a system of equations derived from economic theory, representing the behaviour of agents like households, firms, and policymakers. In DSGE models, economic theory dictates the behaviour of the agents according to microeconomic (intertemporal optimising) principles, from which the final equations are derived. Such models thus stress theoretical coherence and are typically quite compact as a result.

The general equilibrium aspect implies that all markets (goods, labour, capital) are modelled to clear simultaneously, considering the interdependencies among these markets. The stochastic element accounts for the transmission of random shocks into the economy and the resulting economic fluctuations. The dynamic nature of the models reflects the impact of current choices on the future.

DSGE models capture expectations formation and intertemporal decision-making by agents with a view to the model being driven by ‘deep’ behavioural parameters in economic theory that are meant to be invariant to policy changes.²⁵ Parameterisation involves a combination of calibration and structural estimation to inform these values.

The emphasis on theoretical coherence makes DSGE models popular for policy analysis. However, the accuracy of predictions depends heavily on the assumptions made about the behaviour of economic agents and the nature of the shocks. Moreover, as Del Negro and Schorfheide (2012) note, there is often a trade-off between the coherence of these theoretical foundations and forecasting performance. While there have been various improvements in methods to both expand and estimate DSGE models, it remains the case that such models are typically:

- much smaller than might be desired for the current purpose e.g. to ensure detailed coverage of the wide array of variables desired by the IFIs e.g. by detailed categories of government revenue and expenditure
- more complicated to build, maintain and further develop
- have fewer (straightforward) places for intervention when considering how to impose expert judgment on the forecast

This may explain the low prevalence of DSGE models in IFIs, with no true DSGE model examined in the model review that follows.

Representative operational models are most likely to be found in central banks, as in the case of COMPASS (Bank of England, UK) and NEMO (Norges Bank, Norway).

4.1.2. Large-Scale Macroeconometric Models

The large-scale macroeconometric approach is perhaps the most traditional approach to modelling, representing the economy by integrating extensive empirical data and historical correlations between variables rather than solely relying on theoretical constructs (though theory

²⁵ In this regard, DSGE models and their predecessors are intended as a solution to the Lucas Critique, by which relationships observed in historical data may not be a good guide to future policy effects because the underlying behavioural responses (parameters) may themselves be policy-/context-specific.

does inform the specification of the equations). These models represent the economy as a system of econometric equations, capturing interactions between different sectors and variables. The models can provide insights into complex economic systems and make use of statistical methods suitable for forecasting. In contrast to DSGE models they are arguably more vulnerable to the criticism that their statistical relationships may not hold under future policy changes (the Lucas Critique).

The models allow for flexibility in specifying relationships and incorporating a wide range of economic variables and shocks. However, the models may not accurately capture structural relationships within the economy without the support of theoretical foundations. Their reliance on historical data also poses challenges in capturing structural changes or unforeseen events, leading to potential inaccuracies in forecasting. Large-scale models are prone to overfitting, where they are able to capture the variation in historical data with great accuracy, while having limited accuracy when generating projections.

Representative models include the UK Office of Budget Responsibility model and SMEC (Danish Economic Council).

A cousin of the large-scale macroeconometric models are small-scale reduced-form models, often in the form of individual time-series models or small (B)VAR/VECM-style models. These models are easier to estimate and typically involve fewer restrictions on the relationships between variables than large-scale models. Small-scale reduced-form models typically act as a cross-check for short-term or medium-term outlooks, and are a flexible tool for testing the usefulness of new types of information e.g. additional explanatory variables.

4.1.3. Semi-Structural Econometric

Semi-structural econometric models represent more of a balance between the theory-heavy nature of DSGE models and the potentially more *ad hoc* approach of large-scale models. The main differences seen in prevailing semi-structural models concern how households conceive of income and their consequent consumption behaviour. While a large-scale macroeconometric model might model consumption on the basis of current or past household income, a semi-structural model will more explicitly try to represent expected or permanent income (which must then be constructed as a variable, because it is not directly observed). This in turn implies a role for future expectations that must then be dealt with in the model. Such models are interesting because, alongside their macroeconometric features, elements of their behaviour are perhaps DSGE-like in having various options to model forward-looking behaviour, even if these models do not ultimately operate to strict microfoundations as DSGE models do.

Examples of such models include FRB/US (Federal Reserve Board, US) and LENS (Bank of Canada); as well as Saffier 3.0 (CPB, the Netherlands).

4.1.4. Comparison

The three model types elaborated above each feature trade-offs in their ease of implementation, flexibility, accuracy and understandability. The table below provides an overview of the benefits and drawbacks of each model type deemed to be of particular relevance to IFIs when considering whether a model type can meet identified needs.

Model Types	Benefits	Drawbacks
DSGE	- Underpinned by economic theory: Analytically traceable, making it possible to explain both how and why policy changes or other shocks propagate through the system. - Forward-looking: Expectations of the future determine today's outcomes. - Feature 'deep' parameters that are robust to policy changes and drive agent behaviour.	- Poor accuracy during shocks. The bigger the shock, the lower the accuracy. - Overly optimistic micro-foundations (e.g. full information) leave the models vulnerable to the Lucas Critique. - Assume that markets always clear and movement towards the equilibrium is ever present. - Exogenise shocks, even though shocks often arise from within the system.
Large-scale macroeconomic	- Capable of explaining much variation in historical data. - Let the data speak for themselves, with limited imposed assumptions.	<i>Ad hoc</i> in nature. - Historical data may be a poor reference for future dynamics. Without structural elements, it may prove difficult to provide a rationale for projections.
Semi-structural	A 'best of both worlds' approach between DSGE models and large-scale macroeconomics: Both a structural explanation for how and why an economy develops the way it does, while reducing the number of assumptions necessary for a DSGE model.	Shares the downsides of both DSGE and large-scale macroeconomic models. Which downsides shine through more depends on which model type a specific semi-structural model resembles most.

4.1.5. Practices in similar EU IFIs

The classes of model (and the accompanying examples) introduced above and discussed in the following sections are indicative of the types of models in use for macroeconomic-fiscal modelling and analysis. Before discussing those models in more detail, this section briefly considers practices in EU IFIs in MSs with similar characteristics as the three covered by this project. This section highlights how other such IFIs are, broadly, at similar levels of sophistication to those in this project.

As the European Fiscal Board (2023) highlights, methodological approaches vary across EU IFIs, with smaller IFIs tending to favour simpler methods for forecast assessment and endorsement. Such methods include qualitative assessments or comparisons between forecasts produced by other institutions (rather than by the IFIs themselves) to judge the national forecasts. The European Fiscal Board (2023) also found that around one-third of IFIs used in-house models of some form in their assessments and that just six produced their own budgetary forecasts.

In considering practices in IFIs in similar MSs (that is, smaller, open economies), possible comparators include:

- the other Baltic countries: Estonia and Latvia
- Slovenia, as an economy of similar size and which joined the EU at the same time (though Lithuania would adopt the euro somewhat later, in 2015, rather than 2007)
- other small MSs:
 - Cyprus, as another small island economy, like Malta
 - Luxembourg, a small economy with a (very) heavy emphasis on financial services

Of these countries, the approach in Cyprus (the Cyprus Fiscal Council), Estonia (the Estonia Fiscal Council), Latvia (Latvia's Fiscal Discipline Council) and Luxembourg (National Council of Public Finance) mirrors that in Malta, with the IFIs not currently in a position to produce their own complete independent forecasts. Instead, various forecast comparisons and descriptive assessments are carried out to gauge the plausibility of the forecasts and inform an endorsement decision. As for Malta, forecasts are sourced from a variety of national (e.g. central bank) and international (European Commission, IMF etc) institutions. As such, the development of a new

macroeconomic model in Malta would confer additional capabilities on MFAC, beyond what is currently in place in the other IFIs mentioned.

In contrast, the approach to forecasting in Slovenia bears a closer resemblance to what is currently in place in Lithuania. The Institute of Macroeconomic Analysis and Development (IMAD), one of two IFIs in Slovenia, constructs its forecasts on a component-by-component basis, much like NAO LT in Lithuania.²⁶ Individual components (e.g. output, expenditure, trade, labour market) are projected separately by a range of different methods (including a nowcasting model for the short term, for aggregates like GDP) and reliance on expert judgment before being brought together and reconciled to derive a final annual forecast to t+3 years. Published forecasts are produced to a somewhat higher level of detail than NAO LT's with, for example, tables of projected breakdowns of: gross value added by sector and the balance of payments. Of note, given the discussion in this report of forecast evaluation exercises, is that IMAD also publishes detailed tables of forecast performance (GDP growth and annual inflation) by various metrics, both for its own forecasts but also a variety of national and international institutions. Certainly in time, as more forecasts are produced, such in-house analysis would be possible, and efficiently so, using the new models to be developed for the three IFIs covered by this current project.

While not a feature of its endorsement function, the other IFI in Slovenia, the Fiscal Council, does operate a new (as of 2024) demographic model to conduct longer-term fiscal sustainability analysis.

4.2. Models Reviewed

We examined a range of macroeconomic-fiscal models to understand the ideal structure, leading practices, and key considerations related to model blocks. In contrast to the earlier scoping, the emphasis of this review shifted to single-country models, though other approaches/models are occasionally referenced as appropriate and the ECB-BASE model is looked at more closely. Our final selection of models reviewed consists of:

- One semi-structural model (FRB/US) and one large-scale macroeconometric model (the OBR macroeconomic model), to contrast the approaches along these dimensions.
- One multi-country, semi-structural model (ECB-BASE).
- Three models of small, open EU economies, with one being semi-structural in nature (Saffier 3.0) and two more macroeconometric (SMEC and STEM).

These models represent a selection of macroeconomic-fiscal models in use by different institutions and inform an indicative view of practices in other institutions. The review has not been exhaustive and has, instead, looked to pick out key features that will warrant further consideration during the practical (implementation) phase of the work to follow.

4.2.1. FRB/US (Federal Reserve Board, US)

FRB/US is a large-scale estimated general equilibrium model of the US developed by the US Federal Reserve Board (1996). In common with DSGE models, FRB/US represents households

²⁶ Note that, in contrast to the other IFIs covered by this review, the Institute of Macroeconomic Analysis and Development is responsible for producing the forecasts that then feed into the Ministry of Finance's analysis. A separate IFI, the Slovenian Fiscal Council, is responsible for assessing and endorsing the final forecasts from the Ministry.

and firms as optimising agents, albeit in a more flexible manner than a true DSGE model, and with equations that seek to better capture movements in the historical data. FRB/US is also more detailed than a typical DSGE model, with richer representations of the real, fiscal, and monetary sides of the economy. In the current context, FRB/US can be considered a semi-structural model.

Long-run expectations are an important anchor for the projections with short-term dynamics (deviations) arising from adjustment costs, on an error-correcting basis. A notable feature of FRB/US is its ability to consider alternative ways of forming expectations on the part of economic agents. Model-consistent expectations expressly reflect rational expectations in the sense that agents' expectations match the forecasts of the model itself. In contrast, a simpler treatment of expectations makes use of a smaller model, a vector autoregression (VAR) of past values but also long-run expectations of key variables, to which agents' forecasts eventually converge. How this relates especially to the consumption function is discussed below.

4.2.2. OBR macroeconomic model (Office for Budget Responsibility, UK)

The OBR macroeconomic model is a large-scale macroeconometric model of the UK economy (Office for Budget Responsibility, 2013). Originally developed by the UK's ministry of finance (HM Treasury), the model's main purpose is to forecast public finances to inform UK fiscal events (budget announcements). As such, the model has a detailed description of the monetary and fiscal sector, though many components are exogenous to the model, and sourced from government departments as needed when scrutinising budgetary plans. The domestic financial sector is treated separately in the model and equations follow an error-correction form to model both short- and long-run dynamics.

4.2.3. ECB-BASE (European Central Bank, EU)

The ECB's model is designed to provide a tool for forecasting and policy simulations for the Euro area as a whole. It draws inspiration from the FRB/US model and LENS, the model used by the Bank of Canada. The model is semi-structural, aiming to find a middle ground with a solid theoretical basis while maintaining a high degree of empirical fit and consistency. The model contains an extensive framework for the demand side (consumption, investment, government and exports), a framework for the supply side (capital and labour), a fiscal block (disaggregating various sources of revenue and spending) and a financial block (wealth, monetary policy, interest rates). ECB-BASE is designed to make flexible use of various auxiliary models. For instance, expectations either stem from agents knowing the full dynamics of the system (rational expectations) or from agents using limited information, as captured by a small-scale VAR model.

The ECB does not use ECB-BASE in isolation. Rather, it is part of a broader toolkit of models, which act as one another's benchmarks for consistency. As such, it is not the only model with which the ECB tests the potential effects of events such as monetary policy shocks, or global demand shocks. The model is used in tandem with models such as the New Area Wide Model. ECB-BASE ultimately always converges to a well-defined balanced growth path in the long run. In scenarios without a shock (the baseline), the main model properties are computed at this steady state, while shock scenarios are presented as a temporary deviation from this steady state.

4.2.4. Saffier 3.0 – The Netherlands Bureau for Economic Policy Analysis

Saffier 3.0 is the main macroeconomic model used by the CPB for producing short- and medium-term (up to five-year) macroeconomic projections and scenario analysis (see Bettendorf et al., 2024). The main equations in Saffier follow an error-correction specification by which variables gradually adjust back to their long-run equilibrium values (as a function of their explanatory variables). The model has been designed to operate under forward-looking expectations but current documentation available on the model suggests that expectations remain static in nature. Supply and demand constitute the major blocks of the model, with wages and prices acting as the stabilising mechanism. The exogenous treatment of the interest rates and foreign prices in the model is consistent with a ‘medium, open economy’ conceptualisation of the Dutch economy. While the public sector is described in considerable detail, Saffier 3.0 is used in conjunction with supplementary models that provide detailed analysis of the labour market, taxes and government spending, which are otherwise exogenous. In this regard, the CPB approach is better characterised as operating a suite of models, of which Saffier is the principal organising macroeconomic model. A series of forecasting rounds serve to compare and reconcile the results from Saffier (which is intentionally kept small in scope) with more detailed models to converge on a final forecast.

4.2.5. Simulation Model of the Economic Council (SMEC) (Danish Economic Councils, Denmark)

SMEC models the Danish economy as a small, open economy in which exchange rate, interest rates, and inflation expectations are determined exogenously (as in Grinderslev et al., 2023). Economic activity in the model is primarily demand driven in the short term, while long-run values are exogenously determined by structural levels of workforce and employment. Wages and price ensure equilibrium between demand and supply. However, sluggish adjustments lead to long-lasting effects following a shock. The model considers fiscal policy to be exogeneous but determines the public balance endogenously. Among its disaggregations, the model treats the housing sector separately. The model’s projection period focuses primarily on the medium-term (5-10 years) with the economy assumed to have returned to equilibrium by the final year.

4.2.6. Short-Term Quarterly Econometric Forecasting Model for Malta (STEMM) (Ministry for Finance, Malta)

STEMM is a medium-scale Keynesian model in which aggregate demand determines output in the presence of price rigidities in the short-term (see Economic Policy Department, 2019). It is the basis for the official macroeconomic projections, the fiscal projections and the fiscal targets of the Government of Malta. Most categories of the government revenue are determined endogenously. Behavioural equations are modelled in error-correction form with the exception of certain equations in the price block. The model helps analyse developments and evaluate the impact of economic shocks through quantitative simulations. However, STEMM has no long-term forecasting capabilities and can only perform ex ante analysis and simulation of three standard macroeconomic shocks (exchange rate, foreign demand, and monetary policy shock). In contrast to the other models reviewed, STEMM lacks an explicit supply side.

4.3. Model Blocks

The models examined encompass a variety of structures and variables. To summarise, we categorise the variables into several common model blocks. We begin with the components of total demand and fiscal elements, followed by additional extension model blocks. Within each model block, we discuss its fundamental function, highlight the key variables it contains, and outline the model options available along with the corresponding actions for their evaluation.

All the models reviewed share similar high-level features. That is, they all have some treatment of the following core components (blocks):

1. GDP and its breakdown by component of final demand, distinguishing, most notably household consumption, government expenditure, investment and net trade; representing the key macroeconomic outcomes from the model
2. The fiscal block, relating government outlays (expenditure, not all in the real economy) and revenues (e.g. from taxation) to derive deficit and debt indicators; as critical outputs from the model from an IFI perspective
3. The labour market, which determines employment (relevant to income) and unemployment (which may influence other variables such as benefits)
4. Prices and wages, which may curb expenditure and raise incomes, respectively
5. The financial block, which is not usually highly developed in such models
6. Production and the supply side, which determines sectoral output but also limits to production

4.3.1. Final expenditure

As an identity, final expenditure represents the components of GDP by the expenditure method, consisting of:

- Household consumption, as the largest component of final expenditure, driven by household income (which in turn relates to economic activity)
- Government expenditure, which must be at a level of disaggregation to inform fiscal analysis on the part of the IFIs
- Investment, composed predominantly of:²⁷
 - Gross Fixed Capital Formation (GFCF) as the largest component, representing investment in / acquisition of fixed assets such as plant and machinery, transport equipment and new dwellings and other buildings.
 - (Changes in) inventories, which is usually a small component of final expenditure but may be volatile depending on economic circumstances
- Trade, which is important to small open economies such as Lithuania and Malta, both in terms of:
 - Exports, which are sensitive to economic conditions in the rest of the world
 - Imports, to meet demand

Each of the above has different drivers, some of which may be external to the model (i.e. exogenous variables, such as economic activity in the rest of the world, which is an assumption that drives export demand) and some of which may be driven by variables that are determined

²⁷ The final component of investment (strictly, Gross Capital Formation) is acquisitions less disposals of valuables, which is small in most economies.

within the model (i.e. endogenous variables, such as income, which drives household consumption).

Of the above, household consumption, investment and trade are discussed below, with government expenditure discussed as part of the fiscal block.

4.3.2. Household Consumption

Household consumption is the largest component of GDP and final demand. The main (long-term) explanatory variables are usually some combination of real labour income and real financial wealth. In more traditional models (e.g. the OBR macroeconomic model), the typical approach is to use observed values of these concepts as the drivers, often with a long-run restriction/hypothesis that the elasticities sum to 1. This has the property that, in the long run, consumption moves with income.

More recent models (e.g. FRB/US and Saffier 3.0) build more explicitly from an optimal consumption theoretical framework and the concept of *permanent* (lifetime) income. In these models, some concept of permanent income must be defined and derived, as a (discounted/risk-adjusted) stream of future income. As well as being constructed, permanent income must also be projected for future periods, requiring some treatment of expectations into the forecast period. Options for generating such expectations include:

- Static expectations, as in the version of Saffier 3.0 documented in Bettendorf *et al.* (2021), with permanent income growing at a trend rate (e.g. matching the balanced growth path) and thus invariant to other developments over the forecast period.
- Model-consistent expectations, as one option in FRB/US. Here, agents' expectations are identical to the forecasts produced by the model itself. Households thus possess a detailed understanding of the economy (model) in which they operate such that their expectations are rational (in the technical sense).
- VAR-based expectations, again as an option in FRB/US. By this approach, households have some understanding of the economy, but one that is simpler than under model-consistent expectations.²⁸ A small VAR model projects future values to inform household expectations.²⁹

As in the earlier discussion of different model types, these more recent models are heavier on theory, requiring more effort to derive the necessary variables, which may be unobserved and reliant on further assumptions to construct (most notably in the application of discount rates to obtain present-value estimates of permanent income). A further complication of this approach is that it implies an absence of liquidity constraints. Liquidity constraints limit the amount that households can borrow, potentially preventing them from consuming in a way consistent with their permanent income. The prevailing approach, as in FRB/US, is to model household consumption as arising from a combination of lifecycle (as above) and liquidity-constrained households. The latter's consumption is more in keeping with the more traditional approach, based on current disposable income.

Most models implement some form of error-correction approach by which the steady state or equilibrium values above eventually prevail but with the possibility of short-term deviations

²⁸ The exception is the case in which VAR-based expectations coincide with the model, making them model consistent and rational.

²⁹ ECB-BASE (Angelini *et al.*, 2019) follows similar principles. Bettendorf *et al.* (2021) also detail a similar approach to constructing VAR-based expectations but that version of Saffier 3.0 continues to operate under simpler static expectations.

driven by factors such as shorter-term income fluctuations, borrowing costs (interest rates, mortgage payments) and unemployment.

The breakdown of household consumption varies with the more structural models focusing most on aggregate consumption while more econometric approaches may distinguish, for example, between durable and non-durable goods, and services (e.g. as in the OBR model).

The principal decisions about household consumption concern:

- The functional form of the equation(s), whether operating on more observed (e.g. real income, real wealth) or derived (e.g. permanent income) concepts.
 - If considering permanent income, the feasibility of doing so
 - For specifications that entail some explicit treatment of expectations, methods for projecting those expectations e.g. static, model-consistent or VAR-based
- The level of disaggregation in consumption, with large-scale macroeconomic approaches more likely to adopt (i.e. be more flexible to) disaggregated approaches.

At the current time, the more traditional large-scale macroeconomic approach is likely to be most feasible, especially with a view to forecasting, constrained by longer-term structural features. This will likely afford opportunities to also consider more disaggregated approaches to consumption.

Insofar as the modelling approach is meant to be modular, once a working consumption function is in place along these lines, we can discuss with the IFIs whether further scoping (feasibility testing) of more elaborate structures is worthwhile within the constraints of the current project.

4.3.3. Investment

As noted previously, the two main components of investment are Gross Fixed Capital Formation (GFCF) and changes in inventories.

GFCF is generally broken down into at least private and public investment, with the former usually determined by behavioural equation(s) and the latter most often treated as exogenous, to capture governments' stated investment plans.

Within private investment, some distinction between business and household investment is also common. In FRB/US, the OBR macroeconomic model, Saffier 3.0 and SMEC, desired business investment in the long run is related to output and relative costs, following the logic of profit-maximising firms / cost minimisation. This implies target levels of the capital stock. In terms of dynamics, the adjustment to long-run values may be augmented by current output (as an accelerator effect) and partially constrained by cash flow, to represent limits in access to capital markets (as in FRB/US, which introduces further sluggishness to the adjustment process).

The above approach to business investment contrasts with the treatment in STEMM, which determines long-run private investment as a function of expected return on investment (proxied by the stock exchange index), the long-term interest rate and exports (as a measure of economic competitiveness and/or external demand, both of which might increase attractiveness to foreign investors). Moreover, because investment is largely supported by imported goods, the corresponding investment deflator, to convert from real to nominal values, is linked to import prices. The treatment in STEMM is interesting in the context of a small, open economy because

it highlights how the nature of financing and production may play a role in determining the final specification.

Where modelled, investment in dwellings is usually some function of relative prices and costs of capital.

The level of detail in other investment breakdowns varies, with Saffier 3.0 separating public healthcare investment (drawing from the CPB's separate healthcare model) from other government investment.

Changes in inventories can be either handled as exogenous assumptions (e.g. in the OBR model, SMEC and STEMM) or according to some adjustment mechanism that seeks to achieve some target level of GDP (as in Saffier 3.0) or inventories (linked to business sector output, as in FRB/US).

The principal decisions about investment concern:

- The nature of the activity (output) and cost drivers to be considered, subject to an assessment of the relative importance of external financing, to inform the final equation specification(s).
- The level of disaggregation, with some distinction between private and public investment important, and with the breakdown by other categories to be scoped during the implementation phase.

4.3.4. Trade

The treatment of trade is more common across the models reviewed, with:

- Exports driven by external demand (weighted towards main trading partners) and measures of price competitiveness
- Imports driven by domestic demand and, again, measures of price competitiveness

As well as final domestic and foreign price indices, other relevant prices/rates include global commodity prices and exchange rates.

Two features of Saffier 3.0 that are of note are: its treatment of re-exports as a separate category from other exports; and the use of the CPB World Trade Monitor as an input to Saffier's trade projections. The treatment of re-exports recognises its large share of total Dutch exports while contributing comparatively less to value added compared to domestically produced goods and services.³⁰ The use of a dedicated trade model similarly highlights the role of overseas demand activity in the domestic economy and how a suite of models helps to keep the core macroeconomic model more compact.

Models differ most in their breakdown of categories e.g. in distinguishing goods (perhaps going further, to oil and non-oil goods) versus services. STEMM is relatively rich in this regard, breaking

³⁰ Compared to domestically produced exports, increases in re-exports have a much smaller impact on GDP and a larger impact on imports.

each of exports and imports down to nine (differing) categories. Similarly, in Lithuania, data on goods exports are usually disaggregated to:

- goods of Lithuanian origin excluding mineral products (around half of goods exports)
- re-exports excluding mineral products (around 35%)
- mineral products (around 15%)

Goods of national origin in Lithuania are largely agricultural and industrial in nature. Most re-exports flow from Western Europe to CIS countries. Again, the above represent breakdowns of relevance, and which might move differently under different conditions. These will need to be examined in detail during model development if such a level of breakdown is desired by NAO LT.

The main considerations in the specification of the trade block concern:

- The desired breakdown of export and import categories, to reflect components of most interest or importance in assessing future movements in the economy

4.3.5. Fiscal

The fiscal block encompasses government revenue, expenditure, and consequent public finance indicators relating to deficits and debt.

As macroeconomic-fiscal models, the models to be developed for NAO LT and MFAC must be detailed enough to support in-depth assessment of fiscal variables. In practice, this requirement translates to disaggregations corresponding to ESA 2010 (see Chapter 23 of Eurostat, 2013).

The treatment of the various categories of expenditure and revenue differs, with some determined exogenously, to reflect discretionary components usually set in government budgetary plans; while others are endogenous, reflecting non-discretionary components linked to economic circumstances (once relevant tax or benefits rates etc have been set). For example, gross capital formation is likely to be exogenous, representing decisions on the part of the government, while many taxes and social contributions will be determined by some rate (e.g. a tax or benefits rate) applied to the relevant variable (e.g. the corresponding tax base or unemployment). Rates are usually effective/average rates rather than the statutory rates, avoiding the problem of disaggregating tax and benefits schedules in detail (increasing model size and complexity) but at the expense of a certain degree of accuracy.

In the fiscal block, the table below lists the relevant categories.

Expenditure	Revenue
Compensation of employees (D.1)	Total taxes on production and imports (D.2)
Intermediate consumption (P.2)	Property income receivable (D.4)
Subsidies payable (D.3)	Current taxes on income, wealth, etc. (D.5)
Social benefits and social transfers in kind (D.6)	Net social contributions receivable (D.61)
Gross capital formation (P.5)	Current transfers receivable (D.7)
Capital transfers payable (D.9)	Capital transfers receivable (D.9)
Interest payable	
Net lending/net borrowing (B.9)	
Property income payable (D.4)	

Expenditure	Revenue
Current taxes on income, wealth, etc. (D.5)	
Current transfers payable (D.7)	

Decisions about the fiscal block will relate mainly to:

- Agreement about the necessary breakdowns, determined largely by IFI requirements and data availability
- The distinction between exogenous and endogenous components, which should be straightforward to agree with the IFIs

4.3.6. Labour

The labour block of an economic model usually distinguishes:

- Demand, arising from economic activity
- Supply, which follows from exogenous assumptions about (working-age) population with labour force participation modelled if possible, to reflect economic reasons for entering or leaving the workforce such as benefits and unemployment

Unemployment follows as the difference between the labour force (on the supply side) and employment (driven by the demand side).

As with other variables, it is common to separate private/market employment (endogenous) from public employment). Approaches to private employment vary, ranging from:

- Employment linked to output and productivity (SMEC) or aggregate hours and average hours worked (FRB/US)
- Determination as a function of sectoral value added and wages (STEMM) or by a similar approach, rooted more explicitly in a production function (Saffier 3.0)

Various approaches can thus be tried during development although much will likely follow from the selection of breakdowns on the production side.

4.3.7. Prices and Wages

There are various prices/deflators and wages that must be represented in the model.

Prices are often a function of different input costs (including labour and imports as appropriate) and sometimes productivity.

Where implemented, wages vary somewhat in their treatment e.g. in modelling wages along the lines of a New Keynesian Phillips curve (a function of inflation and unemployment) or a more wage-bargaining approach (considering productivity, unemployment and possibly a reservation wage or similar).

The final specification of the price and wage blocks will need to be economy-specific, drawing on existing country analysis as appropriate e.g. of inflation.

4.3.8. Financial Block

In contrast to the representation of the real economy, which is typically well-developed in macroeconomic models, the elaboration of financial components may vary and is often more limited.

Financial blocks may determine monetary policy (interest rates) but also other market rates and financial market performance, affecting bond yields, dividends (income) and wealth. Some of these elements are more difficult to model and so may be better treated as exogenous, with sensitivities / alternative scenarios as appropriate.

Both MSs use the euro as their currency and are thus tied to ECB monetary policy.

Most decisions about the financial block will likely relate to the extent to which financial variables (principally interest rates, maybe the stock market) affect other components of the model and whether these variables should be endogenous or exogenous.

4.3.9. Production / Supply / Potential Output

The counterpart to demand is production/supply. In terms of production, the key variables concern economic output e.g. GVA. The breakdown of GVA is often relatively limited, distinguishing key sectors (goods/services, public/private) and driven by a combination of domestic and foreign demand. As with trade, STEMM is relatively large in its disaggregation of sectors, identifying 12 sectors.

As well as sectoral output, the other key component on the supply side is some concept of potential output. In many models, the gap between actual and potential output (the output gap) may serve as a further adjustment mechanism. There are various approaches to estimating potential output, such as (see, for example, Ladiray *et al.*, 2003):

1. Direct measures, making use of survey data
2. Structural approaches relying on economic theory and econometric methods, whether by Structural VARs or production function-based approaches
3. Non-structural statistical methods, applying various detrending or decomposition techniques to analyse the business cycle

Where implemented endogenously in the models, structural approaches employing a production function appear most common, as in Saffier 3.0 (as well as ECB-BASE). This has the advantage of using information generated by the model for potential output to change over time. If implemented as exogenous projections, approaches can be more mixed in their approach (e.g. applying a combination of the above) with the corresponding disadvantage that potential output does not then change in response to model-based factors.

As discussed with the IFIs, the final models should have some endogenous treatment of the output gap but with the option to over-ride these values with an exogenous projection e.g. those already produced by NAO LT for Lithuania.

4.4. Summary

The model comparison exercise, as well as IFI discussion, highlights a few features of note for the implementation phase:

1. Agreement that an integrated model is desired to improve efficiency and consistency of the forecasting process, but with a need to be careful that the core model does not grow to a size that makes it unmanageable for relatively rapid application e.g. on the order of 2-3 weeks to produce a new forecast.
2. That the models implemented should feature structural properties, i.e. have their specifications determined by economic theory, to be able to project over the longer term, rather than being overly reliant on more autoregressive approaches, which only fare well in the short term.
 - a. In this regard, most models specify their equations as some form of error-correcting relationship with short-term fluctuations modelled alongside a gradual adjustment back to an implied steady-state/equilibrium path.
3. Given the IFIs' stated requirements (forecasting, including of detailed components, especially fiscal variables), a large-scale macroeconomic model does indeed appear suitable for the IFIs' purposes; and similar models are in use in other IFIs around the world.
 - a. There is no clear trend towards DSGE models in IFIs (perhaps reflecting the points above).
 - b. Large-scale macroeconomic models are relatively more straightforward to setup and expand, suiting an ongoing and long-term approach to model development and capacity in the IFIs.
 - c. Semi-structural models may be of interest, but are somewhat more complex and stricter on aspects of economic theory, which may represent a trade-off with the flexibility of large-scale macroeconomic models for forecasting and disaggregation. In any case, as mentioned above, large-scale models could be gradually extended with more semi-structural features in the future e.g. as in the consumption function

The table below summarises various design considerations for the implementation phase, with the proposed approach where known or relevant.

Variable	Options	Approach
Household consumption	Specification of relevant income/wealth: Current versus permanent income	Current income preferred initially. Scope to discuss and test feasibility of permanent income at a later stage
	Level of disaggregation in consumption e.g. goods/services, durables/non-durables	To agree and test individually with IFIs (always beginning with modelling the aggregate as a benchmark)
	Whether to construct aggregate consumption from disaggregate categories or specify equations to breakdown the aggregate	To agree and test individually with IFIs
	Role for expectations (in the forward-looking case)	Review as part of permanent income approach, if desired
Investment	Equation specification, bearing in mind possible external sources of finance	To agree and test individually with IFIs
	Level of disaggregation in GFCF e.g. private/public	To agree and test individually with IFIs
Change in inventories	Endogeneity or otherwise of stockbuilding	To agree and test individually with IFIs
Government consumption	Level of disaggregation	To agree and test individually with IFIs

Strengthening the Capacity of Independent Fiscal Institutions (IFI) | Review of existing analytical tools, methodologies (Deliverable 1A)

Variable	Options	Approach
	Distinction between exogenous and endogenous components	To agree and test individually with IFIs (but most should be exogenous)
Exports and imports	Level of disaggregation in exports and imports	To agree and test individually with IFIs
	Role and treatment of re-exports as required	To agree and test individually with IFIs (perhaps more relevant to NAO LT)
Government revenue and expenditure	Level of disaggregation	Largely following ESA 2010 / IFI requirements
	Distinction between exogenous and endogenous components	Should be straightforward to agree individually with IFIs
Labour force	Specification of employment demand equation(s)	To agree and test individually with IFIs (may follow from specification of output and sectoral detail)
	Specification of labour force participation rate	To agree and test individually with IFIs
Prices	Price drivers e.g. domestic versus foreign	To agree and test individually with IFIs, ideally informed by country-specific empirical work
Wages	Form of the wage-setting equation(s) e.g. wage-bargaining versus Phillips curve	To agree and test individually with IFIs, ideally informed by country-specific empirical work
Output	Level of disaggregation	To agree and test individually with IFIs according to identified sectors of interest
Potential output	Approach to on-model estimation	To agree and test individually with IFIs, but likely to follow a structural (production function) approach

5. MODEL DEVELOPMENT AND WORKPLAN

Whereas the previous three chapters have laid out more on the requirements and options for model development, this chapter sets out the practical considerations for the upcoming implementation phase. In the sections that follow we present:

1. The overarching principles that will govern our approach to implementation
2. A draft roadmap for model development that adheres to those principles, with the finer details to be agreed with the individual IFIs at the start of this next phase
3. The proposed workplan to deliver the implementation phase; again, with finer details to be agreed with the individual IFIs, balancing IFI-specific work with periodic cross-IFI information exchange given the likely similarities of the models in terms of both design (economics, equations) and implementation

For the most part, this chapter presents a common approach to both IFIs, in the sense that both models will be developed following a similar process. Nevertheless, the work below should be understood as two distinct programmes of work, but running to broadly similar timelines to jointly develop capability across the two IFIs. It is likely that there will be periods in which we are advancing work with one IFI slightly ahead of the other e.g. to reflect different availability over the course of implementation.

5.1. Principles

The next phase of the work is implementation, in which we will work with the IFIs to develop both new modelling tools and the capability in the IFIs to maintain and develop those tools independently. To achieve this, our approach to the next phase of the work, culminating in Deliverable 1B, will adhere to the following principles:

1. A **progressive model development strategy** to produce a series of model versions during the implementation phase, beginning with an early small/simple but, crucially, operable model which we will then expand with each subsequent version
2. **Automated workflows** wherever practicable, to support reproducibility of results and aid regular updates in the future
3. **Live technical documentation and user guides** to accompany each model release, tracking the models' specification and properties over time
4. A **version control system** in which to store the model and any supporting files

In doing so, we will ensure that all parties are building shared knowledge of the models, their features and uses. This process will provide a solid foundation for more formal capacity building in the phase that follows.

We discuss each of these principles below.

5.1.1. Progressive Model Development Strategy

Our model development strategy will prioritise the early production of a small but working model and accompanying infrastructure. The idea is that this will constitute a complete (if basic) modelling setup with:

- A model able to generate initial (crude) forecasts out to the required time horizon(s), consisting of:
 - an initial database to accompany this version of the model
 - estimated behavioural equations and identities
 - a restricted set of results e.g. for GDP and household consumption only
- Accompanying code for data collection (e.g. through an API) and processing to generate the initial database
- Accompanying documentation for this first version of the model

This initial model (the minimum viable product) will provide the means for a first handover exercise with the IFIs, to ensure that IFI staff are able, by some combination of documentation and hands-on sessions, to:

1. Deploy the model to their own machines
2. Run the model to reproduce the initial test projections
3. Re-run the data processing scripts to reproduce the database
4. Re-estimate the model to reproduce the parameters

In doing so, IFI staff will have, and be equipped to operate, a first version of the model early on in the process. This will establish a platform and mechanism for subsequent model versions. That is, once IFI staff are able to set up and run the first model, the process for future model developments should run similarly.

Various aspects of the models will need to be disaggregated e.g. to recognise that different components of consumption or exports influence the economy differently and/or behave or respond differently to economic activity, income or prices. In these cases the approach to building up additional detail begins with modelling the aggregate first (e.g. total household consumption) to establish a benchmark equation and see its effect on the expanded model. After that, we will then proceed to estimating the individual components according to disaggregations agreed with each of the IFIs. By following this approach we will be able to judge the disaggregated equations in isolation but also examine how they fare in the model compared to a simpler aggregate approach. Depending on the stability of the resulting model, this may also inform the specification of the individual equations.

From a technical standpoint, we will also run a set of test simulations to examine the model's properties. At this stage, and given the extent of the model implemented at this point, this is likely to amount to tests of exogenous increases in expenditure (e.g. government expenditure) or prices (e.g. consumer prices) to gauge the current model's responses. We will conduct similar tests each time we produce a new model version, to see how subsequent developments alter the model's properties. In this way, each subsequent release of the model can be viewed in terms of the functionality (model blocks/equations) added and the effect on the model's responses to adding that functionality. This will also serve as another form of knowledge transfer and capacity building, because all parties will be able to see how changes to the model affect its properties and, over time, build an understanding of the most important relationships in the model.

As laid out below (in Section **Error! Reference source not found.**, under **Error! Reference source not found.**), the aim during the implementation phase is to first develop a small working model and to then release a succession of further models, each expanding on the previous version. By ensuring an operable model throughout, the work will ensure that IFI staff are learning about the model's emerging properties on an ongoing basis, and in a way that facilitates ongoing application. In particular, we will begin running the model out to at least t+4 years and review longer-term projections to t+7 years at an early stage, to judge the effective time period over which the model can operate.

This approach will not only continually demonstrate how to operate the model but also how to carry out the various procedures (including data updates) that the IFIs will eventually need to carry out themselves.

While not a substitute for the formal capacity building phase, this approach will ensure that informal

5.1.2. Automated Workflows

Both IFIs expect to produce forecasts at least twice a year and with quick turnarounds on forecast production (in both cases, a matter of weeks each time).³¹ This emphasises the importance of efficient data updates, both to incorporate new data as they are released and any revisions to historical data. To do this effectively requires, as far as possible, an automated process to:

- Collect (download) the new data from their respective sources e.g. preferably using the APIs of the respective national statistics offices^{32,33}
- Process the data as required e.g. to construct or derive variables from the raw data as needed
- Assemble the data into a structured file format to for econometric estimation and inclusion in the model

While our current recommendation is that the models themselves are both implemented in EViews (as specialist econometric software that both IFIs are already familiar with), there is scope to tailor the data collection and processing pipeline to each IFIs' circumstances and preferences. From the inception phase, NAO LT already has capacity in R and this may be the preferred software package in which to implement the data pipeline.³⁴ The other main alternative to R is Python.³⁵ Both R and Python are open-source programming languages in widespread use for data analysis. Both have extensive libraries for data access and processing, and large active communities of users. As such, either would be well-suited for the data processing step prior to estimation and modelling in EViews.

³¹ Both IFIs intend to produce forecasts twice a year with, in the case of:

- NAO LT: in exceptional circumstances, forecasts up to four times a year
- MFAC: an interest in being able to produce four forecasts a year, even if some are for internal use only

³² Statistics Lithuania provides a RESTful API through its Official Statistics Portal to retrieve data:
<https://osp.stat.gov.lt/web/guest/rdb-rest>

³³ The Malta National Statistics Office also provides a RESTful API through its Statistical Database:
<https://statdb.nso.gov.mt/>

³⁴ <https://www.r-project.org/>

³⁵ <https://www.python.org/>

As below, either programming language would involve writing code that is straightforward to store in a dedicated version control system.

As far as possible, we will implement automated workflows by which IFI staff can reproduce and update the models' databases with as few code changes as possible. This will permit efficient data processing and, as needed, programmatic checks and comparisons between old and new vintages of the resulting database.

In the case of NAO LT, we expect to work with R for the data processing, on the basis that the team is already proficient in this programming language.

For MFAC, with no strong knowledge in either programming language, Python is the suggested, and slightly more accessible, option to build capability quickly.

5.1.3. Live Technical Documentation and User Guides

Model development is an ongoing process with the final design of the model evolving over the course of the implementation phase. As such, while the broad shape of the model development plan is laid out in this document, it will be important to maintain a live set of documents that track the implemented model over time.

We currently expect the documentation to accompany the models to consist of:

1. The technical specifications of the model, for reference, detailing:
 - a. the overall structure of the model and its constituent equations
 - b. the theory and interpretation of the model and its equations
2. One or more user guides that describe standard operations and procedures to maintain and develop the model including the following use cases:
 - a. how to update the model database
 - b. how to update assumptions
 - c. how to generate a new forecast and/or scenarios or sensitivities

Both documents will be 'live' in the sense that they will evolve alongside the gradually developing model. Each release of the model will be accompanied by an updated set of documentation reflecting any changes since the previous version.

As below, formatted documents (e.g. in Microsoft Word) are not so amenable to storage in version control software. Instead, our approach will make more use of Microsoft SharePoint to share and collaborate on draft versions of the documentation, periodically 'releasing' the next version to accompany a given release of the model. Each successive version of the documentation will detail any changes or new developments to the model and procedures. Older versions will be archived accordingly, to be able to refer back to earlier documentation as appropriate. **Version Control System**

An important aspect of model development is keeping track of model versions. Each version of a model will consist of a specific set of code, data and other files (e.g. documentation). During development under this project, each discrete model version will represent a further expansion of the model to increase its scope and functionality; as well as new data as the project progresses. The same will apply beyond the project as new versions of the model are developed

and, crucially, new forecast vintages are produced by the IFIs. This emphasises the importance of a system with which to track model versions over time, to be able to examine changes and, as necessary, recover older model versions.

For this purpose we will use specialist version control software to store the models. There are various candidate solutions in this regard, with Git and Subversion among the most popular options.^{36,37} Considerations when selecting version control software include:

- useability for non-specialists i.e. economists who may not need to work intensively with the software on a daily basis
- prevalence among the wider community, with a preference for tools that are heavily used by a wide range of users, and thus well supported and with extensive help/documentation available online
- how/where the version control is to be hosted, whether on IFIs' own servers or in the cloud³⁸

Version control systems are most suited to text files because changes can be tracked efficiently at the level of individual lines/words/characters, because it is the changes that are logged. This makes these systems suited to content such as code (e.g. Python/R scripts and EViews program files) and plain text data (e.g. CSV files and related file formats). Such systems are less suited to binary files such as zip files, Microsoft Word documents and Microsoft Excel spreadsheets, because changes cannot be stored as changes in the same way. These files must instead be stored as replacement files each time. For this reason, we expect to largely keep such files separate from the main code repository, with various options for storage available. Documentation is likely to be best stored separately (e.g. for now, in the project SharePoint folder, in separate folders per IFI) while we may choose (with agreement from the IFIs) to implement a separate archiving system if databases (and their vintages) are to be stored in a binary format. Further discussion of the setup will follow when we kick off the implementation phase with the IFIs.

Our current proposal is to use Git, with the models stored on private repositories (owned by the individual IFIs) and held on GitHub (i.e. in the cloud). This can be discussed/revised in the early stages of the implementation phase. The main consideration with this approach is confirming the IFIs' policies with respect to IT and storing code outside of their own systems i.e. on GitHub servers.

Discussions with both IFIs indicate no strong expertise in version control systems and we will ensure adequate training to make best use of whichever software is agreed.

As above, for accessibility, we currently propose to store technical documentation separately to the model code. We will consider the same for data files that may not be so amenable to dedicated version control software.

³⁶ <https://git-scm.com/>

³⁷ Apache Subversion: <https://subversion.apache.org/> Though it is common to use separate client software such as TortoiseSVN: <https://tortoisesvn.net/>

³⁸ As below, the prevailing version control software is currently Git, with the most popular online hosting option being GitHub. GitHub provides a solution for storing Git repositories in the cloud (importantly, on GitHub's own servers) with various supporting features to aid software engineering tasks such as issue/bug tracking and feature development (and subsequent merging/integration). It is important to be aware that storage on GitHub entails storing code and possibly data on external servers held by GitHub.

5.2. Approach

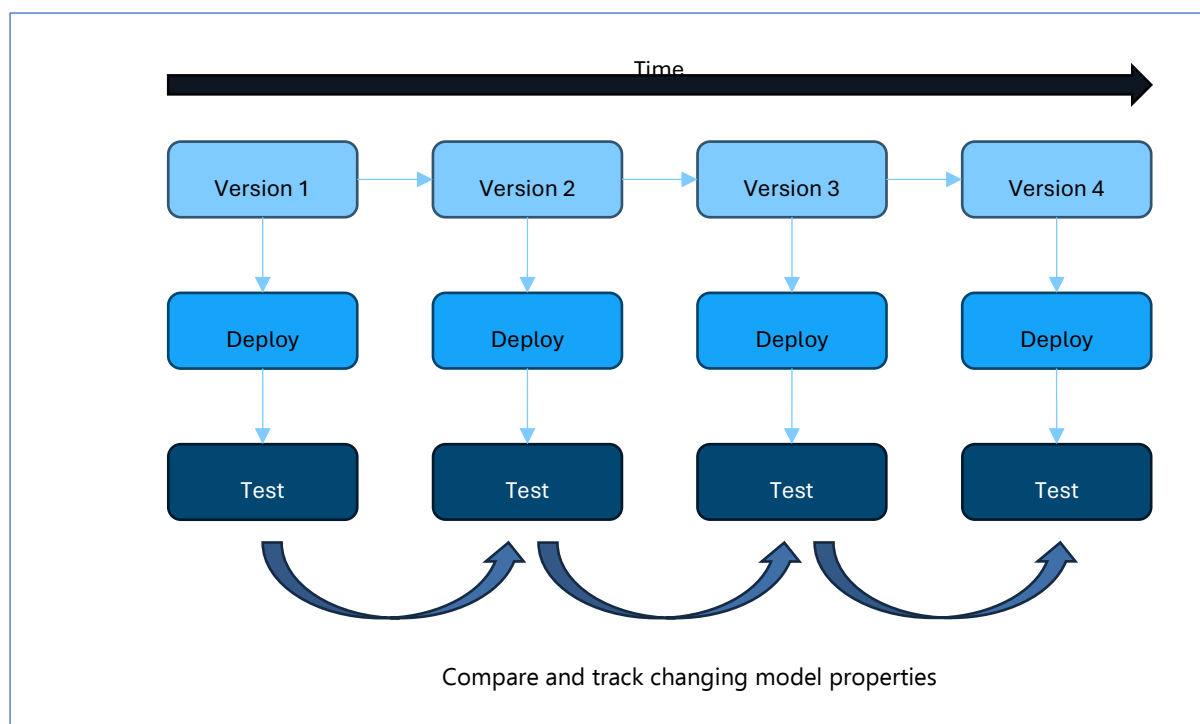
As set out above, our initial aim is to develop a first working version of the model that, while missing many of the blocks that will eventually make up the final model, will be operable at an early stage by IFI staff and the project team. This will provide a platform with which to kickstart handover (because we aim to equip staff to run at least some version of the model early on) and to track the evolution of the model's properties over time i.e. how adding new components that increase the number of endogenous variables and feedbacks leads each expanded model to behave differently in response to the same changes in inputs.

By this approach, a working model should satisfy the following requirements:

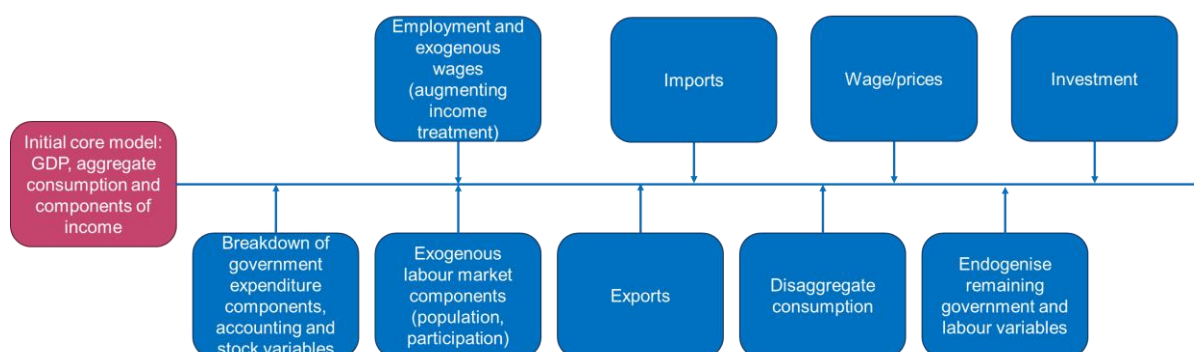
1. In a state that it can be deployed to a user's machine in the same way as the eventual final model i.e. following a standardised set of procedures that can be tested and refined
2. Implement a working pipeline (whether in R or Python) to download and process raw data into the required format for the model
3. Be ready to (re-)estimate an initial set of equations based on the input data
4. Generate an initial forecast (however crude) in the required format along with test simulations as agreed (e.g. exogenous increase in government expenditure, price shock etc)

Having established these features in the first working version (which may take some additional time and effort at an early stage), there will be firmer foundation on which to extend the model in collaboration with the IFIs.

Initial work on a new model block will involve examination of the equations in isolation, assessing various estimation diagnostics including parameter stability, and in-/out-of-sample forecasting performance. Having tested the equations in this way, the block will be integrated into the model and its effect on the system will then be assessed. This may necessitate the imposition of parameter restrictions either for stability (e.g. to ensure lagged responses do not amplify earlier shocks or are otherwise explosive in nature) or theoretical reasons (e.g. in testing or imposing unit income elasticities of consumption in the long term). Successive model versions will then be deployed to the IFIs and discussed/presented to show how the models' properties change over time.



An indicative sequence of model development might look as follows, with our preference to begin with the main loop that combines household expenditure, production and income with other components of final demand initially exogenous. This would cover the majority of final demand (i.e. the consumption function) and yield initial projections of GDP, as a core variable. Further work would then more fully specify the fiscal block (as an area of key interest to the IFIs), gradually adding and endogenising variables to expand the model.



The sequence of model developments (and when enough blocks would be added to constitute a next version of the model) is currently tentative and may change or be resequenced in response to what is learned at each step. The current rationale behind the above is as follows:

1. An initial core model that relates GDP, income and consumption will cover the largest component of final demand and thus show movements once components of GDP are added exogenously, for a crude first simulation e.g. of higher government expenditure or price increases
2. An initial breakdown of exogenous government expenditures and accounting will begin to build up the key fiscal variables of interest, to see how they then change as the model's components are increasingly endogenised

3. Exogenous labour market variables and wages serve as a precursor to endogenising employment demand, thus completing the initial loop of consumption to production to employment
4. Exports and imports will then build out further components of final demand
5. Further steps (not all shown, for reasons of space) will then gradually fill in further details to monitor how the models' properties change

Each step in the model development will involve a concentrated period of time devoted to that block, with preparatory time beforehand (in collaboration with the IFI) to agree scope and matters like desired disaggregations etc.

5.3. Workplan

Implementation, culminating in Deliverable 1B (upgraded / newly developed analytical tools) is currently scheduled to run over a roughly 12-month period, although the expectation is that model development (refinement) will continue into the third phase and Deliverable 1C: capacity building and further documentation.

This section sets out the proposed workplan (in draft) to carry out the model development following the approach and principles set out previously.

5.3.1. Tasks

Task 1: Confirm Technical Requirements, Workplan and Next Steps

The implementation phase will begin with us confirming, with each IFI, the workplan and technical requirements, as well as points of contact and desired attendees at different meetings (see Section 5.3.3). The technical requirements will concern, in particular:

1. Final agreement (or otherwise) of EViews or R as the preferred software for the model
2. Confirmation of the preferred programming language to implement automated data updates:
 - a. NAO LT: R
 - b. MFAC: Python
 - c. HFISC: R and Python
3. Agreement on the version control system and procedures for collaboration

From a modelling standpoint, we will also seek to confirm the scope of the first version of the model (which, as above, would very likely begin with the consumption → GDP → production → income loop).

We will also confirm the milestone of the first model version and make arrangements for first handover and in-person workshops.

Task 2: Early Work on Data Pipeline for First Model Version

Following agreement to proceed, we will begin to develop the automated pipeline for downloading and processing data in the required format. This will focus initially on the variables covered by the first model version and ensure that new variables are convenient to add to the pipeline, that new periods can be easily added, and, wherever deemed appropriate, outputs and checks aid comparisons of old and new data vintages.

Note that we will also consider including some further variables for later blocks, as a test of potentially more complicated equations, to determine relative merits of annual versus quarterly data.

Task 3: Test Estimation for First Model Version

With the initial dataset collected and processed, we will carry out initial estimation of the equations, focusing in particular on the consumption function (both aggregate and disaggregate) and, potentially, a small number of equations not directly relevant to the first version of the model. The reason for the latter is that, within the first 2-3 months, we aim to have decided with MFAC as to whether the model for Malta is better elaborated at quarterly or annual frequency.³⁹ To make an informed decision, we will agree, say, two further equations to test at both quarterly and annual frequency e.g. employment (as a key component of a macroeconomic model) and wages or prices (as equations for which inference is frequently more challenging). In doing so, we will have more information as to the quality of the data and availability of sample sizes for estimation.

This part of the work will thus:

- Begin the empirical work on the model's equations
- For MFAC: Inform a final decision as to the use of quarterly or annual data

Task 4: Develop First Model Version for Testing

With the initial equations now estimated and reviewed in isolation, we will proceed to bring the equations together into a system (first model) to examine the overall performance of the model and conduct initial simulations as described previously.

Task 5: Deploy First Model Version

While we will have previously shared elements of the model and documentation, this next task is to more formally handover the first version of the model as a complete package, including data pipelines etc.

We consider this an appropriate stage to provide a fuller training session/workshop in person to each of the IFIs. This will cover training in setting up the model, running a data update, (re)estimating the equations and then running the model to view its outputs.

We will agree the timing and format of the workshops with each IFI but would suggest that such training would running over 2-3 days, with the option to then work with the IFIs on the early part of the next model version.

Note that around this time (September/October), we expect the NSOs to release a new set of benchmark national accounts, which may lead to revisions in the data and changes in base years etc. This will serve as test of the modelling setup, with an opportunity to:

- test and update the automated data processing system in light of a combined data update and revision
- re-estimate the current models' equations on the revised data, and their implications for parameters and model properties

³⁹ For NAO LT, the requirement for quarterly frequency in the short term has already been confirmed.

As well as the handover and training materials, this task will also produce a first ‘lessons learned’ document of issues and other points to consider as we continue the model development.

Task 6 /Continuation: Ongoing Rounds of Model Development

Having successfully deployed the first version of the model with a small number of blocks implemented, the remainder of the implementation phase will proceed in the iterative manner described previously, in collaboration with the IFIs:

- Scoping (prior to commencing a new round of model development): Agree the block(s) to be added to the next model version, including:
 - exogenous and endogenous variables
 - desired disaggregations, following further discussion and data assessment in conjunction with the IFIs
 - equation specification(s) to be tested
 - Update the data pipelines to extend the model database
- Carry out estimation and single-equation testing to determine the preferred equations
- Carry out system-level testing to see how the expanded model’s properties have changed
- Update documentation and handover the next version of the model to the IFIs for testing

The balance of work between the project team and the individual IFI staff in carrying out the above will be agreed each cycle.

Depending on IFI availability and the number of blocks to be added, a new version of the model may take, indicatively, 6-8 weeks to produce. With time in between to confer with the IFIs and review the results, we would suggest at most 2-3 full further model versions (complete for deployment with accompanying documentation) over the period, although we would of course share interim versions with the IFIs more informally in between those releases, once staff are equipped to access the relevant repositories.

5.3.2. Meetings

Regular meetings

We propose the following regular meetings during the implementation phase:

1. Individual IFI meetings: Minimum once per month, focusing on operational and technical matters
 - a. These will discuss IFI-specific matters and be more technically focused e.g. covering data issues (variable definitions, units and API considerations).
 - b. Progress updates will look to review the IFI-specific workplan and risks on an ongoing basis and agree any next steps or actions to continue advancing with the work.
 - c. We suggest fixing a regular time each month for these calls with the option to reschedule relatively easily as needed, given the likely smaller group for these calls.
 - d. During periods of greater intensity and/or IFI availability, there is the option for more frequent or longer meetings to make more rapid progress, which we will review with the IFIs as needed.
2. Cross-IFI meetings: Once per month, focusing on peer/IFI learning and knowledge exchange

- a. These meetings will bring the IFIs and project team together to discuss broader lessons learned and share ongoing experience of the development process.
- b. As applicable, comparative properties of the models, especially with respect to responses (multipliers/elasticities) and forecasting performance (out to t+4 and/or t+7 years), to improve understanding of key drivers and parameters and models such as these.

In all cases, we will book a full set of meetings early on in the project, to ensure as much notice as possible. We will prepare an agenda in advance of each meeting and note actions following the meeting (in many cases, leading to changes being reflected in live documents and notes).

Workshops and Other Training (In Person)

We currently propose one workshop to support handover of the first working release of the model. We propose that these workshops take place in each of Lithuania and Malta for 2-3 days each, to provide training in setting up, updating and running the model. As well as discussing the models to date and next steps, these may also afford an opportunity to work together on various aspects of the model development.

Given the proposed timetable and IFI commitments in September, our proposal is to run these first workshops in late August (MFAC) and the first half of October (NAO LT).

We have not currently proposed a further in-person workshop but this may be useful in the second half of the 12-month implementation phase e.g. in March for MFAC and April for NAO LT, between or ahead of periods of higher workload. We suggest confirming interest and plans towards the end of 2024 to gauge the purpose and usefulness of a further workshop at that time. It may be that this serves as a useful time to more fully simulate a data or forecast update using a more complete version of the model but, equally, this may be better deferred until the more formal capacity building phase.

For HFISC we propose to organise a workshop in autumn 2025, once we have a working version of the model.

6. NEXT STEPS

Subject to clarifications and any further approval, the next steps are to begin work on the next phase of the project: implementation (Deliverable 1B).

As in the previous chapter, the first task in implementation is to clarify the IFI-specific workplans and timetable with the respective IFIs, certainly in detail to the end of December 2024, with key actions as follows in each case:

1. Agree software selection, initial setup and collaboration arrangements
2. Agree scope of first model version
3. Confirm contact points, working group and meeting schedule (to also fit cross-IFI meeting schedule)
4. Begin planning for the respective workshops

Subject to agreement, the implementation phase will then commence in earnest.

6.1. Outputs

The outputs of the next phase consist of:

1. Deliverable 1B: Technical report(s) on the upgraded / newly developed analytical tools and accompanying technical documentation
2. In support of the above, for each IFI individually:
 - a. Operable models for IFI staff to make use of, in readiness for more formal capacity building in the phase after (Deliverable 1C: Capacity building)
 - b. Supporting software infrastructure (especially for data updates) to enable ongoing use and updates to the models

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