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A Review of Tax Revenue Forecasting Models for the Scottish Housing Market

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The aim of this report is to provide an overview of different approaches to modelling the Scottish housing market for the purposes of tax forecasting. The strengths and weaknesses of each different modelling approach are assessed against a range of criteria.

Key findings

- Practitioners generally rely on more than one approach for modelling the housing market in the budget preparations of national or sub-national governments. Different models are used for different purposes, such as forecasting, policy costing, and distributional analysis.
- For tax forecasting applications, most practitioners in the UK and elsewhere rely on a multivariate model with causal explanatory variables and a specification based on the long-run relationship between the costs of renting a house and the costs of owning and occupying a house. These costs include mortgage interest, maintenance, and the opportunity cost of alternative financial investments, among others. These models are also popular in academic research.
- The decision to change the current approach and select a different model or models will depend on the priorities of fiscal planners and the importance they place on each of the criteria against which we have reviewed the models.

Background

This technical report was commissioned by the Scottish Government in response to recommendations by the Scottish Fiscal Commission to explore the modelling options for forecasting the Scottish housing market, which in turn is required for forecasting residential Land and Buildings Transaction Tax (LBTT) revenues.[1] It provides a comparative evidence base for forecasters to decide whether to change their current approaches, and how to proceed should they decide to do so. The findings of the report may also have a more general application in markets other than housing and for taxes other than LBTT.

Methodology

To find the alternative approaches, we explored the academic literature and interviewed professional forecasters in government departments and central banks in the UK and elsewhere.

The model classes we evaluated include:

- simple rules of thumb, growth accounting models, and external consensus forecasts that do not require estimated model parameters (we refer to these as technical assumptions)
- time series models that use only the history of housing prices and transactions themselves (known as univariate time series models)
- behavioural models that use other explanatory economic variables such as incomes and inflation (known as multivariate regression models)
- collections of multivariate equations that are estimated simultaneously as a system with few restrictions on how variables influence each other (known as vector autoregression models)
- models that incorporate long-run economic relationships between housing market variables and predict the path of the housing market required to maintain these equilibriums (known as error-correction models)
- models that apply a variety of the above techniques within a national accounting framework for the determination and projection of gross domestic product (commonly referred to as large-scale macroeconometric models)
- macroeconomic models that use microeconomic foundations and are estimated as a system (known as dynamic stochastic general equilibrium models)

[1] See recommendation 3.32 of the Scottish Fiscal Commission's Report on Draft Budget 2016-17, available at http://www.fiscalcommission.scot/media/1094/draft-budget-2016-17.pdf.

- models based on either a sample or the entire population of tax returns or property registrations to model the housing market (known as microsimulation models).

We assessed the extent to which each model class has been applied to housing markets for forecasting or policy purposes. If the model has been widely used for forecasting, we assessed its likely accuracy over the short- and medium-term budget horizon.

For practical budgeting purposes, forecast model selection may take into consideration a wide range of qualities beyond accuracy. We also assessed the following properties of each model class:

- Can the model tell a clear story about forecast revisions?
- Does it lend itself to transparent communication with stakeholders such as parliamentarians, industry groups, and the public?
- Can the model be implemented using data available in Scotland?
- Does it require an appropriate amount of resources to develop and maintain?

In addition to the formal model assessments, we also looked at several refinements to the above approaches and complementary approaches that can be used in parallel to them. These included Bayesian techniques and dynamic factor modelling, among others.

Findings

The results of our evaluation are summarized in Table S1. The strengths and weaknesses of each model are compared across evaluation criteria. Selecting a new approach for the housing market forecasting framework would need to consider the priorities of the forecasting body as well as the forecast's role in the wider budget framework.

If forecasters are concerned only with minimizing forecast errors, there are many examples of univariate time series, vector autoregressive, and error-correction models applied to the housing market in the literature and each would generally be expected to perform well for the Scottish market. Univariate time series models are particularly appropriate for the short run—years 1 and 2. For longer horizons, such as years three to five of the budget outlook, there is evidence that suggests error-correction models would perform well.

Policy models (for example, to estimate the impact of budget measures on house prices, or the impact of consumer behaviour such as tax forestalling on transactions) call for explanatory variables in the equation specification with causal interpretation. This indicates a role for multivariate models, which may or may not include elements of error-correction models, in preference to a univariate or vector autoregressive approach.

Table S1: Model Assessment Results

	Criteria	Rule	Univariate	Multivariate	VAR	ECM	Macro	DSGE	Microsim
Application	forecasting	good	good	fair	good	good	fair	poor	poor
	policy	fair	poor	good	poor	fair	fair	fair	good
Accuracy	short run	fair	good	fair	good	fair	fair	fair	N/A
	medium run	fair	fair	fair	fair	good	fair	fair	N/A
Communication	story telling	fair	poor	good	poor	good	good	fair	good
	transparency	good	fair	good	fair	fair	fair	poor	good
Data compatibility		fair	good	fair	fair	fair	fair	good	poor
Resources		good	good	fair	good	fair	poor	poor	poor

Legend
Rule: Forecasting by technical assumption (rule of thumb, growth accounting model, and external consensus)
Univariate: Univariate time series approaches
Multivariate: Multivariate regression models
VAR: Vector autoregressive models
ECM: Error-correction models
Macro: Large-scale macroeconometric models
DSGE: Dynamic stochastic general equilibrium models
Microsim: Microsimulation models

There are few models or techniques that demonstrated value for forecasting housing market turning points, the prediction of which would be particularly useful given the importance of the housing sector to the wider macroeconomy. There is some evidence that probit models (that is, models that estimate the probability of an event occurring—for example a 10 per cent fall in real housing prices) could be useful for recognizing a peak or a trough. But in general, predicting structural shifts in the path of the housing market is difficult and relies on the intuition and judgment of forecasters and careful monitoring of high-frequency data.

Communicating results in budget publications and before parliamentary committees generally requires explanatory variables that represent economic determinants and other structural influences. Simple structural models that incorporate intuitive variables with expected signs are best (for example, rising employment may be expected to increase the volume and price of residential property transactions). If, however, the priority is to be transparent and have an independent forecast free of

concerns over political interference, then using a technical assumption based on an external consensus forecast (that is, an average of a survey of non-government forecasters) may be useful.

Limitations on the availability of data at a Scotland level for some variables, while not ruling out any modeling approach, may impair the performance of some models that have a large number of parameters to estimate.

Resources would not need to be expanded greatly for most approaches, if at all. Further, more resource-intensive models may be justified on the basis of the housing market's importance for other budget purposes (such as the macroeconomic outlook or for costing social housing policy).

Finally, we received useful insight from a survey of UK and international forecasting practitioners, revealing the following main points:

- Most practitioners use a variety of models for different outcomes (forecasting versus policy costing) or to challenge the forecast of the main model.
- In the UK, the most commonly applied model is an error-correction framework based on asset pricing theory comparing the rental price of housing with the user cost of owner-occupied housing.
- Judgment is important to the forecast, especially in the early quarters of the forecast period, where monitoring and ad hoc adjustments of growth rates are often used.
- Practitioners do not devote significant resources to modelling the housing sector in most cases, regardless of the approach. Teams typically consist of between one and six analysts working on the housing sector (and in the upper end of this range, analysts are generally not dedicated to housing on a full-time basis).

The views expressed in this report are those of the researcher and do not necessarily represent those of the Scottish Government or Scottish Ministers.

This report is available on the Scottish Government Publications Website (http://www.gov.scot/Publications/Recent)

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