Technical assessment of the Scottish Fiscal Commission's methodologies

by Scott Cameron[1]

Overview

The Scottish Fiscal Commission (SFC) has a central role in Scotland's new fiscal framework, with responsibility for producing the official forecasts for GDP, devolved taxes, and devolved social security expenditure. This technical assessment informs and accompanies the OECD Review of the Scottish Fiscal Commission 2019. It looks in depth at the models and methods used by the SFC, assesses their suitability using the OECD's technical assessment framework, and highlights any areas for further development.

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The OECD's technical assessment framework for independent fiscal institutions (IFIs)

The review team assessed the Scottish Fiscal Commission's (SFC's) tools according to the technical assessment framework for IFIs developed by the OECD's Public Governance Directorate. That framework answers the question: are the IFI's tools appropriate to deliver its mandate?

For the review team to provide an opinion on the appropriateness of an IFI's tools, the assessment framework weighs both academic and practical considerations. The former challenge whether a tool would hold up to peer review in a scientific forum. The latter challenge whether a tool is fit to serve the day-to-day activities of the institution in its mandated role supporting the executive, legislature, and other stakeholders. The practical work required of an IFI can differ considerably from a university economics department in goal, timeframe, and resources.

In some cases, academic and practical considerations are complementary. In others, they conflict. For example, a goodness of fit test may conclude that an economic variable regarded as a key policy lever or source of risk should be excluded from a forecasting equation (if, for example, it adds more statistical noise than explanatory power). However, budget planners regard forecast accuracy as just one of their objectives. Fiscal outlooks are first and foremost a planning tool. A legislature cannot adequately plan if an IFI's outlook does not capture key policy levers and risks in a convincing narrative, even if including such variables in the modeling means accepting inferior out-of-sample forecast performance compared to alternative specifications. Both academic and practical considerations are an important basis on which to judge a tool, and often an IFI must strike a balance between these tensions.

The technical assessment framework also compares an IFI's tools to the practices of other institutions in the OECD's networks. While a tool's popularity does not guarantee its merit (the consensus can be wrong), it is nonetheless a strong indicator of whether the SFC's clients can be confident that they are receiving analysis on par with other legislatures and governments.

The OECD's technical assessment framework is not a line-by-line audit of model code nor a complete model-selection exercise comparing candidate specifications and performing out-of-sample validation. To do so would be beyond the capability of a small group of external assessors in a short timeframe. Further, macro-fiscal forecasting and policy modeling is a human process replete with judgement in each round of a budget cycle. A periodic external assessment cannot take the place of an IFI's other legislated channels of accountability (in the SFC's case this is regular scrutiny by the Scottish Parliament, academic commentators, and the public). The review will nonetheless identify any models or analytical decisions by SFC staff that are not suited to their purpose, fail to advance the SFC's mandate, or do not adhere to the OECD Principles for Independent Fiscal Institutions.

Assessment criteria

The framework assesses the technical fitness of an IFI's macro-fiscal analysis tools across seven academic and practical criteria that correspond to questions an IFI should reflect upon when choosing the tools to deliver its mandate (Table 1).

Table 1: assessment criteria

1.	**Theory**	Does peer-reviewed literature support (or not provide a strong argument against) this tool for the analysis, given the available data and sample size?
2.	**Accuracy**	Is this tool likely to give accurate results (or avoid systematic bias) if applied to this problem?
3.	**Communication**	Can the tool's outputs be convincingly communicated to stakeholders?
4.	**Transparency**	Can the tool's methodology and assumptions be provided to the IFI's stakeholders in a manner that will satisfy requirements for transparency and accountability?
5.	**Proportionality**	Are the resources devoted to this tool proportionate to the activity's weight in the IFI's mandate and its materiality to the public finances?
6.	**Sustainability**	Does the tool require a level of expertise that is appropriate to expect from IFI analysts to avoid revisions as the result of staff turnover or the gradual erosion of the model's performance over time?
7.	**Precedent**	Is the approach used widely at other IFIs and public finance institutions?

Adapting the framework to the SFC's context, institutional setting and mandate

Because IFIs fall across a spectrum of roles and responsibilities, the assessment criteria above must be adapted to the Scottish context and specified in terms of the SFC's institutional arrangements and primary and secondary governing legislation, as well as its memorandums with other government agencies and discretionary operating guidelines it has set for itself.

The main references the review team used to adapt the framework for the SFC include, among others:

- **Fiscal Framework Agreement**: The agreement between the Scottish government and the United Kingdom government on the Scottish government's fiscal framework, February 2016 [Link]
- **SFCA**: The Scottish Fiscal Commission Act, 2016 [Link]
- **SFC Framework Document**: Scottish Fiscal Commission Framework Document: Agreement between the Scottish Ministers and the Scottish Fiscal Commission, September 2017 [Link]
- **SFC-ScotGov Engagement Protocol**: Protocol for engagement between the Scottish Fiscal Commission and the Scottish Government, March 2018 [Link]
- **OBR MoU**: Memorandum of Understanding between the Scottish Fiscal Commission and the Office for Budget Responsibility, January 2019 [Link]

Below describes how each criterion in Table 1 has been adapted to reflect the SFC's context and mandate.

1. Theory

This criterion asks whether a tool is grounded in a bedrock of peer-reviewed literature and would hold up to academic scrutiny. Although there is not often a consensus on a theoretically 'best' approach for a given macro-fiscal procedure, there are often approaches that are rejected, for reasons such as poor performance with low-frequency data and limited sample sizes, or that have been shown to be fundamentally flawed (for example certain regression specifications with nonstationary data).

Section 2(e) of the *SFC Framework Document* requires the SFC to make its forecasts "available to academic commentators for scrutiny." Such an explicit requirement to produce work that will withstand academic scrutiny is relatively unique among IFIs, and the review team will accordingly place a substantial weight on this criterion when determining the overall level of appropriateness of a tool.

For macroeconomic forecasting, Scotland's low-information environment will be an important consideration for model selection, choosing only the subset of methodologies that are able to contend with limited data with limited history and limited power of statistical tests.

For fiscal forecasting, model selection will be somewhat more flexible, as some finely grained administrative data is available, either sampled or from the universe of administration files.

There is significant tension in economic modelling theory between choosing models for forecasting and models for policy analysis, as both have different objective functions and demand different specifications. For example, if the sole goal of a model is to produce the best forecast, structural economic relationships grounded in theory should only be used if they improve forecasting performance. Otherwise, they should be ignored (see Blanchard, 2017).

If, however, it is important to capture the government's policy levers and the economic environment to produce a useful planning framework, it is necessary to build models that fully and accurately capture the structural relationships between causal policy parameters and economic determinants, even if it means sacrificing forecast performance.

The SFC's mandate emphasizes both considerations: providing accurate forecasts and providing the planning framework for budget preparations. Its model selection choices must therefore be evaluated on balancing the twin theoretical goals of capturing dynamics to provide accurate forecasts, along with capturing enough structure to trace the effects of policies and shocks.

The review team also relied upon research and guidance from supranational organisations such as the EU in Leal et al (2008) and the IMF Institute for Capacity Development (2013) that prescribe best practices for theory-based model selection in macro-fiscal frameworks.

2. Accuracy

This criterion draws on academic research and practitioner experience to determine whether a chosen tool is likely to be more accurate compared to other model options for the application. The review team also considers the IFI's model selection performance tests and forecast assessments where available in published research papers or provided on background.

Following Musso and Phillips (2002), the review framework evaluated the accuracy of the SFC's macro-fiscal tools along two dimensions: (1) the quantitative magnitude of forecast errors as measured by the mean error, the mean absolute error and the root mean squared error, and (2) the ability to predict direction of change in final outcome.

The team also considered whether the model's specification and workflow were chosen to avoid three common types of fiscal forecasting errors: policy errors, economic errors, and technical (behavioural) errors, as in Auerbach (1999).

Finally, the team considered whether a tool or procedure was likely to be structurally biased. A model's forecast accuracy will be context-specific and no one model will be correct under all circumstances. However, it will often be obvious if a technique it likely to prove structurally biased over the forecasting horizon (for example, if no adjustment is made for non-compliance in an identity-based tax revenue model, the forecast is likely to be persistently optimistic).

The financial health of the Scottish Finances is tied directly to the accuracy of the SFC's forecasts, particularly the income tax forecast, in a manner that is unique among IFIs. The mechanisms laid out in the *Fiscal Framework Agreement* for assessing Scotland's block grant adjustments and reconciling forecasts to outturn, combined with Scotland's limited borrowing powers, create atypically severe fiscal planning consequences for inaccurate forecasts. This criterion will therefore have a greater weight in determining the model's aggregate score than a typical IFI assessment, where moderate shortfalls or windfalls from forecasting errors may only have a minor impact on cash and debt management strategies and may be an acceptable tradeoff in favour of better communication and transparency.

That said, the forecasts produced by the SFC for fiscal planning must by necessity be conditional forecasts. Holding a conditional forecast to account based on accuracy is problematic, as it depends on a confluence of unforeseeable and unobservable factors:

- Conditional economic data is estimated and may be inaccurate.
- Economic inputs are revised, and vintages are not always available.
- Fiscal forecasts are very sensitive to the cyclical position of the economy. The output gap is not observable, and its estimation frequently changes. It will never be known with certainty, even after the fact—that is, there will be no 'actual' on which to recondition the model and evaluate the forecast's accuracy.
- Controlling for changes in announced policy actions or the appearance of non-announced policy measures means estimating the cost of policy changes, many of which are never known with certainty.
- Accounting methods change. Historical data may not have been collected to restate past results and there may be no "actuals" available to assess the forecast.
- There are significant lags in the availability of fiscal data. Outcomes for several tax categories do not appear for several years. By the time actual data is available to evaluate a forecast, the policy and economic environment is likely to have shifted such that a model revised to fit that data is no longer appropriate.
- Aggregation masks moving parts. Was the forecast of total income taxes accurate or did large errors in the tax liabilities of pensioners offset the errors of wage earners?
- Professional judgment plays a crucial role in forecasts. The information set when generating forecasts is much smaller than available when performing *ex post* comparisons. It is impossible to go back and determine exactly which information sets were available to analysts when applying judgment.

Considering these problems with forecast assessments of conditional forecasting tools, the assessment team does not place a high weight on *ex post* forecast results, but does attempt to provide an opinion about whether, *ex ante*, the tool could be expected to perform well in applied macro-fiscal frameworks.

3. Communication

This criterion measures how easily the model and its results could be explained to stakeholders. Models that are simple, causal, and intuitive for non-specialists to interpret will score highly. Those that describe behaviour using univariate time-series methods or a black box of latent, or unobservable, forces inferred by the co-movement of many stochastic series (e.g. dynamic factor models) will score poorly.

The SFC's core responsibility, as laid out in the *SFCA*, secondary legislation and memorandums is to "inform the Scottish budget" during several fiscal events throughout the year. Specifically, the Commission must provide its five-year projections of devolved revenues, social security spending, and the macroeconomic environment to Scottish Ministers, the Scottish Parliament, and the Scottish public along with detailed commentary on the outlooks and how they were derived.

Further, the *SFC-SG Protocol* requires the SFC to provide opportunities for the Scottish Government to comment on the SFC's forecasts before they are published. For the government to adequately comment on the outlook would require the SFC to adequately explain it. The more convincingly the model's results may be communicated, the less likely the Scottish Government will comment on it unfavourably.

Finally, the Scottish Government is prescribed by legislation to base its budget plan on the SFC's forecasts (or must justify a departure from it). This requires the SFC's models to have outputs that have an internally consistent and intuitive economic and fiscal narrative, with enough context and causality that budget drafters can provide a convincing story to the public. That is, they should be causal and structural models (rather than purely time-series statistical models).

4. Transparency

This criterion measures how readily a model's inner workings could be published so that its results could be repeated by an external researcher, to the extent required by the IFI's legislation and operating guidelines and the degree to which the institution strives to conform to international guidelines on IFIs and budget transparency. Models of which the IFI has full intellectual ownership and understanding, that use open-source software, and that rely on little judgment, or at least structured judgment that can be readily published, will score highly.

The SFC is required, under Subsection 2(3) of the *Scottish Fiscal Commission Act 2016* to " include an explanation of— (a) the methodology used by the Commission, and (b) the factors which have been taken into account including, in particular— (i) the assumptions which the Commission made, and (ii) the risks which it considered to be relevant."

Further, Subsection 2(6) grants additional powers to the SFC to publish assumptions for the sake of transparency.

> *Reports prepared under this section may include such other information relating to the forecasts, assumptions, projections or assessments being made as the Commission considers appropriate.*

Finally, Section 8 of the *Protocol for engagement between the Scottish Fiscal Commission and the Scottish Government* requires the SFC to "publish alongside its forecasts a detailed explanation of the methodology used and of factors that it has taken into account, in particular assumptions and risks."

There is room for interpreting the definition of methodology and assumptions. It could range from a high-level overview to providing the full model code and datasets. However, given that explanations

are required to be "detailed" and the Commission has the legislative flexibility to be as transparent as they wish, we will hold the models that the SFC chooses to a high *conceptual* standard of transparency.

A high conceptual standard of transparency requires models to be in free, open-source (or widely available) software, have workflows that can permanently archive data vintages and model iterations so that precise results may be duplicated by external stakeholders in the future, and rely only upon judgment that can be documented for posterity.

The extent to which the SFC leverages this conceptual level of transparency in practice is addressed elsewhere in the team's review.

5. Proportionality

> *This criterion asks whether the level of effort and resources required to develop and maintain a model are proportionate to the modeled activity's importance to the IFI's mandate and the overall public finances. Models of inconsequential taxes and spending programs that are sophisticated and receive a great deal of attention and a high share of the IFI's resources would score poorly. The criterion also asks whether modeling efforts have a sufficiently high "return" on investment. That is, if the underlying activity is volatile and largely unknowable, it would not be prudent to invest a great deal of resources in a sophisticated model.*

An IFI's investment of resources into a tool should reflect its mandated priorities and the importance of the underlying activity to the overall public finances.

The fully devolved taxes for which the SFC has been mandated are the two taxes collected by Revenue Scotland: Land and Buildings Transaction Tax and Scottish Landfill Tax, along with locally administered Non-Domestic Rates. Fully devolved benefits include all spending by Social Security Scotland, along with benefits administered by DWP on behalf of the Scottish Government.[2]

The SFC is also responsible for forecasting income tax. Scotland receives the proceeds of HMRC-administered non-savings non-dividend income tax and can set rates and thresholds. However, actual receipts are not known for several years following the tax year, after which a reconciliation process makes up for any difference between the revenues forecast by the SFC and the block grant adjustments calculated by HM Treasury using forecasts from the OBR. Forecast errors can therefore have significant consequences to the Scottish fiscal framework. These consequences suggest that the Commission would do well to devote a great deal of attention to income tax forecasting (assuming more attention means better forecasts).[3]

In addition to the currently devolved and mandated authorities, the SFC has been providing illustrative estimates of the wider fiscal framework and programs that could see further devolution in the future. These are important exercises for stakeholders but should nonetheless receive a lesser share of analytical resources until they are fully devolved to Scotland.

The SFC has a relatively narrow mandate compared to other IFIs but a large burden to shoulder in Scotland's future. The Commission has largely served as a proof of concept to demonstrate Scotland's

[2] Benefits also include two areas of spending by local authorities, Scottish Welfare Fund and Discretionary Housing Payments, along with the employability programmes run by the Scottish Government.

[3] That said, even if the SFC is able to forecast revenues perfectly, there may still be large reconciliations if the OBR has significant forecast errors. Reconciliations could also be small if both the SFC and the OBR have large but offsetting errors.

institutional and technical readiness in order to prepare for greater devolved authority over taxation and social security programs. While a program area like landfill tax would not normally merit sophisticated modeling, the review team must keep in mind these wider considerations when assessing the SFC's investment in models are proportional to solely their fiscal importance.

The Commission should also not lose sight of the underlying properties of the program and data. If a simple rule of thumb has a high degree of accuracy and provides a concise narrative to the legislature, the Commission may be well-advised to use it, even if the revenue or spending program is a large share of the overall budget. If an important revenue or spending program is fundamentally unpredictable and knowable, the Commission may be ill-advised to invest significant resources in modeling it.

6. Sustainability

This criterion measures how readily a model can be maintained by the IFI's permanent staff and be handed to new or junior analysts in the event of staff turnover. Sophisticated and idiosyncratic models that require a highly specialised doctoral skillset and are likely to fall into disrepair if a key developer is no longer available to maintain it (and cannot be readily replaced) will score poorly. Models with a simple approach that use widely familiar techniques and software will score well.

One of the greatest challenges an IFI faces is persuading the legislature that its analysis is credible when there have been significant breaks and discontinuities as a result of changes to modeling approaches or staff turnover.

IFIs typically have a small staff with few resources compared to their peer groups at finance ministries and central banks. For their analysis to be manageable and sustainable, their choice of models should reflect this.

IFIs often report to OECD working groups that the day-to-day requirements of serving the legislature do not always hold the attention of PhD economists who have been seconded for model development. The workload often does not permit boundary-pushing research at the forefront of the field. Reports often have a timeline of days or weeks, not months or years. On occasion, IFIs have invested great amounts of time and money in building a model only to have an expert depart and those left behind unable to run it. More often, models are passed to junior analysts with neither the time nor the specialised training to maintain its performance at a level suited to the work.

Some IFIs are large enough to have dedicated innovation units with research analysts and PhD economists seconded as in-house experts. Sophisticated models would be appropriate in their hands to maintain. For other smaller offices, there needs to be an element of realism in matching models to analysts, and simpler approaches may be more appropriate.

The SFC falls in this latter category, with a small staff of around 15 analysts, although its expert commissioners and relationships with Scottish universities do allow a degree of boundary-pushing analysis. Nonetheless, the appropriate level of sophistication for its models should be geared to the typical competencies of a junior analyst with a degree in economics or a numerate field.

7. Precedents

This criterion assesses whether other IFIs and research divisions in finance departments and central banks use the modeling approach for the same application. That a model is common does not

mean it is appropriate; however, a widespread technique can reassure an IFI's stakeholders that they are receiving similar analysis as stakeholders in other jurisdictions.

One of the advantages to the OECD's technical evaluation framework is the knowledge gained through the OECD's various IFI and budget official networks, and its previous IFI evaluations. The review team has compiled a database documenting model selection and procedures at a wide variety of IFIs across different regions and fiscal frameworks and institutional arrangements.

Benchmark institutions in the OECD's evaluation framework include the Congressional Budget Office in the United States, the Office of the Parliamentary Budget Officer in Canada, the Independent Authority for Fiscal Responsibility in Spain, the Portuguese Public Finance Council, the Swedish Fiscal Policy Council, and the Office for Budget Responsibility in the United Kingdom, among others.

The review team has been cautious in comparing the SFC's techniques with the Office for Budget Responsibility, as the two IFIs have agreed to collaborate on model development and in some cases use the same models. Assuming one model is suitable based on the others could be circular reasoning.

Assessment opinions

Choosing a model involves trade-offs and tensions that can be difficult to balance. Analysts at IFIs must prioritise certain criteria over others when choosing an appropriate tool for the job. For this reason, the review team cannot offer a final pronouncement on whether a tool is the *best* tool for the analysis. Instead, the review team will apply the seven assessment criteria to form an opinion on whether the tool is appropriate or inappropriate for delivering the SFC's mandate.

If the review team assesses that a tool is appropriate but has further comments and recommendations to bring it in-line with best practices, the review team will issue a qualified opinion, as in Table 2.

Table 2: Assessment opinions

Score	Action
Adverse opinion	The tool is not suited to the task and should be changed as soon as possible
Appropriate, qualified opinion	The tool is not inconsistent with generally accepted standards for a macro-fiscal framework, but analysts should review its use and explore other options that may be better practice
Appropriate, unqualified opinion	The tool is appropriate, and no further action is recommended

Results

The technical assessment concluded that each of the SFC's methodological approaches are appropriate for its analysis and legislative requirements and generally match the standards accepted for the macro-fiscal frameworks of other IFIs.

In the case of the SFC's medium-term economic forecasting tool SGGEM, a qualified opinion of appropriateness has been issued. While appropriate for the Commission's age and circumstances, the tool should be reviewed to bring aspects of its ownership, communication, and transparency more in-line with practices at longer-established IFIs. The SFC is already well into this review process and began material work to address this issue in 2018, before the OECD's review began. The SFC plans to develop its in-house macroeconomic model by late 2019, to be further refined and run in parallel to SGGEM in 2020.

A summary list of the SFC's tools and the review team's assessment is provided in Table 3. A full breakdown of each criteria's outcome and discussion for each model has been provided in the appendix.

Table 3: The SFC's methodological approaches were assessed to be appropriate

Activity	Model	Opinion	
Monitoring (first four quarters)	ARIMA-X and ad hoc SGGEM adjustments	Appropriate	Unqualified
Medium-term economic forecasting	SGGEM	Appropriate	Qualified
Medium-term fiscal forecasting:	Income tax	Appropriate	Unqualified
	Income tax behavioural responses	Appropriate	Unqualified
	VAT (Value added tax)	Appropriate	Unqualified
	Non-domestic rates	Appropriate	Unqualified
	LBTT (Land and buildings transaction tax)	Appropriate	Unqualified
	Non-residential LBTT	Appropriate	Unqualified
	ADS (Additional dwelling supplement)	Appropriate	Unqualified
	First time buyer relief and ADS increase	Appropriate	Unqualified
	Non-residential LBTT	Appropriate	Unqualified
	Scottish landfill tax	Appropriate	Unqualified
	Air passenger duty	Appropriate	Unqualified
	Carer's allowance and supplement	Appropriate	Unqualified
	Discretionary housing payments	Appropriate	Unqualified
	Best start grants	Appropriate	Unqualified
	Best start foods	Appropriate	Unqualified
	Funeral expense assistance	Appropriate	Unqualified
	Employability services	Appropriate	Unqualified
	Attendance Allowance	Appropriate	Unqualified
	Cold Weather Payments	Appropriate	Unqualified
	Disability Living Allowance (Child)	Appropriate	Unqualified
	Disability Living Allowance (Working age)	Appropriate	Unqualified
	Disability Living Allowance (Pensioners)	Appropriate	Unqualified
	Severe Disablement Allowance (SDA)	Appropriate	Unqualified
	Winter Fuel Payments	Appropriate	Unqualified
	Industrial Injuries Benefit	Appropriate	Unqualified
	Personal Independence Payment	Appropriate	Unqualified
Assessment of reasonableness of official numbers	Ad hoc spreadsheet analysis	Appropriate	Unqualified
Forecast evaluations	Ad hoc spreadsheet analysis	Appropriate	Unqualified

Narrative report

Overall macro-fiscal framework

The SFC's overall macro-fiscal framework is an iterative procedure with a core macro model and satellite fiscal models. That is, rather than having a detailed fiscal block within the macro model, the SFC uses the macro model's economic outputs as inputs in detailed separate fiscal models, before inputting them back into the macro model as an aggregated government sector in a number of forecasting rounds until the results converge to consistency.

This is common to 80% of the macro-fiscal forecasting frameworks used in government agencies assessed by Leal (2008) and adjusted for more recent observations from the review team. It is also, in the opinion of the review team, the appropriate 'sweet spot' for a macro-fiscal framework within an IFI. A fully integrated fiscal block in a macro model does not provide the granularity required for budget planning. Nor is a fully satellite system (where the IFI produces only fiscal forecasts while taking the macroeconomy as exogenous, either from an internal or external projection) able to render the macro-fiscal framework on a satisfactorily consistent basis.

That said, there are still minor consistency issues, stemming largely from the SFC's limited mandate to evaluate only a subset of overall revenue and spending programs within the Scottish budget and the UK budget overall. This limited mandate, along with data and resource limitations, force the SFC to use a mix of internal and outsider forecasts and policy costings in the modelling framework. The mix they have chosen is appropriate given the circumstances, bringing advantages of inside-government information where possible and a degree of alternative perspectives and independence to the work where not. Inconsistencies are kept to a minimum with the protocols the SFC has secured with other Scottish and UK agencies. The SFC should be commended for navigating these cumbersome institutional constraints.

Macroeconomic planning

The SFC constructs recent quarters, the current quarter, and immediate future quarters (**in-year estimates and monitoring**) using statistical ARIMA time-series models (predicting a variable's future behavior based only on its recent past behavior) combined with some simple regressors capturing leading indicators. This is a satisfactory mix with favourable theoretical underpinnings, good forecasting properties, and allows some—albeit limited—story-telling ability to parliament and the public. Their approach requires relatively few analytical resources and is suited to their mandate, age, and overall analytical capacity. Other IFIs can be prone to over-investing in relatively volatile short-run monitoring, leaning more on either detailed causal/structural modeling or purely statistical (yet resource intensive) approaches such as dynamic factor modelling.

The **medium-term economic outlook** is produced with a global macro-econometric model (SGGEM), developed and customised for Scotland by a third party (the National Institute of Economic and Social Research) and owned formally by the Scottish Government. It is constrained to the SFC's assessments of the supply-side potential of the Scottish economy, the SFC's short-term modelling, and the views and judgment of the Commission and SFC analysts.

Many IFIs similarly outsourced their macroeconomic projections in the first years of their mandate, and it was the appropriate choice for the SFC. The SGGEM and the NiGEM model it is based on score highly on theory, accuracy, and communication criteria.

That said, there are many superfluous and black-box elements to the NIESR model that do not offer the full planning benefits of an in-house macro forecasting framework and run risk the risk that all moving parts of the model are not fully understood. Further, the proprietary nature of the model and its software make it ill-equipped to fully fulfil the legislated requirement of making all methodologies and assumptions available for scrutiny by the Scottish Ministers, Parliament, academic commentators, and the public.

Producing a macroeconomic forecast for the basis of the Scottish budget is a core component of the SFC's governing legislature. In the interest of communication, transparency, and consistency, the SFC would be well-justified in devoting resources and priority to building medium-term macroeconomic tools entirely in-house in the future. This could be done with current resources and expertise, using a simple reduced-form macro-econometric model.

The SFC has already started down a path to do so and planned to construct a replacement model (to be used in parallel until satisfactory performance may be demonstrated) before the OECD review process began. The model is expected to be run in parallel to SGGEM in late 2019. For now, the review team has issued a qualified opinion that the SGGEM model meets the criteria for inclusion in an acceptable macro-fiscal framework of an IFI of the SFC's age and circumstances. However, the SFC's stakeholders should monitor the plan to bring the macro model in-house and confirm its progress, if it is to remain appropriate as the SFC matures.

Fiscal planning

The satellite **medium-term fiscal models** use a widely established blend of structural/causal and statistical fiscal forecasting procedures familiar to the review team and recommended by guidance from international organisations such as the IMF Institute for Capacity Development. For taxation measures, these techniques include effective rates methods, elasticity-based methods, econometric regression methods, and simple rules-based approaches. For spending measures, these include identifying and projecting qualified recipients and benefit amounts.

The SFC's fiscal models generally fare well across all criteria, given the practical constraints of its work. All else the same, an IFI such as the SFC whose legislation requires annual forecasting performance appraisals could be inclined to choose models solely specified to achieve the best possible forecasts, at the expense of the structural features required to serve as a useful planning framework to their government and parliament. The Commission has instead deftly managed the difficult tradeoffs of forecasting performance and policy planning, choosing to serve Parliament ahead of their own performance appraisals.

Specifically, the SFC's income tax model meets or exceeds the best-practices of other IFI's, such as:

- Capturing the economic cycle through determinants such as earning growth, employment, and hours worked provided by the macro model
- Modeling each source of income that receives different tax treatment separately
- Capturing changes to the income distribution, the progressivity of the tax code, and fiscal drag using survey microdata from the Survey of Personal Income
- Capturing the behavior of high-income taxpayers using an ad-hoc satellite model that uses the latest academic research on the mobility of taxpayers, income-shifting, and tax-motivated incorporation.

The Land and Buildings Transaction Tax model is more sophisticated that in other IFIs, using registration data, a fitted distribution of housing prices, and housing price forecasts. The Scottish Landfill Tax is similarly sophisticated, capturing projections for landfill waste that consider plans for alternative waste treatment facilities, indexation of policy parameters, and other program levers. These models are well suited for providing the narratives and transparency demanded by a Scottish budget framework that features them as key steps in the progress of devolution. Although they use resources that are somewhat disproportionate in their relation to the overall Scottish public finances, these taxes and their modelling were a key component of Scotland's strategy to demonstrate its technical and institutional capacity to handle greater devolved fiscal authority. Stakeholders should expect the analytical resources devoted to these areas to naturally shift to taxes and spending programs of greater fiscal materiality as devolution expands.

The Commission has some **policy costing** capacity at present in order to update its forecasts following Scottish Government policy decisions or in the run-up to fiscal events. Although policy costing is not part of the Commission's core role, the practical realities of the institutional framework and divisions of forecast and policy responsibilities between the SFC and Scottish Government require a complicated working relationship involving shared policy tools and dual-purpose forecasting models that have some policy costing capacity (described in a recently published paper paper). The SFC has done well to manage this challenging arrangement with the tools at their disposal.

Another core function of IFIs—assessing the **longer-term sustainability of fiscal policy**—is not currently an explicit component of the SFC's mandate. Scotland has limited borrowing powers, and a traditional debt sustainability analysis would be unnecessary. Nonetheless, the overall sustainability of the structure of Scotland's spending programs and revenues given demographic change on the horizon of ten, twenty, fifty years or further may be of interest to the Scottish Ministers and Scottish Parliament and is an area for the SFC to explore in the future. The SFC's long-run assessments of the supply-side of the economy and potential GDP are the building blocks to this long-term analysis.

The SFC's tools to assess the reasonableness of the Scottish Government's borrowing outlook and perform its mandated annual forecast evaluation are appropriate and in-line with best practices.

Where the SFC excels

- **Practical and creative workarounds to limited Scottish statistics**. The Scottish economic accounts are still in their infancy, with short time horizons and less-than comprehensive coverage of the economic indicators available to other IFIs. Similarly, many of the other economic, financial, and social statistics that other jurisdictions take for granted are not available. The SFC has found methodologically sound and creative solutions to surmount these limitations in practice.
- **Managing consistency**. Given the SFC's mandate to only examine a subset of Scottish revenue and spending responsibilities, it will always be a challenge to maintain consistency in the macro-fiscal framework, both between the Commission's economic, tax, and spending models, as well as the OBR's policy costings and complete fiscal stance of the Scottish and UK governments more generally. The Scottish fiscal framework and the institutional position of the SFC is a uniquely challenging environment for forecasters. The SFC's staff and the tools they have developed are managing the challenges deftly.
- **Sophisticated modelling of smaller revenue sources and spending programs.** Many smaller tax and spending areas receive more thorough attention and analysis than would be the case at peer IFIs, given their relative fiscal immateriality and an IFI's limited analytical resources. These include

the areas related to devolved excise taxes such as LBTT and Scottish Landfill Tax, and spending programs such as Funeral Support Payments and Winter Fuel Payments.

- **Open-source software**. The SFC's extensive use of open-source software in areas other than their macroeconomic modeling is well ahead of the curve of their IFI peers and places them in an excellent position to lead by example on transparency.

Areas for future consideration

- **Full ownership of macroeconomic modelling.** While the medium-term SGGEM model is appropriate for the young age of the Commission, a longer-term solution with full ownership in open-source or at least non-proprietary software should be developed as the Commission matures (the SFC is well underway with a workplan to address this).
- **Consider model combinations and a broader tool set, resources permitting.** A consistent result from forecasting literature is that model combinations and averages generally produce better results than a single model. One way to confront the challenge of being required to produce accurate forecasts and also have structural model specifications for policy and budget planning could be to run both statistical time-series and structural models in parallel, as a sense-check and to limit outlier results. Similarly, after the SFC develops its in-house macroeconomic model it may wish to run the SGGEM in parallel indefinitely, as a second opinion. The Commission could also further explore using averages from private sector outlooks as benchmarks against which to compare its forecasts (it does so now to some extent, but the process could be more formalised and structured).
- **Maximise use of inside information**. While averaging different model results often leads to better forecast performance, a single forecast can be superior if the analyst has insider domain knowledge (such as in a government finance department, which has real-time tax receipts from monthly payroll and business tax-filer data). If the SFC is to have an institutional role as the forecast of record, the Scottish fiscal framework would benefit from ensuring that the SFC has access to inside knowledge to the greatest extent possible under confidentiality and access to information laws (including the institutional separation of data from policymakers).
- **Explore and bring clarity to the objective of the office's models.** The SFC's mandate and memorandums emphasize two goals that could be at odds with one another when developing models: (1) provide the most accurate forecasts possible (suggested by the Commission's requirement to provide annual forecast assessments), and (2) provide forecasts with enough structural policy detail that the Scottish Ministers may use them in drafting the budget. In an ideal world, a structural model that captures all factors necessary for planning the public finances (that is, policy parameters and economic determinants) would also generate the best forecasts. Unfortunately, owing to a wide range of real-world factors, the best public finance forecast is often a simple univariate time-series approach (such as assuming this year's revenue growth will be the same as last year's revenue growth). But simple statistical models are of little use to budget planners, who need to explore different scenarios, perform stress tests, and tell economic narratives that are sensible to budget stakeholders. For the SFC to balance these goals requires its models to have a clear objective function that is not currently provided by its governing legislation or memorandums. This places its analysts (and external reviewers) in the challenging position of subjectively balancing forecasting and policy considerations.

Conclusion

The review team's opinion is that the SFC's tools meet the criteria for an acceptable macro-fiscal planning framework for supplying the Scottish Ministers with the legislated inputs to the budget conversation (that is, macroeconomic assumptions and a devolved taxes and social security outlook). In making this assessment, the review team looked at each individual tool in detail, as well as the broad workflows of the SFC's macro-fiscal analytical processes.

Stakeholders should bear in mind that even the most appropriate tools are constrained by the underlying volatility and inherent unpredictability of economic and financial data. There is no dissonance between a best-practice forecast tool and frequent and sizeable forecast errors.

The review team did not do a line-by-line audit of the code, data or spreadsheets of each model. The macro-fiscal planning framework is a human process and the OECD's review is not a substitute for the SFC's legislated and institutional channels of accountability, including regular scrutiny by the Scottish Ministers, Parliament, academics, and the public.

Further, it is good practice for an IFI to frequently, if not perpetually, review and improve its tools and workflows. This is particularly true in Scotland and the SFC's institutional context, where data and statistical workflows are still emerging. While the review team concluded that the current models at time of review are fit for purpose, stakeholders should expect the SFC to continue to develop its models as its expertise matures and new data comes online.

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Appendix: individual model assessments

Economic planning assumptions

1. SGGEM

Tool	SGGEM medium-term economic forecasting model
Description	A large-scale macroeconometric model built by NIESR and the Scottish Government as an extension to NIESR's NiGEM model including a Scottish country block. Constrained to a potential output path prepared in a satellite model. Model provides components of demand consistent with closing the output gap over the medium term. UK economy, prices, interest rates, and government expenditure are exogenous. Focus is on Scottish household income and expenditure.
Type	Macroeconometric structural error correction model at quarterly frequency, equations estimated separately, imposed national accounting identities.
Mandate	SFCA Subsection 2(2) *In particular, the Commission must on at least 2 occasions for each financial year prepare reports—* *(ab) containing its forecasts in respect of Scotland's gross domestic product excluding the value of oil, gas and other hydrocarbons produced in the Scottish sector of the UK continental shelf for each of—* *(i) the remaining quarters (if any) of the financial year in which the report is made and each of the quarters of the subsequent financial year, and* (ii) *the 4 subsequent financial years*
Outputs	Macroeconomic variables for years one to five of outlook, at quarterly frequency, as inputs to fiscal models. GDP demand components, GDP deflator, inflation, employment, demand components deflators, compensation per employee, credit, net disposable income, household saving ratio, etc.
Working paper	NiGEM documentation: https://nimodel.niesr.ac.uk/index.php?t=5. Scottish Fiscal Commission (2017). *Current approach to forecasting September 2017* (SG/2018/155). Edinburgh: SFC. http://www.fiscalcommission.scot/publications/occasional-papers/current-approach-to-forecasting-september-2017/.
Reports	Scotland's economic and fiscal forecasts
Software	Subscription-based proprietary NiGEM software
1. Theoretical justifications	Good. On paper, ECMs are the gold standard of macroeconometric modelling. May be too aggregated for the Scottish case to provide thorough analysis of Scottish public finances with full consistency between the macro and fiscal outlooks. Largely a problem of data. As Scottish accounts improve so too will this. SFC has plan to address. Suited to twin goals of capturing data and dynamics with enough structure to trace effects of policies and shocks.
2. Accuracy	Good. Because of its theoretical underpinnings and reliance on medium-run equilibrium conditions (closing of the output gap) and use of levels and dynamics via error correction models, these models are likely to improve upon naïve forecasts for the medium run.

3. Communication	Fair. This type of macroeconometric modeling can produce coherent, intuitive narratives in-line with economic theory. Coefficients and directions are meaningful. However, the third-party nature of the software renders much of it a black box, with overly complicated external sectors, and the Commission may not be fully versed on what's going on under the hood in any given model run.
4. Transparency	Poor. The model is proprietary and largely a black box to outsiders. Results cannot be replicated without a subscription (and not easily even with a subscription). Detailed descriptions would not be able to be published by the SFC and are not available from NIESR. Although some high-level overviews are available, these do not provide information on the model adaptations for the SFC's processes or information on any given model run.
5. Proportionality	Fair. The model is efficient, requiring only one or two skilled analysts to run. Much of the maintenance is outsourced to support staff at NIESR. However, given the prominence of macro forecasts within the SFC's mandate and the importance to the Scottish budget of macroeconomic planning assumptions, it would be appropriate to invest more resources in developing a fully in-house macroeconomic model for Scotland and the UK. NiGEM is much more sophisticated than required, particularly in its external sector, than the needs of the office, and this additional level of sophistication can complicate interpretation of the model's results. A leaner reduced-form macro model that is fully owned would lend itself to better forecast workflows and internal challenge discussions.
6. Sustainability	Good. Junior analysts with a degree in economics or a numerate field could support and run the model. NIESR training courses are run frequently throughout the year.
7. International precedence	Fair. This type of model is the most common approach to the macroeconomic outlook and widespread among benchmark institutions. However, the SFC is an outlier in that they outsource the building, development, and maintenance to a third-party subscription-based service. It is appropriate for the age of the Commission (some benchmark institutions also outsourced initially).
Verdict	Appropriate, qualified. The tool in general is appropriate; however, the outsourcing of the model development and maintenance to a third party does not permit the level of transparency to which the SFC should aspire. Benchmark institutions have complete ownership of in-house models. It was suited to the young age of the Commission but given its importance to the mandate and budget planning assumptions, the SFC would be justified in investing additional resources in replacing it with an in-house model. SGGEM could be run in parallel to an in-house model during the transition or maintained indefinitely as a second opinion, if sufficient resources are available. SFC is currently in the process of developing an in-house model. If that review and development is completed, and it meets the specs that they have planned, it would result in an appropriate and unqualified opinion from the research team.

2. Potential output projections

Tool	Potential output model
Description	Potential output is estimated and projected using labour productivity, average hours worked, labour market participation, unemployment and total population. Population and labour projections are based on cohort demographic models. Filtering techniques and judgements are applied to calculate trends. This allows an implied output gap to be estimated. The implied output gap is complemented by an alternative historic measure of Scotland's output gap calculated with surveys of spare capacity such as labour shortages, factors limiting production, orders on order book for both the UK and Scotland.
Type	HP filter, labour-based potential output function of the form Y = Y/L*L. Cross-checked against other cyclical indicators and judgments, particularly around the path of potential following the 2008 global financial crisis.
Application	Forecasting potential output over next six years to anchor the medium-term outlook.
Mandate	SFCA Subsection 2(2) *In particular, the Commission must on at least 2 occasions for each financial year prepare reports—* *(ab) containing its forecasts in respect of Scotland's gross domestic product excluding the value of oil, gas and other hydrocarbons produced in the Scottish sector of the UK continental shelf for each of—* *(i) the remaining quarters (if any) of the financial year in which the report is made and each of the quarters of the subsequent financial year, and* (ii) *the 4 subsequent financial years*
Outputs	Historic potential output and output gap for Scotland, six-year forecast of potential output and components.
Working paper	Paper on long-run forecasts of the Scottish economy: http://www.fiscalcommission.scot/publications/occasional-papers/forecasting-the-long-run-potential-of-the-scottish-economy-march-2018/.
Reports	Scotland's economic and fiscal forecasts
Software	Excel
1. Theoretical justifications	Good. Labour input-based production function for potential adheres to principles in academic literature, supranational guidance, and benchmark institutions and is appropriate for the age of the office and typical path of economic model capacity building. Suited to Scotland's limited data. Over the longer term, the SFC could work with statistics providers to improve the data environment with the goal of bringing capital into the production function. This capability would be many years away, but is a worthwhile goal. Other jurisdictions have found capital modeling particularly important in explaining output dynamics following the 2008 financial crisis.
2. Accuracy	N/A. Potential output unobservable and don't lend themselves to assessments of accuracy. But can say that future demographics mostly determined by the population today (complete coverage in census survey). Generally deterministic or filter based. Some margin for error in fertility and immigration assumptions. Provided assumptions are reviewed regularly, should not lead to systematic bias.
3. Communication	Good. Straightforward to explain to economists and stakeholders.

4. Transparency	Fair. Considerable judgment and subjectivity in choosing filtering parameters. To be transparent and make assumptions readily available for academic commentators and the public would require publishing all code and spreadsheets with each forecast round. But no restrictions against publishing spreadsheets. Data vintages and model iterations are readily archivable, but judgment and subjective decisions would need extensive documentation.
5. Proportionality	Good. A suitable investment for the importance of the macroeconomic outlook in the Commission's mandate and for budget planning. Simple approach. While additional investment to model capital in the production function would be an asset, it would not necessarily result in improved forecast performance or capturing underlying trends which are uncertain and unobservable under even the best circumstances.
6. Sustainability	Good. Simple approach, easy for a junior analyst with a degree in economics or a similar field to support and run the model, requiring basic economist tool kit. Familiar software.
7. Precedent	Good. Approach is common to most benchmark IFIs starting out, and some mature IFIs; However, most move to production function including capital, data permitting.
Verdict	Appropriate, unqualified.

3. Nowcasting and short run forecasts

Tool	Nowcast and short-run economy forecasts (1 to 4 quarters ahead)
Description	ARIMA-X forecasts to build the medium-term macro model, using a single leading indicator (from more-timely UK series, Scottish and UK surveys or market data) as an exogenous independent variable to estimate/forecast each macro series. Individual forecasts are combined and weighted using Akaike Information Criterion as a measure of historic fit, increasing the weight in the forecast of models with better historic fit. Judgment is used to decide how to bring the short-run forecasts into the medium-term framework. Depending on wider considerations, may use greater or fewer quarters of the short run forecast. Some eyeballing to mean-reversion and to trend growth rates.
Type	Weighted average ARIMA model using exogenous leading indicators. One goal: fit data and capture dynamics.
Mandate	SFCA Subsection 2(2) *In particular, the Commission must on at least 2 occasions for each financial year prepare reports—* *(ab) containing its forecasts in respect of Scotland's gross domestic product excluding the value of oil, gas and other hydrocarbons produced in the Scottish sector of the UK continental shelf for each of—* *(i) the remaining quarters (if any) of the financial year in which the report is made and each of the quarters of the subsequent financial year, and* (ii) *the 4 subsequent financial years*
Outputs	Forecasts of Scottish GDP, earnings and employment up to 4 quarters ahead of the latest available data point as inputs to medium-term SGGEM forecasting model
Working paper	No paper from the SFC, but a similar methodology is discussed by the FAI: https://www.strath.ac.uk/media/departments/economics/14-11b.pdf (MIDAS approach discussed in the paper is not used when facing data of mixed frequencies, in favour of constant temporal weighting for data points when moving from more timely data to quarterly frequency for inputs to the model.
Reports	Scotland's economic and fiscal forecasts
Software	R, Excel
1. Theoretical justifications	Good. No strong priors on economic relationships, (lets the data speak for itself). Univariate models can produce ex ante forecasts and may be well suited to Scotland's macroeconomic data environment that remains limited. But conditioning on auxiliary outturn or forecasts of exogenous variables allows more timely information to be brought into the modelling framework. Based on sound, well-studied economic relationships and academic consensus. Adheres to principles in peer-reviewed literature and supranational guidance.
2. Accuracy	Good. Research suggests simple univariate models returning to trend will provide good short-run forecasts. No systematic bias provided coefficients are regularly re-estimated. ARIMA models showed mixed but broadly positive performance in out-of-sample forecasts, and in many cases, outperform more sophisticated models.
3. Communication	Fair. Univariate time series models do not generally offer a direct causal interpretation of coefficients and can be difficult to communicate. That is, they predict what will happen, not why. However, a univariate equation need not be entirely atheoretical, and the SFC has combined the statistical forecasts with a structural leading indicator that allows a story to be communicated to stakeholders.

4. Transparency	Fair. Equations and estimated coefficients would need to be published frequently, as specifications and estimates are likely to change with each addition of new or revised data. Fiscal sensitivity tables could not be estimated and published to provide a check on model revisions given economic developments. However, the relative simplicity lends them some merit, as scrutinizers with a general economics background would largely be able to understand and test the assumptions. Good use of open-source software. But amount of judgment at play would require extensive documentation at each forecast round to make assumptions and decision processes transparent for academic commentators and the public to scrutinize.
5. Proportionality	Good. A suitable investment for the importance of the macroeconomic outlook in the Commission's mandate and for budget planning. Simple yet effective approach. Unlikely to benefit from additional sophistication or analytical resources.
6. Sustainability	Good. ARIMA-X models are an accessible forecasting model for small teams with limited technical background. Excel and R have packages with detailed procedures that can guide the model selection procedure, active community to assist. R code requires some specialist background, but reasonable to expect of junior analysts with a degree in economics or a similar field.
7. Precedent	Good. Yes, most benchmark IFIs use a mix of ARIMA and other simple regressions and forecast combinations to build the nowcasts and short-run monitoring quarters.
Verdict	Appropriate, unqualified.

4. Demographic projections

Tool	Demographic model
Description	Cohort-specific model of population growth and labour force participation, using ONS principal population projections adjusted by the Annual Population Survey.
Type	Age-period-cohort model with birth cohort-specific habits and preferences.
Mandate	SFCA Subsection 2(2) *In particular, the Commission must on at least 2 occasions for each financial year prepare reports—* *(ab) containing its forecasts in respect of Scotland's gross domestic product excluding the value of oil, gas and other hydrocarbons produced in the Scottish sector of the UK continental shelf for each of—* *(i) the remaining quarters (if any) of the financial year in which the report is made and each of the quarters of the subsequent financial year, and* *the 4 subsequent financial years* and Section 2(2)(a)(iii) *[…] the Commission must on at least 2 occasions for each financial year prepare reports containing its 5-year forecasts of receipts from income tax attributable to a Scottish rate resolution.*
Outputs	Population projections for labour input for potential output model. Estimated annual population growth rates by age group for determining the number of Scottish taxpayers by age band, which is applied to the data used in the SPI forecast model.
Working paper	Scottish Fiscal Commission (2017). *Current approach to forecasting September 2017* (SG/2018/155). Edinburgh: SFC. http://www.fiscalcommission.scot/publications/occasional-papers/current-approach-to-forecasting-september-2017/.
Reports	Scotland's economic and fiscal forecasts
Software	Excel
1. Theoretical justifications	Good. Adheres to principles in academic literature and supranational guidance. Suited to Scotland's data. Appropriate sensitivity and alternative scenario methodology.
2. Accuracy	Good. Generally deterministic. Some margin for error in fertility and immigration assumptions. Future demographics mostly determined by the population today (complete coverage in census survey).
3. Communication	Good. Can produce coherent, intuitive narratives in-line with economic theory. Straightforward to explain to non-specialists.
4. Transparency	Good. Growth assumptions can easily be published and challenged by academic commentators and the public. No constraints or business considerations to prevent releasing spreadsheet model. Data vintages and model iterations readily archivable. Effort to publish transparent working paper in process.
5. Proportionality	Good. A suitable investment for the importance of the macroeconomic outlook and Scottish income tax in the Commission's mandate and for budget planning. Simple yet effective approach. Unlikely to benefit from additional sophistication or analytical resources.
6. Sustainability	Good. Excel models can be passed to analysts with a general economics background or even non-specialists. Techniques that should be in a public finance analyst's toolkit.

7. Precedents	Yes. Same methodology underlying the demographic projections in benchmark IFIs; however, these are usually produced by the national statistics agency rather than internally
Verdict	Appropriate, unqualified.

Taxes

5. Income tax

Tool	Income tax forecasting model
Description	The Survey of Personal Incomes (SPI) Public Use Tape (PUT), based on individual income tax taxpayer records from HMRC, is adjusted for more timely aggregate outturn data. These are then grown by economic determinants such as employment and earnings from the economy outlook, plus additional determinants such as state pension forecasts from OBR, and demographic and population projections from ONS. This creates a forecast of the number of taxpayers and incomes over the next 6 years. The baseline or alternative income tax policies are then applied to forecast income tax liabilities. A number of additional off-model adjustments are made to complete the forecast, capturing issues such as UK policy changes that affect Scottish income tax (such as pensions auto-enrolment); gift-aid payments; baseline behaviour change such as the growing number of individuals switching from income to corporation tax; and effect of policy change-induced taxpayer behaviour on income tax liabilities, primarily related to high earners.
Type	Sample of administration data to capture distribution of income, fiscal drag. Income categories for tax purposes each forecast separately and grown with economic determinants from macroeconomic model. Twin goals: fit to data and capture dynamics, but with enough structure to trace effects of policies and shocks
Mandate	Section 2(2)(a)(iii) *[…] the Commission must on at least 2 occasions for each financial year prepare reports containing its 5-year forecasts of receipts from income tax attributable to a Scottish rate resolution.*
Outputs	Income tax liabilities
Working paper	Scottish Fiscal Commission (2017). *Current approach to forecasting September 2017* (SG/2018/155). Edinburgh: SFC. http://www.fiscalcommission.scot/publications/occasional-papers/current-approach-to-forecasting-september-2017/. Behavioural adjustments: http://www.fiscalcommission.scot/publications/occasional-papers/how-we-forecast-behavioural-responses-to-income-tax-policy-march-2018/.
Reports	Scotland's economic and fiscal forecasts
Software	SAS and Excel
1. Theoretical justifications	Good. Based on sound, well-studied economic relationships and academic consensus. Adheres to principles in peer-reviewed literature and supranational guidance. Suited to Scotland's data.
2. Accuracy	Good. Forecast evaluation results within acceptable tolerances given underling variance. Similar errors to OBR. Specification tests suggest good out-of-sample performance.
3. Communication	Good. Can produce coherent, intuitive narratives in-line with economic theory. Coefficients are interpretable. Straightforward to explain to non-specialists. Structural determinants with intuitive variables.

4. Transparency	Good. Growth assumptions could be (and generally are) published and challenged by academic commentators and the public. Data vintages and model iterations archived with appropriate protocols. Explained at a high level in working papers. Although modelling partially in proprietary software, an effort has been made to be as transparent as possible and programs to assess open-source software options in place.
5. Proportionality	Good. More resources devoted to Income tax forecasting than most offices but is more important to the office's mandate and the overall Scottish public finances than in others.
6. Sustainability	Good. SAS modelling requires some specialist background, but junior analysts with a degree in economics or a similar field would be capable if given professional development opportunities.
7. Precedent	Good. Exceeds best practices of benchmark IFIs. Common approach but taken further, handled with greater sophistication.
Verdict	Appropriate, unqualified.

6. Income tax behavioural responses

Tool	Income tax behaviour model
Description	A range of taxable income elasticities is taken from a review of peer-reviewed literature and assumptions from HMRC for the UK after adjusting to reflecting differences between Scottish and UK tax. Following a policy change, the TIE is multiplied by the percentage change in the taxpayer's net-of-tax rate (1 – effective marginal tax rate) to estimate the percentage change in a taxpayer's taxable income.
Type	Behavioural adjustment with taxable income elasticity.
Mandate	SFCA Section 2(2)(a)(iii) *[…] the Commission must on at least 2 occasions for each financial year prepare reports containing its 5-year forecasts of receipts from income tax attributable to a Scottish rate resolution.*
Outputs	Adjustment to total income tax liabilities
Working paper	Scottish Fiscal Commission (2018). *How we forecast behavioural responses to income tax policy*. Edinburgh: SFC. http://www.fiscalcommission.scot/publications/occasional-papers/how-we-forecast-behavioural-responses-to-income-tax-policy-march-2018/
Reports	Scotland's economic and fiscal forecasts
Software	Excel
1. Theoretical justifications	Good. Model selection and parameters come directly from research papers.
2. Accuracy	Good. Difficult to measure ex post, but appropriate attempt to arrive at the most accurate forecast possible. SFC's internal specification and performance tests show that the adjustment is likely to fall within acceptable tolerances given underling variance. Not likely to have significant biases.
3. Communication	Good. Can produce coherent, intuitive narratives in-line with economic theory. Coefficients are interpretable. Straightforward to explain to non-specialists.
4. Transparency	Good. Elasticity assumptions can be made readily available and scrutinised by academic commentators and the public. Spreadsheets could readily be made public.
5. Proportionality	Good. A suitable investment for the importance of income tax in the Commission's mandate and overall public finances. Simple yet effective approach. Unlikely to benefit from additional sophistication or analytical resources.
6. Sustainability	Good. Working with elasticities should be a core competency of every public finance analyst's toolkit. Spreadsheet models easily passed to new analysts.
7. Precedent	Good. Approach is common to most benchmark IFIs.
Verdict	Appropriate, unqualified.

7. VAT (Value added tax)

Tool	VAT forecasting model
Description	Historical data is taken from HMRC estimates of assigned VAT. Scottish economic determinants are used to forecast total theoretical VAT liability (VTTL). HMRC and OBR forecasts of the standard rated share, tax gap and policy costings are used to adjust the VTTL forecast to arrive at revenues.
Type	Theoretical tax liability from proxy tax bases with full rate structure. Policy model with twin goals: fit to data and capture dynamics, but with enough structure to trace effects of policies and shocks.
Mandate	Section 2(2)(a)(iv) *[…] the Commission must on at least 2 occasions for each financial year prepare reports containing its 5-year forecasts of receipts from assigned VAT receipts.*
Outputs	Assigned VAT revenue
Working paper	http://www.fiscalcommission.scot/publications/occasional-papers/value-added-tax-vat-approach-to-forecast-september-2018/.
Reports	Scotland's Economic and Fiscal Forecasts
Software	R
1. Theoretical justifications	Good. Based on sound, well-studied economic relationships and academic consensus. Adheres to principles in peer-reviewed literature and supranational guidance. Suited to Scotland's data. Proxy bases and equations replicate underlying data generating process closely.
2. Accuracy	Good. Forecast evaluation results within acceptable tolerances given underling variance. Similar errors to OBR. Specification tests suggest good out-of-sample performance.
3. Communication	Good. Can produce coherent, intuitive narratives in-line with economic theory. Straightforward to explain to non-specialists. Structural determinants with intuitive variables.
4. Transparency	Good. Growth assumptions and standard-rated shares can be easily published and challenged by academic commentators and the public. Good use of free and open-source software. Data vintages and model iterations could be archived with appropriate protocols. Explained at a high level in working papers.
5. Proportionality	Good. Although not yet central to the office's mandate, will become a significant responsibility of the SFC and is of great importance to the Scottish public finances. A wise investment in capacity building.
6. Sustainability	Good. R code requires some specialist background, but reasonable to expect of junior analysts with a degree in economics or a similar field and appropriate to address with professional development opportunities.
7. Precedent	Good. Meets or exceeds best practices of benchmark IFIs.
Verdict	Appropriate, unqualified.

8. NDR (Non-domestic rates)

Tool	NDR forecasting model
Description	Non-Domestic Rates, commonly known as business rates, are paid by owners and occupiers of all non-domestic property in Scotland. The amount paid is based on the 'rateable value' of the property, which can be appealed, and any reliefs to which the property or ratepayer are entitled. Historical data is from the Scottish Assessors and Local Authority NDR returns. The model has four steps: Estimating the size of the tax base, estimate the gross bill faced by the tax base, deduct reliefs, estimate any other adjustments such as back-dated appeals losses and write-offs.
Type	Bottom-up bases times rates. Bases are forecast from data from Local Authorities with projections and assumptions for the poundage, appeals losses. Policy model with twin goals: fit to data and capture dynamics, but with enough structure to trace effects of policies and shocks.
Mandate	Section 2(2)(a)(ii) *[…] the Commission must on at least 2 occasions for each financial year prepare reports containing its 5-year forecasts of receipts from non-domestic rates.*
Outputs	Contributable amount of NDR, that is the amount collected by Local Authorities and paid to the Scottish Government.
Working paper	Scottish Fiscal Commission (2017). *Current approach to forecasting September 2017* (SG/2018/155). Edinburgh: SFC. http://www.fiscalcommission.scot/publications/occasional-papers/current-approach-to-forecasting-september-2017/.
Reports	Scotland's Economic and Fiscal Forecasts
Software	Excel
Theoretical justifications	Good. Based on mechanical relationships of the legislated tax system. Adheres to principles in supranational guidance. Suited to Scotland's data.
Accuracy	Good. Recent methodology changes and data limitations prevent full analysis. But initial indications are that errors are small and comparable to forecast errors made by the OBR and the Scottish Government. Some uncertainty around reliefs, but immaterial to overall outlook. Likely to outperform statistical time series approaches. Not likely to have significant biases.
Communication	Good. Can produce coherent, intuitive narratives related to changes in the tax base. Straightforward to explain to non-specialists.
Transparency	Good. Assumptions can be made readily available and scrutinised by academic commentators and the public. Spreadsheets could be published. Data vintages and model iterations readily archivable.
Proportionality	Good. A suitable investment for the importance of the tax in the Commission's mandate and overall public finances. Unlikely to benefit from additional sophistication or analytical resources.
Sustainability	Good. Models can be passed to analysts with a general economics background. Identities, straightforward structural econometric equations, intuitive relationships.
Precedent	Good. More sophisticated methodology than used in benchmark IFIs (as expected given the higher importance of the taxes in the SFC's mandate and Scotland's public finances).
Verdict	Appropriate, unqualified.

9. LBTT (Land and buildings transaction tax)

Tool	Residential LBTT forecast model
Description	Residential LBTT is paid on all residential property transactions in Scotland, it is a progressive tax paid and replaced the UK wide Stamp Duty Land Tax in 2015. The model generates a distribution of residential transactions by house price band using a lognormal distribution. Defining this distribution requires three pieces of information: the mean house price, the median house price and the total number of transactions. These three determinants are forecast using ARIMA models. The Commission has indicated that it will be moving to a price bins approach similar to microsimulation. It will be based on the same general approach (forecasting the distribution).
Type	Tax rates applied to a base modeled forecast with economic determinants and an imposed statistical distribution to capture tax brackets. Policy model with twin goals: fit to data and capture dynamics, but with enough structure to trace effects of policies and shocks.
Mandate	Section 2(2)(a)(i) *[…] the Commission must on at least 2 occasions for each financial year prepare reports containing its 5-year forecasts of the devolved taxes.*
Outputs	Residential LBTT revenues (excluding ADS)
Working paper	Scottish Fiscal Commission (2017). Current approach to forecasting September 2017 (SG/2018/155). Edinburgh: SFC. Available at: http://www.fiscalcommission.scot/publications/occasional-papers/current-approach-to-forecasting-september-2017/.
Reports	Scotland's Economic and Fiscal Forecasts
Software	R and Excel
1. Theoretical justifications	Good. Based on sound, well-studied economic relationships and academic consensus. Adheres to principles in peer-reviewed literature and supranational guidance. Suited to Scotland's data.
2. Accuracy	Good. Limited data, only pre-audited outturn data for 2017-18. Cannot yet evaluate forecasts a full year ahead. IYE estimates within reasonable error thresholds. Likely to produce similar errors as OBR. Likely to outperform statistical time series approaches. Not likely to have significant biases, although too early to quantitatively assess. Volatility of the outturn data may hinder formal accuracy tests.
3. Communication	Good. Can produce coherent, intuitive narratives in-line with economic theory. Coefficients are interpretable. Straightforward to explain to non-specialists.
4. Transparency	Good. Assumptions can be made readily available and scrutinised by academic commentators and the public. Good use of free and open-source software. Data vintages and model iterations readily archivable.
5. Proportionality	Good. A suitable investment for the importance of the tax in the Commission's mandate and overall public finances. Unlikely to benefit from additional sophistication or analytical resources.

6. Sustainability	Good. Models can be passed to analysts with a general economics background. Identities, straightforward structural econometric equations, intuitive relationships. R code requires some specialist background, but reasonable to expect of junior analysts with a degree in economics or a similar field.
7. Precedent	Good. More sophisticated methodology than used in benchmark IFIs (as expected given the higher importance of the taxes in the SFC's mandate and Scotland's public finances).
Verdict	Appropriate, unqualified.

10. Additional Dwelling Supplement

Tool	Additional Dwelling Supplement (ADS) forecast model
Description	The ADS surcharge is a tax of 4% applied to the total value of prescribed non-principle residential property transactions such as buy-to-let or second homes. ADS is also payable on purchases of new primary residences before completing the sale of previous property but can be reclaimed if the previous primary residence is sold within 18 months. The model generates a distribution of residential transactions by house price band using a lognormal distribution. Defining this distribution requires three pieces of information: the mean house price, the median house price and the total number of transactions. These three determinants are forecast using ARIMA models.
Type	Distribution projected and applied to transactions and prices. Policy model with twin goals: fit to data and capture dynamics, but with enough structure to trace effects of policies and shocks.
Mandate	Section 2(2)(a)(i) *[…] the Commission must on at least 2 occasions for each financial year prepare reports containing its 5-year forecasts of the devolved taxes.*
Outputs	ADS forecast
Working paper	Scottish Fiscal Commission (2017). *Current approach to forecasting September 2017* (SG/2018/155). Edinburgh: SFC. http://www.fiscalcommission.scot/publications/occasional-papers/current-approach-to-forecasting-september-2017/.
Reports	Scotland's Economic and Fiscal Forecasts
Software	R and Excel
1. Theoretical justifications	Good. Based on sound, well-studied economic relationships and academic consensus. Adheres to principles in peer-reviewed literature and supranational guidance. Suited to Scotland's data.
2. Accuracy	Good. Forecast evaluation results within acceptable tolerances given underling variance. Good balanced of structural and statistical time series approaches. Not likely to have significant biases. Has suffered from similar overestimates of transactions as LBTT but offset by overestimated reclaiming/repayments.
3. Communication	Good. Can produce coherent, intuitive narratives in-line with economic theory and distributional developments, albeit with some challenges owing to univariate ARIMA projections of underlying distributional parameters. Straightforward to explain to non-specialists.
4. Transparency	Good. No constraints or business considerations to prevent releasing R code. Good use of free and open-source software. Data vintages and model iterations readily archivable.
5. Proportionality	Good. A suitable investment for the importance of the tax in the Commission's mandate and Scotland's overall public finances.
6. Sustainability	Good. R code requires some specialist background, but reasonable to expect of junior analysts with a degree in economics or a similar field. Model can be passed to analysts with a general economics background. Uses straightforward statistical techniques and structural equations that should be in a public finance analyst's toolkit.
7. Precedent	Good. Similar methodology is used in benchmark IFIs.
Verdict	Appropriate, unqualified.

11. First Time Buyer relief and ADS tax increase behavioural adjustment models

Tool	Ad hoc policy costing tool for First Time Buyer relief and ADS tax increase
Description	Tool to adjust the main Residential LBTT model for policy initiatives related to the First Time Buyer relief and ADS tax increase. Distribution of revenue is estimated using SFC's forecasts for prices and transactions. New tax rate is applied to initial set of prices and transactions. An adjustment is made for forestalling in advance of the policy change if required (transactions being brought forward to avoid the new higher tax). To calculate the longer-term response of taxpayers to the policy change (the behavioural effect), the effective tax rates under the old system are compared to the new system. OBR elasticities are applied to the difference to determine how many transactions will be lost as a result of the new tax rate, and what the effect on house prices will be.
Type	Behavioural elasticities applied to changes in effective tax rates. Policy model with twin goals: fit to data and capture dynamics, but with enough structure to trace effects of policies and shocks.
Mandate	Section 2(2)(a)(i) *[…] the Commission must on at least 2 occasions for each financial year prepare reports containing its 5-year forecasts of the devolved taxes.*
Outputs	Multiple sets of determinants prices and transactions which depict revenue before and after the introduction of the tax changes. Post-policy determinants account for the behavioral effect of the introduction of the tax change.
Working paper	None
Reports	Scotland's Economic and Fiscal Forecasts – detail is included in the Annexes to the December publications where the policy changes were announced. First Time Buyer Relief was announced and costed in December 2017, Scottish Fiscal Commission (2017) Scotland's Economic and Fiscal Forecasts – December 2017 (link). The increase in the Additional Dwelling Supplement was announced and costed in December 2018, Scottish Fiscal Commission (2018) Scotland's Economic and Fiscal Forecasts – December 2018 (link).
Software	R and Excel
1. Theoretical justifications	Good. The OBR elasticities were adapted from HMRC assessments of past policy interventions that were performed using sound econometric techniques and controls.
2. Accuracy	Good. Although HMRC's analysis excluded Scotland, there is no reason to believe that behavioural effects should be different for Scottish taxpayers (and rough internal analysis shared with the review team confirms). The SFC could benefit from additional research efforts to estimate and publish elasticities from Scottish interventions or by leveraging the research programs of academics who work on the Scottish market.
3. Communication	Good. Coefficients are interpretable. Can produce coherent, intuitive narratives in-line with economic theory. Straightforward to explain to non-specialists.
4. Transparency	Good. Elasticity assumptions can be made readily available and scrutinised by academic commentators and the public. The OBR publishes detailed tables and explanations. Good use of free and open-source software.

5. Proportionality	Good. A suitable investment, given the importance of housing market tax forecasts and analysis to the Commission's mandate and the overall public finances (although the incremental costs are small—the tool has been used in multiple policy costings, and the results range from a £6m tax lost for the First Time Buyers costing to £27 m tax gain for the higher ADS tax rate). Although analysis and elasticity estimates for the Scottish housing market would provide reassurance, any significant investments to produce them would probably have a negligible marginal benefit, unless drastically different than the rest of the UK.
6. Sustainability	Good. R code requires some specialist background, but reasonable to expect of junior analysts with a degree in economics or a similar field. Familiarity with activity and revenue elasticity relationships should be in basic toolset of public finance economists.
7. Precedent	Good. Exceeds the sophistication of many benchmark IFIs.
Verdict	Appropriate, unqualified.

12. Non-residential LBTT

Tool	Non-Residential LBTT forecast model
Description	Non-Residential LBTT is paid on non-residential property and land transactions in Scotland. The model has three components: an in-year estimate, a base year and a forecast beyond the in-year forecast. The in-year estimate is constructed using the seasonal pattern of revenues from previous years. The remainder of the forecast uses administration data that has been aggregated by price band. Prices and transactions in each price band are grown in line with market forecasts for prices and transactions. These determinants are linked to the Commission's forecasts for GDP growth (transactions) and the GDP deflator (prices). The base year for the forecast is a three-year average of the most recent years for data is available for the distribution of transactions by price band.
Type	Bottom-up administration/survey data grown with market forecasts for prices and transactions and economic determinants. Policy model with twin goals: fit to data and capture dynamics, but with enough structure to trace effects of policies and shocks.
Mandate	Section 2(2)(a)(i) *[…] the Commission must on at least 2 occasions for each financial year prepare reports containing its 5-year forecasts of the devolved taxes.*
Outputs	Non-Residential LBTT revenues (excluding ADS)
Working paper	Scottish Fiscal Commission (2017). Current approach to forecasting September 2017 (SG/2018/155). Edinburgh: SFC. http://www.fiscalcommission.scot/publications/occasional-papers/current-approach-to-forecasting-september-2017/.
Reports that use	Scotland's Economic and Fiscal Forecasts
Software	Excel
1. Theoretical justifications	Good. In-line with EU and IMF guidance and benchmark institutions. Suited for Scotland's data.
2. Accuracy	Good. In-year estimates generally very accurate (or as accurate as possible given the volatility of the tax), provided there are several months of observations. Could test to see if sensitive to economic factors and gear quarterly pattern to economy. Base year and projections likely to fall within acceptable error intervals, although they may nonetheless be large in terms of absolute value given the volatility of the tax.
3. Communication	Good. Can produce coherent, intuitive narratives in-line with market conditions, economic theory, and policy innovations. Straightforward to explain to non-specialists.
4. Transparency	Good. Transactions and price assumptions can easily be published and scrutinised by academic commentators and the public. No constraints or business considerations to prevent releasing spreadsheet. Data vintages and model iterations readily archivable.
5. Proportionality	Good. A suitable investment for the importance of the tax in the Commission's mandate and overall public finances (£208 million in 2018-19).
6. Sustainability	Good. Spreadsheet models can be passed to analysts with little experience or expertise in real estate market. Simple moving average where appropriate. Simple growth-rates. Identities and straightforward structural equations, intuitive relationships.
7. Precedent	Good. Exceeds the sophistication of many benchmark IFIs.
Verdict	Appropriate, unqualified.

13. Scottish Landfill Tax (SLfT)

Tool	SLfT forecast model
Description	SLfT is paid on waste landfilled in Scotland, the amount of tax paid—either standard-rate or reduced-rated—depends on the category of waste. Outturn data from Revenue Scotland on standard-rated and reduced-rate tonnages at landfills is grown at the same rate as projected growth in household and business waste generated, net of recycling. Waste tonnage is deducted to account for additional incineration capacity due to come online. From 2021, biodegradable municipal waste tonnage is deducted as a result of the Scottish Government's forthcoming ban. Finally, the standard and reduced tax charges per tonne are applied, indexed to UK RPI inflation.
Type	Revenue forecast model. Policy model with twin goals: fit to data and capture dynamics, but with enough structure to trace effects of policies and shocks.
Mandate	Section 2(2)(a)(i) *[…] the Commission must on at least 2 occasions for each financial year prepare reports containing its 5-year forecasts of the devolved taxes.*
Outputs	SLfT revenues
Working paper	Scottish Fiscal Commission (2017). *Current approach to forecasting September 2017* (SG/2018/155). Edinburgh: SFC. http://www.fiscalcommission.scot/publications/occasional-papers/current-approach-to-forecasting-september-2017/.
Reports that use	Scotland's Economic and Fiscal Forecasts
Software	Excel
1. Theoretical justifications	Good. Standard base-times-rate model, following EU and IMF guidance and benchmark institutions. Suited for Scotland's data.
2. Accuracy	Good. Forecast evaluation results within acceptable tolerances given underling variance. Similar errors to OBR. Likely to outperform statistical time series approaches. Not likely to have significant biases. Large construction projects can bring large unavoidable forecast errors.
3. Communication	Good. Can produce coherent, intuitive narratives in-line with economic theory and underlying regulatory trends, technological developments, and policy innovations. Straightforward to explain to non-specialists.
4. Transparency	Good. Growth assumptions can easily be published and scrutinised by academic commentators and the public. No constraints or business considerations to prevent releasing spreadsheet model, although some discussions with SEPA and construction information may be sensitive. Data vintages and model iterations readily archivable.
5. Proportionality	Good. Materiality to overall public finances is small (£136 million in 2018-19) and analyst workload also small. High importance to the Commission's mandate and relatively small investment, but greater model development would have negligible returns.
6. Sustainability	Good. Excel models can be passed to analysts with a general economics background or even non-specialist. Simple growth equations, intuitive relationships.
7. Precedent	Good. Approach is common to most benchmark IFIs for similar environmental taxes or taxes with similar fiscal materiality.
Verdict	Appropriate, unqualified.

14. APD (Air Passenger Duty)

Tool	APD forecast model
Description	Air Passenger Duty is paid by passengers departing UK airports. The amount paid depends on the distance and class of travel. APD was scheduled to be devolved in April 2018 and replaced by Air Departure Tax but has been delayed due to state aid issues. The model uses the historic time series of Scottish passengers to forecast future passenger numbers. We use Civil Aviation Authority survey data to allocate passengers into the different destination bands and classes. The appropriate tax rate will then be applied to these passengers to estimate total APD receipts.
Type	Combination of survey data and statistical projection model. Policy model with twin goals: fit to data and capture dynamics, but with enough structure to trace effects of policies and shocks. Currently being adapted for new CAA survey data for Scotland for 2018 and simplified. Results below should remain unaffected by development plan.
Mandate	Section 2(2)(a)(i) *[…] the Commission must on at least 2 occasions for each financial year prepare reports containing its 5-year forecasts of the devolved taxes.* In anticipation of devolution, the SFC is building model capacity and preparing illustrative forecasts.
Outputs	Illustrative APD revenues (estimates of the Scottish share are produced but no Scottish revenues are collected).
Working paper	Scottish Fiscal Commission (2017). Current approach to forecasting September 2017 (SG/2018/155). Edinburgh: SFC. http://www.fiscalcommission.scot/publications/occasional-papers/current-approach-to-forecasting-september-2017/.
Reports that use	Scotland's Economic and Fiscal Forecasts
Software	Excel, R
1. Theoretical justifications	Good. Standard base-times-rate model, following EU and IMF guidance and benchmark institutions. Suited for Scotland's data.
2. Accuracy	Good. Although no Scottish outturn data available yet for formal evaluation, the methodology is likely to outperform statistical time series approaches. Not likely to have significant biases.
3. Communication	Good. Can produce coherent, intuitive narratives in-line with economic theory and underlying regulatory trends, technological developments, and policy innovations. Straightforward to explain to non-specialists.
4. Transparency	Good. Passenger projections can easily be published and scrutinised by academic commentators and the public. No constraints or business considerations to prevent releasing spreadsheet and R code. Good use of free and open-source software. Data vintages and model iterations readily archivable.
5. Proportionality	Good. Materiality to overall public finances is small and not yet mandated, but analyst workload to develop has been small and a good exercise in capacity-building for the future. Will be important to the Commission's mandate and an investment with a high marginal return. Unlikely to benefit from additional investment in model sophistication or analytical resources.

6. Sustainability	Good. Excel models can be passed to analysts with a general economics background or even non-specialists. R code requires some specialist background, but reasonable to expect of junior analysts with a degree in economics or a similar field and appropriate to address with professional development opportunities (a generalist skill with high returns for broad public-sector roles). Simple growth equations, intuitive relationships.
7. International precedence	Good. Approach is common to most benchmark IFIs for similar excise taxes or taxes with similar fiscal materiality.
Verdict	Appropriate, unqualified.

Social Security

15. Carer's Allowance (CA) and Carer's Allowance Supplement (CAS)

Tool	Carer's Allowance and Carer's Allowance Supplement forecasting model
Description	CA is a weekly payment, worth £66.15 in 2019-20 paid to people who care for someone who is disabled. CAS is paid in two lump sums each financial year to everyone receiving CA in Scotland on qualifying dates. Historic claim rates are determined by the number of individuals receiving CA payments historically by age and gender compared to the population. Claim rates are forecast forward using an ARIMA model in R. The forecast claim rates are multiplied against the projected Scottish population to arrive at caseload. Payment rates are uprated with CPI and the future caseload is multiplied by the future payment amount to arrive at expenditure. An adjustment factor is applied to account for differences between expenditure estimates based on claimant statistics and total actual expenditure. The supplement is calculated using the CA forecast adjusted for different payment frequencies and amounts.
Type	Expenditure forecasting model using ARIMA. Policy model with twin goals: fit to data and capture dynamics, but with enough structure to trace effects of policies and shocks.
Mandate	Section 2(2)(aa) *[…] the Commission must on at least 2 occasions for each financial year prepare reports containing its 5-year forecasts of devolved social security expenditure.*
Outputs	Annual Scottish expenditure and caseload forecasts for Carer's Allowance and Carer's Allowance Supplement
Working paper	http://www.fiscalcommission.scot/publications/occasional-papers/approach-to-forecasting-social-security-september-2018/
Reports that use	Scotland's economic and fiscal forecasts
Software	Excel, R
1. Theoretical justifications	Good. Based on underlying structural relationships. Adheres to principles in supranational guidance. Suited to Scotland's data.
2. Accuracy	Good. Forecast evaluation results within acceptable tolerances given underlying variance. Structural recipients modelling likely to outperform statistical time series approaches. Not likely to have significant biases.
3. Communication	Good. Can produce coherent, intuitive narratives in-line with economic theory. Straightforward to explain to non-specialists.
4. Transparency	Good. Assumptions can be made readily available and scrutinised by academic commentators and the public. Good use of free and open-source software. Spreadsheets could be published. Data vintages and model iterations readily archivable.
5. Proportionality	Good. A suitable investment for the importance of the program in the Commission's mandate and overall public finances (£320 million in 2019-20).
6. Sustainability	Good. Uses straightforward statistical techniques and structural equations that should be in a public finance analyst's toolkit. Spreadsheet models easily passed to new analysts. R code

	requires some specialist background, but reasonable to expect of junior analysts with a degree in economics or a similar field.
7. Precedent	Good. Approach is common to most benchmark IFIs for similar spending programs with similar fiscal materiality.
8. Verdict	Appropriate, unqualified.

16. Discretionary Housing Payments (DHP)

Tool	Discretionary Housing Payments forecasting model
Description	DHP are grants awarded by local authorities to recipients of certain benefits who need financial assistance with housing costs. The Scottish Government provides funding to local authorities who dispense the grants and manage the budget throughout the year. The budget for DHPs is split into two parts. The first is demand-led and dedicated to the mitigation of the 'removal of the spare room subsidy' (RSRS) also known as the bedroom tax, the second is a discretionary fund of fixed value which SFC does not model. For the mitigation of RSRS, the most recent historical spending is projected with the growth of rent levels for social housing and the growth of social housing properties.
Type	Policy model with twin goals: fit to data and capture dynamics, but with enough structure to trace effects of policies and shocks.
Task	Section 2(2)(aa) *[…] the Commission must on at least 2 occasions for each financial year prepare reports containing its 5-year forecasts of devolved social security expenditure.*
Outputs	Annual Scottish expenditure for Discretionary Housing Payments
Working paper	http://www.fiscalcommission.scot/publications/occasional-papers/approach-to-forecasting-social-security-september-2018/
Reports that use	Scotland's economic and fiscal forecast
Software	Excel
1. Theoretical justifications	Good. Based on underlying structural relationships. Adheres to principles in supranational guidance. Suited to Scotland's data.
2. Accuracy	Good. Forecast evaluation results within acceptable tolerances given underlying variance. Structural recipients modelling likely to outperform statistical time series approaches. Not likely to have significant biases.
3. Communication	Good. Can produce coherent, intuitive narratives in-line with economic theory. Straightforward to explain to non-specialists.
4. Transparency	Good. Assumptions can be made readily available and scrutinised by academic commentators and the public. Spreadsheets could be published. Data vintages and model iterations readily archivable.
5. Proportionality	Good. A suitable investment for the importance of the program in the Commission's mandate and overall public finances (£63 million in 2019-20).
6. Sustainability	Good. Uses straightforward statistical techniques and structural equations that should be in a public finance analyst's toolkit. Spreadsheet models easily passed to new analysts.
7. Precedent	Good. Approach is common to most benchmark IFIs for similar spending programs with similar fiscal materiality.
Verdict	Appropriate, unqualified.

17. Best Start Grant (BSG)

Tool	Best Start Grant forecasting model
Benefit Description	BSG is a series of one-off payments to help low income households with the costs associated with having a child. To qualify families must have been awarded at least one of the qualifying benefits. To calculate eligible recipients, the number of children at qualifying ages and households is projected and adjusted by a take-up rate. The result is multiplied by the expected number of payments in each forecast year along with the payment amount.
Type	Policy model with twin goals: fit to data and capture dynamics, but with enough structure to trace effects of policies and shocks.
Task	Section 2(2)(aa) *[…] the Commission must on at least 2 occasions for each financial year prepare reports containing its 5-year forecasts of devolved social security expenditure.*
Outputs	Annual Scottish expenditure and caseload for Best Start Grant
Working paper	http://www.fiscalcommission.scot/publications/occasional-papers/approach-to-forecasting-social-security-september-2018/
Reports that use	Scotland's economic and fiscal forecasts
Software	Excel
1. Theoretical justifications	Good. Based on underlying structural relationships. Adheres to principles in supranational guidance. Suited to Scotland's data.
2. Accuracy	Good. Forecast evaluation results within acceptable tolerances given underlying variance. Structural recipients modelling likely to outperform statistical time series approaches. Not likely to have significant biases.
3. Communication	Good. Can produce coherent, intuitive narratives in-line with economic theory. Straightforward to explain to non-specialists.
4. Transparency	Good. Assumptions can be made readily available and scrutinised by academic commentators and the public. Spreadsheets could be published. Data vintages and model iterations readily archivable.
5. Proportionality	Good. A large investment for the importance of the program in the Commission's mandate and overall public finances (£12 million in 2019-20) but shouldn't detract from other work.
6. Sustainability	Good. Uses straightforward statistical techniques and structural equations that should be in a public finance analyst's toolkit. Spreadsheet models easily passed to new analysts.
7. Precedent	Good. Approach is common to most benchmark IFIs for similar spending programs with similar fiscal materiality.
Verdict	Appropriate, unqualified.

18. Best Start Foods (BSF)

Tool	Best Start Foods forecasting model
Description	BSF provides weekly payments to eligible families where the mother is pregnant and/or has children under the age of three. These payments are pre-loaded to a smartcard every four weeks and can be used to purchase a range of healthy foods. The number of eligible pregnant women and children it projected from ONS population estimates for the qualifying age cohorts, adjusted for a qualification ratio derived from historical data from the Department of Health and Social Care. A take-up rate is applied to the eligible population and the result is multiplied by the number of payments in a year and an average annualised payment.
Type	Policy model with twin goals: fit to data and capture dynamics, but with enough structure to trace effects of policies and shocks.
Task	Section 2(2)(aa) *[…] the Commission must on at least 2 occasions for each financial year prepare reports containing its 5-year forecasts of devolved social security expenditure.*
Outputs	Annual Scottish expenditure and caseload for Best Start Foods
Working paper	http://www.fiscalcommission.scot/publications/occasional-papers/approach-to-forecasting-social-security-september-2018/
Reports that use	Scotland's economic and fiscal forecast
Software	Excel
1. Theoretical justifications	Good. Based on underlying structural relationships. Adheres to principles in supranational guidance. Suited to Scotland's data.
2. Accuracy	Good. Forecast evaluation results within acceptable tolerances given underlying variance. Structural recipients modelling likely to outperform statistical time series approaches. Not likely to have significant biases.
3. Communication	Good. Can produce coherent, intuitive narratives in-line with economic theory. Straightforward to explain to non-specialists.
4. Transparency	Good. Assumptions can be made readily available and scrutinised by academic commentators and the public. Spreadsheets could be published. Data vintages and model iterations readily archivable.
5. Proportionality	Good. A large investment for the importance of the program in the Commission's mandate and overall public finances (£4 million in 2019-20) but shouldn't detract from other work.
6. Sustainability	Good. Uses straightforward statistical techniques and structural equations that should be in a public finance analyst's toolkit. Spreadsheet models easily passed to new analysts.
7. Precedent	Good. Approach is common to most benchmark IFIs for similar spending programs with similar fiscal materiality.
Verdict	Appropriate, unqualified.

19. Funeral Expense Assistance (FEA)

Tool	Funeral Expense Assistance forecasting model
Description	FEA supports individuals on low incomes with funeral costs. The amount paid in FEA is split into two components. The first covers reasonable burial or cremation costs; the second is a flat rate amount for 'other' expenses associated with the funeral. FEA will replace the UK Government's Funeral Payment system. The number of funerals eligible are estimated by multiplying the projected number of deaths from ONS by estimated proportions eligible after means-testing. The proportions are calculated using information from the Family Resources Survey and Understanding Society Survey. Historical average awards under the UK Government's Funeral Payment system are adjusted by the Scottish Government uprating policy to project future awards. This is then multiplied by eligible claimants to arrive at the expenditure forecast.
Type	Policy model with twin goals: fit to data and capture dynamics, but with enough structure to trace effects of policies and shocks.
Task	Section 2(2)(aa) *[…] the Commission must on at least 2 occasions for each financial year prepare reports containing its 5-year forecasts of devolved social security expenditure.*
Outputs	Annual Scottish Expenditure and caseload for FEA
Working paper	http://www.fiscalcommission.scot/publications/occasional-papers/approach-to-forecasting-social-security-september-2018/
Reports that use	Scotland's economic and fiscal forecasts
Software	Excel, SAS
1. Theoretical justifications	Good. Based on underlying structural relationships. Adheres to principles in supranational guidance. Suited to Scotland's data.
2. Accuracy	Good. Forecast evaluation results within acceptable tolerances given underlying variance. Structural recipients modelling likely to outperform statistical time series approaches. Not likely to have significant biases.
3. Communication	Good. Can produce coherent, intuitive narratives in-line with economic theory. Straightforward to explain to non-specialists.
4. Transparency	Good. Assumptions can be made readily available and scrutinised by academic commentators and the public. Spreadsheets could be published. SAS not ideal. Data vintages and model iterations readily archivable.
5. Proportionality	Good. A large investment for the importance of the program in the Commission's mandate and overall public finances (£6 million in 2019-20) but shouldn't detract from other work.
6. Sustainability	Good. Uses straightforward statistical techniques and structural equations that should be in a public finance analyst's toolkit. Spreadsheet models easily passed to new analysts.
7. Precedent	Good. Approach is common to most benchmark IFIs for similar spending programs with similar fiscal materiality.
Verdict	Appropriate, unqualified.

20. Employability Services

Tool	Employability forecasting model
Description	The Scottish Government's Fair Start Scotland (FSS) service launched on 3rd April 2018. It is a voluntary service designed to help people with disabilities or at risk of long-term unemployment find sustained employment. The Scottish Government has contracted external providers to deliver the service. Performance-related fees are paid to providers based on the length of time individuals are employed and the number of job outcomes. Service fees are paid to providers over the first three years of a contract. Service providers give forecasts of the number of people they expect to help into sustained employment along with the costs of supporting people in each group through the full service to the 12-month employment outcome and how many people in each group would sustain employment for the 13, 26 and 52 weeks. The employability services expenditure forecast is based on data provided by Scottish Government analysts and SFC monitors figures and compares performance against expectations to develop its expenditure forecasts. The model is run by the Scottish Government with the Commission owning and scrutinising the forecasts.
Type	Administration information generated by the service providers and the Scottish Government's performance management activity.
Task	Section 2(2)(aa) *[…] the Commission must on at least 2 occasions for each financial year prepare reports containing its 5-year forecasts of devolved social security expenditure.*
Outputs	Annual Scottish expenditure for Employability Services
Working paper	http://www.fiscalcommission.scot/publications/occasional-papers/approach-to-forecasting-social-security-september-2018/
Reports that use	Scotland's economic and fiscal forecasts
Software	Excel
1. Theoretical justifications	N/A. Resource planning directly from service providers and the government agency responsible.
2. Accuracy	N/A. Resource planning directly from service providers and the government agency responsible.
3. Communication	N/A. Resource planning directly from service providers and the government agency responsible.
4. Transparency	N/A. Resource planning directly from service providers and the government agency responsible.
5. Proportionality	N/A. Resource planning directly from service providers and the government agency responsible.
6. Sustainability	N/A. Resource planning directly from service providers and the government agency responsible.
7. Precedent	Good. Other benchmark IFIs do the same for similar spending programs.
Verdict	Appropriate, unqualified.

21. Attendance Allowance

Tool	Attendance Allowance forecasting model
Description	AA is paid to those over state pension age with a physical or mental disability severe enough that they need someone to help look after them. Modeled as *Spending = caseload x average award x gross-up factor* Caseload is calculated as a percentage of population in each single-year age cohort by year of birth. Each cohort is forecast using the age-specific growth rate of the previous cohort. Average award for each forecast year is calculated as the average award in year t-1 multiplied by CPI in the third quarter of September year t-1. A gross-up factor is applied, as experience shows this to underestimate benefits
Type	Policy model with twin goals: fit to data and capture dynamics, but with enough structure to trace effects of policies and shocks.
Task	Section 2(2)(aa) *[…] the Commission must on at least 2 occasions for each financial year prepare reports containing its 5-year forecasts of devolved social security expenditure.*
Outputs	Annual caseload and expenditure for Attendance Allowance
Working paper	No working paper
Reports that use	Scotland's Economic and Fiscal Forecast.
Software	Excel
1. Theoretical justifications	Good. Based on underlying structural relationships. Adheres to principles in supranational guidance. Suited to Scotland's data.
2. Accuracy	Good. Forecast evaluation results within acceptable tolerances given underlying variance and gross-up factor calibration (though would be an improvement if could capture in model parameters and eliminate unexplained gross up). Structural recipients modelling likely to outperform statistical time series approaches. Not likely to have significant biases.
3. Communication	Good. Can produce coherent, intuitive narratives in-line with demographics and qualification criteria. Straightforward to explain to non-specialists.
4. Transparency	Good. Assumptions can be made readily available and scrutinised by academic commentators and the public. Spreadsheets could be published. Data vintages and model iterations readily archivable.
5. Proportionality	Good. A suitable investment for the importance of the program in the Commission's mandate and overall public finances (£492 million in 2019-20).
6. Sustainability	Good. Uses straightforward statistical techniques and structural equations that should be in a public finance analyst's toolkit. Spreadsheet models easily passed to new analysts.
7. Precedent	Good. Approach is common to most benchmark IFIs for benefits with similar fiscal materiality.
Verdict	Appropriate, unqualified.

22. Cold Weather Payments (CWP)

Tool	Cold Weather Payment forecasting model
Benefit Description	A payment for individuals who qualify for certain means-tested benefits when the temperature in their area is recorded as a average of zero degrees Celsius or below over seven consecutive days. Given the volatility in the expenditure for this benefit, the model follows the fiscal framework agreement and takes an average of historical Scottish expenditure for Cold Weather Payments from 2008-09 onwards.
Type	Rule of thumb: average of historical expenditure
Task	Section 2(2)(aa) *[…] the Commission must on at least 2 occasions for each financial year prepare reports containing its 5-year forecasts of devolved social security expenditure.*
Outputs	Annual expenditure for Cold Weather Payments in Scotland.
Working paper	N/A
Reports that use	Scotland's Economic and Fiscal Forecasts.
Software	Excel
1. Theoretical justifications	Good. Rule of thumb forecasts for small, volatile spending programs are recommended by supranational guidance.
2. Accuracy	N/A. Program is as unpredictable as the weather. Planning assumption appropriate.
3. Communication	Good. "The best we can do is take a historical average" is an easy sell to stakeholders for programs like this.
4. Transparency	Good. Rule of thumb forecasts are among the most transparent. Everyone is operating from the same data with the same model and an outsider can repeat the results exactly. No judgment.
5. Proportionality	Good. Uses as few resources as possible and additional investment would not yield a return, given the impossibility of forecasting weather beyond a week ahead.
6. Sustainability	Good. Uses simple average anyone can inherit spreadsheet and operate.
7. Precedent	Good. Approach is common to most benchmark IFIs for similar small and volatile programs.
Verdict	Appropriate, unqualified.

23. Disability Living Allowance (DLA) – Child

Tool	Disability Living Allowance Child forecasting model
Description	Payments to help with the extra costs of looking after a child who is under 16 and has difficulty walking or needs much more looking after than a child of the same age who does not have a disability. Modeled as *Spending = caseload x average award x gross-up factor* Caseload is calculated as a percentage of the population for both males and females and for each single year of age and each birth cohort. Each cohort is forecast up to age 15 using the age-specific growth rate of the previous cohort. Average award for each forecast year is calculated as the average award in year t-1 multiplied by CPI in the third quarter of September year t-1. Average award is assumed to fall over time, according to the same trend over the last 10 years. A gross-up factor is applied, as recent outturn data has shown the model to underestimate benefits.
Type	Policy model with twin goals: fit to data and capture dynamics, but with enough structure to trace effects of policies and shocks.
Task	Section 2(2)(aa) *[…] the Commission must on at least 2 occasions for each financial year prepare reports containing its 5-year forecasts of devolved social security expenditure.*
Outputs	Annual caseload and expenditure forecasts for Scotland of DLA Child
Working paper	N/A
Reports that use	Scotland's economic and fiscal forecasts.
Software	Excel
1. Theoretical justifications	Good. Based on underlying structural relationships. Adheres to principles in supranational guidance. Suited to Scotland's data.
2. Accuracy	Good. Forecast evaluation results within acceptable tolerances given underlying variance and gross-up factor calibration (though would be an improvement if could capture in model parameters and eliminate unexplained gross up). Structural recipients modelling likely to outperform statistical time series approaches. Not likely to have significant biases.
3. Communication	Good. Can produce coherent, intuitive narratives in-line with demographics and qualification criteria. Straightforward to explain to non-specialists.
4. Transparency	Good. Assumptions can be made readily available and scrutinised by academic commentators and the public. Spreadsheets could be published. Data vintages and model iterations readily archivable.
5. Proportionality	Good. A suitable investment for the importance of the program in the Commission's mandate and overall public finances (£157 million in 2019-20).
6. Sustainability	Good. Uses straightforward statistical techniques and structural equations that should be in a public finance analyst's toolkit. Spreadsheet models easily passed to new analysts.
7. Precedent	Good. Approach is common to most benchmark IFIs for benefits with similar fiscal materiality.
Verdict	Appropriate, unqualified.

24. Disability Living Allowance (DLA) – Working & State Pension Age

Tool	Disability Living Allowance Working and State Pension Age forecasting model
Description	Payments for disabled people who need help with mobility or care costs. Personal Independence Payment is replacing DLA for disabled people aged 16 to 64. The forecast for the Working and State Pensions Age contains claimants between the ages of 18 and 69 as at August 2018; as well as a small number of claimants incoming from DLA child. State Pension age claimants aged 70 and over are covered in the DLA pensioners' model. The migration of the Working and State Pension Age group is assumed to be finished by February 2021 as noted in the OBR's March 2019 publication. The August 2018 caseload is assumed to proportionally decrease from August 2018 to February 2021 evenly across all age groups. Average award forecasts by age groups have been produced in order to account for the changes in award (care and mobility at different levels) paid at specific ages. The age-specific real average award trend has been projected up to August 2019, and the average award is fixed thereafter, uprated for inflation. A gross-up figure is applied which aligns DWP expenditure figures with estimates from StatXplore. This is an average of the gross-up factors observed in recent years.
Type	Policy model with twin goals: fit to data and capture dynamics, but with enough structure to trace effects of policies and shocks.
Task	Section 2(2)(aa) *[…] the Commission must on at least 2 occasions for each financial year prepare reports containing its 5-year forecasts of devolved social security expenditure.*
Outputs	Annual caseload and expenditure forecasts for DLA Working Age and State pension age.
Working paper	N/A
Reports that use	Scotland's economic and fiscal forecast.
Software	Excel
1. Theoretical justifications	Good. Based on underlying structural relationships. Adheres to principles in supranational guidance. Suited to Scotland's data.
2. Accuracy	Good. Forecast evaluation results within acceptable tolerances given underlying variance and gross-up factor calibration (though would be an improvement if could capture in model parameters and eliminate unexplained gross up). Structural recipients modelling likely to outperform statistical time series approaches. Not likely to have significant biases.
3. Communication	Good. Can produce coherent, intuitive narratives in-line with demographics and qualification criteria. Straightforward to explain to non-specialists.
4. Transparency	Good. Assumptions can be made readily available and scrutinised by academic commentators and the public. Spreadsheets could be published. Data vintages and model iterations readily archivable.
5. Proportionality	Good. A suitable investment for the importance of the program in the Commission's mandate and overall public finances (£409 million in 2017-18 but will decline to zero when the PIP migration is completed). Unlikely to benefit from additional attention.
6. Sustainability	Good. Uses straightforward statistical techniques and structural equations that should be in a public finance analyst's toolkit. Spreadsheet models easily passed to new analysts.
7. Precedent	Good. Approach is common to most benchmark IFIs for benefits with similar fiscal materiality.
Verdict	Appropriate, unqualified.

25. Disability Living Allowance (DLA) - Pensioners

Tool	Disability Living Allowance Pensioners forecasting model
Description	Payments for disabled people who need help with mobility or care costs. Individuals in receipt of DLA and who are aged 65 on or before 8 April 2013 are unaffected by the introduction of Personal Independence Payment. DLA pensioners are claimants aged over 65 as at April 2013 and continuing to be eligible for DLA payments. There will be no new entrants into this group. Expenditure is estimated by multiplying the forecast of the future caseload and average award. To produce the caseload forecast, age-specific exit rates are applied to the latest data from DWP, broken down by single year of age. The exit rate represents the likelihood of a claimant leaving the group at a single year of age. The real terms award is projected with a simple linear regression uprated using the OBR's CPI forecast. The historical average award has been derived from the DLA pensioners' award split.
Type	Policy model with twin goals: fit to data and capture dynamics, but with enough structure to trace effects of policies and shocks.
Task	Forecast Section 2(2)(aa) *[…] the Commission must on at least 2 occasions for each financial year prepare reports containing its 5-year forecasts of devolved social security expenditure.*
Outputs	Annual caseload and expenditure forecasts for DLA pensioners
Working paper	No working paper
Reports that use	Scotland's Economic and Fiscal Forecast.
Software	Excel
1. Theoretical justifications	Good. Based on underlying structural relationships. Adheres to principles in supranational guidance. Suited to Scotland's data.
2. Accuracy	Good. Forecast evaluation results within acceptable tolerances given underlying variance and gross-up factor calibration. Structural recipients modelling likely to outperform statistical time series approaches. Not likely to have significant biases.
3. Communication	Good. Can produce coherent, intuitive narratives in-line with demographics and qualification criteria. Straightforward to explain to non-specialists.
4. Transparency	Good. Assumptions can be made readily available and scrutinised by academic commentators and the public. Spreadsheets could be published. Data vintages and model iterations readily archivable.
5. Proportionality	Good. A suitable investment for the importance of the program in the Commission's mandate and overall public finances (£423 million in 2017-18 but will continue to decline). Unlikely to benefit from additional attention.
6. Sustainability	Good. Uses straightforward statistical techniques and structural equations that should be in a public finance analyst's toolkit. Spreadsheet models easily passed to new analysts.
7. Precedent	Good. Approach is common to most benchmark IFIs for benefits with similar fiscal materiality.
Verdict	Appropriate, unqualified.

26. Severe Disablement Allowance (SDA)

Tool	Severe Disablement Allowance forecasting model
Description	Financial support for individuals who are unable to work due to severe disability. This has now been replaced by Employment and Support Allowance (ESA) so there are no new claims. Individuals who made a claim prior to the introduction of ESA and reached the pension age before 6 April 2014 can continue to receive payments. The model takes caseload and average weekly payment data for each quarter from NOMIS. The August data point is used to proxy the caseload and average weekly payments for a financial year and multiplied by quarters to arrive at expenditure figures based on NOMIS data. A comparison between the NOMIS expenditure figures and the DWP expenditure figures provides a gross-up factor which is applied to caseload estimates to give actual expenditure. The forecast caseload is calculated assuming a rate of decline in the caseload and projected forward. The forecast caseload is multiplied by the forecast average weekly payment amount to calculate a raw forecast expenditure. A gross-up factor is applied to arrive at expenditure for SDA.
Type	Policy model with twin goals: fit to data and capture dynamics, but with enough structure to trace effects of policies and shocks.
Task	Section 2(2)(aa) *[…] the Commission must on at least 2 occasions for each financial year prepare reports containing its 5-year forecasts of devolved social security expenditure.*
Outputs	Annual caseload and expenditure forecasts for SDA
Working paper	N/A
Reports that use	Scotland's Economic and Fiscal Forecast.
Software	Excel
1. Theoretical justifications	Good. Based on underlying structural relationships. Adheres to principles in supranational guidance. Suited to Scotland's data.
2. Accuracy	Good. Forecast evaluation results within acceptable tolerances given underlying variance and gross-up factor calibration (though would be an improvement if could capture in model parameters and eliminate unexplained gross up). Structural recipients modelling likely to outperform statistical time series approaches. Not likely to have significant biases.
3. Communication	Good. Can produce coherent, intuitive narratives in-line with demographics and qualification criteria. Straightforward to explain to non-specialists.
4. Transparency	Good. Assumptions can be made readily available and scrutinised by academic commentators and the public. Spreadsheets could be published. Data vintages and model iterations readily archivable.
5. Proportionality	Good. A considerable investment for the small importance of the program in the Commission's mandate and overall public finances (£12 million in 2017-18 but will continue to decline) but unlikely to distract from other research. Unlikely to benefit from additional attention.
6. Sustainability	Good. Uses straightforward statistical techniques and structural equations that should be in a public finance analyst's toolkit. Spreadsheet models easily passed to new analysts.

7. Precedent	Good. Approach exceeds sophistication of most benchmark IFIs for benefits with similar fiscal materiality.
Verdict	Appropriate, unqualified.

27. Winter Fuel Payments

Tool	Winter Fuel Payment forecasting model
Description	An annual lump sum payment to help pay for heating bills. This is awarded to people who are of the age to qualify for the Pension Credit (female state pension age) or older on a qualifying date. Subject to certain criteria, individuals can receive between £100 and £300 to help them pay their heating bills. The model uses demographic projections for the 60+ Scottish population, incorporating changes to the female state pension age, to project the historical WFP caseload forward for qualifying ages. This is multiplied by WFP payment rates to arrive at WFP expenditure.
Type	Simple beneficiaries times rates policy model with twin goals: fit to data and capture dynamics, but with enough structure to trace effects of policies and shocks.
Task	Section 2(2)(aa) *[…] the Commission must on at least 2 occasions for each financial year prepare reports containing its 5-year forecasts of devolved social security expenditure.*
Outputs	Annual caseload and expenditure forecast for WFP
Working paper	No working paper
Reports that use	Scotland's economic and fiscal forecast.
Software	Excel
1. Theoretical justifications	Good. Based on underlying structural relationships. Adheres to principles in supranational guidance. Suited to Scotland's data.
2. Accuracy	Good. Forecast evaluation results within acceptable tolerances given underlying variance. Structural recipients modelling likely to outperform statistical time series approaches. Not likely to have significant biases.
3. Communication	Good. Can produce coherent, intuitive narratives in-line with demographics and qualification criteria. Straightforward to explain to non-specialists.
4. Transparency	Good. Demographic projections and rate assumptions can be made readily available and scrutinised by academic commentators and the public. Spreadsheets could be published. Data vintages and model iterations readily archivable.
5. Proportionality	Good. A suitable investment for the importance of the program in the Commission's mandate and overall public finances. £176 million in 2017-18.
6. Sustainability	Good. Uses straightforward statistical techniques and structural equations that should be in a public finance analyst's toolkit. Spreadsheet models easily passed to new analysts.
7. Precedent	Good. Approach is common to most benchmark IFIs for similar spending programs with similar fiscal materiality.
Verdict	Appropriate, unqualified.

28. Industrial Injuries Benefit (IIB) – Population Share

Tool	Industrial Injuries Benefit forecasting model
Description	Support for individuals who are ill or disabled because of an accident or disease at work or while on an approved employment training scheme or course. The amount spent per person in the relevant population (working age and pensioner population) for both Scotland and Great Britain is calculated for each year. The ratio of spending per capita in Scotland versus Great Britain is calculated and assumptions are made to project the ratio over the forecast period for each of the different IIB benefits. The forecast ratio is applied to Great Britain per capita expenditure forecasts produced by the OBR to calculate future Scottish spending per capita. This is then multiplied by Scottish population projections to arrive at total program spending. The method of using a population share of the OBR forecast has been chosen to forecast IIB due to the limitations regarding available data from DWP. Further work will be performed by DWP prior to devolution to extract information about Scottish claimants.
Type	Population adjusted percentage share of Office of Budget Responsibility (OBR) forecast Policy model with twin goals: fit to data and capture dynamics, but with enough structure to trace effects of policies and shocks.
Task	Section 2(2)(aa) *[…] the Commission must on at least 2 occasions for each financial year prepare reports containing its 5-year forecasts of devolved social security expenditure.*
Outputs	Annual expenditure forecast for Scotland of Industrial Injuries Benefit
Working paper	N/A
Reports that use	Scotland's economic and fiscal forecasts.
Software	Excel
1. Theoretical justifications	Poor. Based on OBR projection.
2. Accuracy	Fair. Forecast evaluation results within acceptable tolerances given underlying variance. Not clear that other approaches that look at the structural and sectoral makeup of trends in Scotland's industries, sectors, and workforce wouldn't provide better forecasts. But data limitations.
3. Communication	Poor. Some story around the determination of ratios, but ultimately forecast with OBR's projections, which may not be a story that is defensible in front of a committee. Again, data limitations prevent other methodologies at this time.
4. Transparency	Poor. Ultimately, would need to rely on the OBR to provide details of the outlook. Unexplained and undocumented judgment when determining the ratio.
5. Proportionality	Fair. Does not use many resources, but the program is material to the public finances (£82 million in 2017-18) and would justify additional resources and modelling capacity, if data issues can be resolved.
6. Sustainability	Good. Straightforward technique. But may require considerable judgment and familiarity with the program. Spreadsheet models easily passed to new analysts.

7. Precedent	Good. With data limitations and programs of this size—not immaterial, but not substantial—other budget offices have been known to make simple adjustments to external forecasts.
Verdict	Appropriate, unqualified. Although the model performs poorly on most key criteria, it is a result of data limitations and unfortunately nothing can be done until further collaboration with DWP results in additional data. An MoU to do so has been agreed and a new approach is scheduled to be used for the fiscal event of Scottish Budget 2020-21, provided DWP fulfills the agreed MoU.

29. Personal Independence Payment (PIP) – Population Share

Tool	Personal Independence Payment forecasting model
Description	A benefit to help with the extra costs from long term ill-health or disability for individuals who face difficulties with daily living, mobility or both. Individuals must be aged 16 to 64 at the time of the claim. The amount spent per person in the relevant population (working age population) is calculated for both Scotland and Great Britain for each year. The ratio of spending per capita in Scotland versus Great Britain is calculated and assumptions are made to project the ratio over the forecast period for each of the different IIB benefits. The forecast ratio is applied to Great Britain per capita expenditure forecasts produced by the OBR to calculate future Scottish spending per capita. This is then multiplied by Scottish population projections to arrive at total program spending. The method of using a population share of the OBR forecast has been chosen to forecast PIP as the SFC model is currently under development and due to complete in summer 2019.
Type	Population adjusted percentage share of Office of Budget Responsibility (OBR) forecast. Policy model with twin goals: fit to data and capture dynamics, but with enough structure to trace effects of policies and shocks.
Task	Section 2(2)(aa) *[…] the Commission must on at least 2 occasions for each financial year prepare reports containing its 5-year forecasts of devolved social security expenditure.*
Outputs	Annual expenditure forecast for Scotland of Personal Independence Payment
Working paper	N/A
Reports that use	Scotland's economic and fiscal forecasts.
Software	Excel
1. Theoretical justifications	Poor. Based on OBR projection.
2. Accuracy	Fair. Forecast evaluation results within acceptable tolerances given underlying variance. Not clear that other approaches looking at Scottish-specific independence considerations wouldn't provide better forecasts. But model capacity limitations.
3. Communication	Poor. Some story around the determination of ratios, but ultimately forecast with OBR's projections, which may not be a story that is defensible in front of a committee. Again, data limitations prevent other methodologies at this time.
4. Transparency	Poor. Ultimately, would need to rely on the OBR to provide details of the outlook. Unexplained and undocumented judgment when determining the ratio.
5. Proportionality	Fair. Does not use many resources, but the program is material to the public finances (£930 million in 2017-18, which will increase significantly once all DLA to PIP migrations are completed) and would justify additional resources and modelling capacity, if data issues can be resolved.
6. Sustainability	Good. Straightforward technique. But may require considerable judgment and familiarity with the program. Spreadsheet models easily passed to new analysts.
7. Precedent	Good. Even with programs this large, other budget offices have been known to make simple adjustments to external forecasts when data is limited.

Verdict	Appropriate, unqualified. Although the model performs poorly on most key criteria, a program is underway to introduce in-house modelling capacity that addresses the gaps. The new approach is scheduled to be used for the fiscal event of Scottish Budget 2020-21, provided DWP fulfills the agreed MoU. The review team is satisfied with the revised modelling capacity it has seen.