

A new version of the Central Bank's DYNIMO model

Monetary policy decisions must be grounded in an assessment of the economic situation and outlook, and such an assessment needs to rely on economic models. As a result, Central Bank staff devote considerable work to the development of various macroeconomic models. Although its main macroeconomic model is QMM (Quarterly Macroeconomic Model; see Danielsson *et al.*, 2019), in recent years the Bank has been developing a dynamic stochastic general equilibrium (DSGE) model for use in forecast preparation, for example as a cross-check for the baseline forecasts obtained with QMM. The Bank's DSGE model, called DYNIMO (Dynamic Icelandic Model), was recently released in its third version, together with a supporting handbook. Version III represents a comprehensive review and update of the model (Thórarinnsson, 2020). This Box presents a brief discussion of DYNIMO and the principal modifications made since the previous version. It also compares DYNIMO forecasts with the baseline forecasts published in *Monetary Bulletin*.

The main characteristics of DYNIMO

DYNIMO is a DSGE (dynamic stochastic general equilibrium) model. Its principal characteristics are as follows:

1. The model is *dynamic* in that the value of economic variables and decisions made at any given time by individuals, firms, and economic policy makers have intertemporal effects.
2. It is *stochastic*, in that deviations of variables from the steady-state can be attributed to stochastic shocks hitting the economy. The assumption is that households and businesses are familiar with the probability distribution of these shocks and make decisions accordingly.
3. It is a *general equilibrium* model, in that economic relationships are derived from the optimisation of businesses' profits and households' consumption. Attempts are made to explain developments in the economy as a whole where equilibrium is determined in all markets simultaneously.

Like most other DSGE models, DYNIMO is New Keynesian; i.e., it assumes that key markets are monopolistically competitive and that nominal variables such as wages and prices are rigid.

In recent years, DSGE models have gained in popularity. The Central Bank of Iceland began developing a DSGE model in 2008 and published the first version in Seneca (2010). Since then, the model has been in constant develop-

ment, and its importance in the Bank's analysis and forecasting has increased.

Key changes in DYNIMO Version III

Macroeconomic models are revised regularly to reflect changed economic conditions, new data that affect parameter estimation, and advances within the field of economics. The following is a summary of key changes made to DYNIMO since previous versions were published. A detailed description of the updated version of the model can be found in the new handbook (Thórarinnsson, 2020).

Model estimation period

In previous versions of DYNIMO, the model was estimated using data for the period 1991-2015, whereas the most recent version uses data for 2011-2019. This prevents the economic impact of the financial crisis from affecting the underlying equilibrium of the model to an excessive degree.

The monetary policy rule in the model

Previous iterations of DYNIMO used a monetary policy rule that reflected changes in the Central Bank's monetary policy objectives over the estimation period. The Bank formally adopted its inflation target in 2001, and in order to reflect the pegged exchange rate regime in place until that time, it was considered appropriate to allow the Bank's interest rates to be determined not only by inflation and the output gap, as in the standard Taylor rule, but by the exchange rate of the króna as well. The new version of DYNIMO uses data from the period after the adoption of the inflation target, however, and therefore applies the standard Taylor rule, in which the Bank's key rate is determined by the deviation of inflation from target and the output gap.

More detailed export sector classification

Iceland is a small open economy that relies on a small number of dissimilar export sectors, particularly tourism, aluminium exports, and fisheries. Aluminium companies' potential output is subject to medium-term constraints, and fisheries' supplies are limited by fishing quotas. In general, aluminium companies utilise all of their potential and therefore respond little, if at all, to short-term fluctuations in product prices and demand. This is also true of fisheries, whose catches are aligned with the quotas issued each year. Because of this, a category called specialised export firms producing non-differentiated goods was included in the most recent version of DYNIMO, so as to generate a more realistic view of an important aspect of the domestic economy. QMM uses a similar classification of export firms.

Selection of parameter values

The Icelandic economy has changed markedly since the time covered by the data used for previous versions of DYNIMO. This can be seen, for instance, in a comparison of the output share of various export sectors, as tourism's share has grown markedly, while the fishing sector's share has shrunk. Furthermore, the past few years have been characterised by relatively low and stable inflation and low interest rates, both in Iceland and elsewhere. The parameters of DYNIMO are "deep" in the sense that they reflect the properties of households' utility functions and firms' production functions. Given the magnitude of the structural changes in the domestic economy, it was necessary to revise these parameters for the new version of the model.

Comparison with QMM

DYNIMO is fundamentally different from QMM, the Bank's main forecasting model. First of all, DYNIMO is a general equilibrium model, where equilibrium is determined for all markets simultaneously, while supply and demand in these markets are derived from the optimisation of households' and businesses' profits and consumption. QMM, on the other hand, is based on statistically estimated behavioural relationships and accounting equations that are not subject to the constraints that general equilibrium imposes on the economic relationships in DYNIMO.

Second, individual equations in DYNIMO are estimated simultaneously, while individual equations in QMM are estimated separately. Furthermore, the parameter values in DYNIMO are either estimated using Bayesian statistical methods or obtained directly from research findings on the behavioural relationships in question.

Third, convergence is guaranteed in DYNIMO; i.e., all variables converge with long-run equilibrium. In QMM, this is not necessarily guaranteed, although the model usually converges with equilibrium when GDP growth is in line with potential output growth and inflation is at target.

Comparison of forecasts

When forecasts are prepared for publication in *Monetary Bulletin*, both DYNIMO and QMM are run, and the resulting forecasts are then compared. For the comparison, DYNIMO uses the same basic information from the Bank's sector experts on the near-term outlook for both individual economic sectors and the global economy as QMM uses to prepare baseline forecasts for *Monetary Bulletin*.

Chart 1 compares the most recent baseline forecast with the DYNIMO forecast through 2024 (a corresponding comparison can also be found in Box 3 in *Monetary Bulletin*

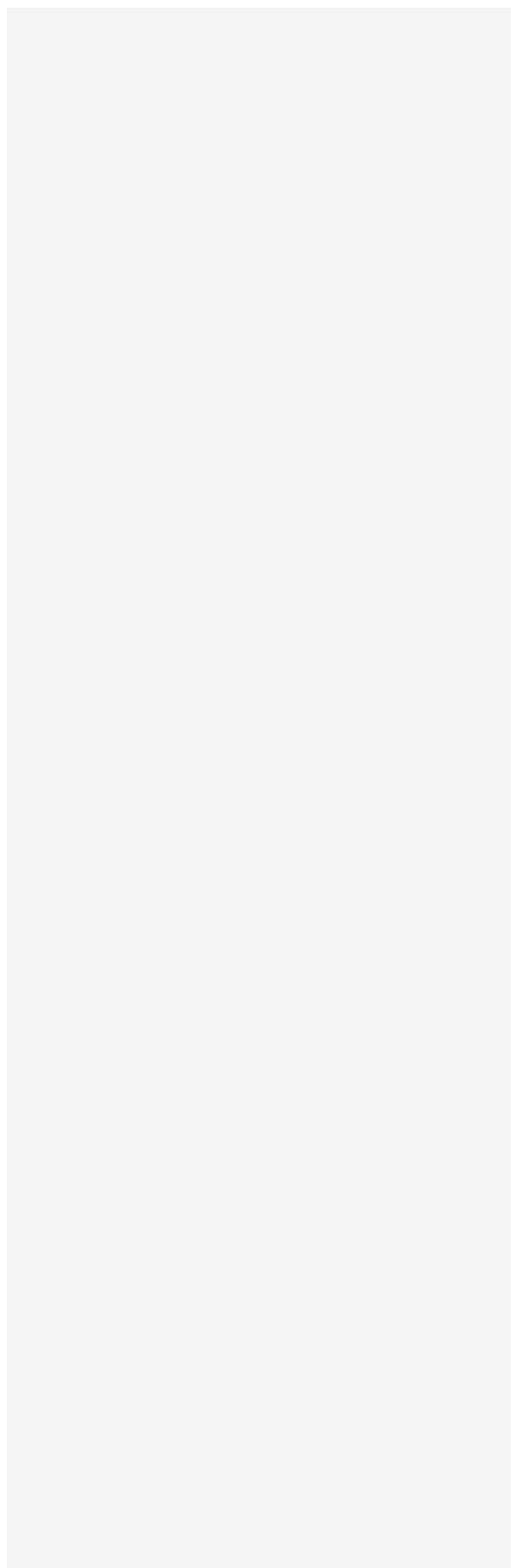
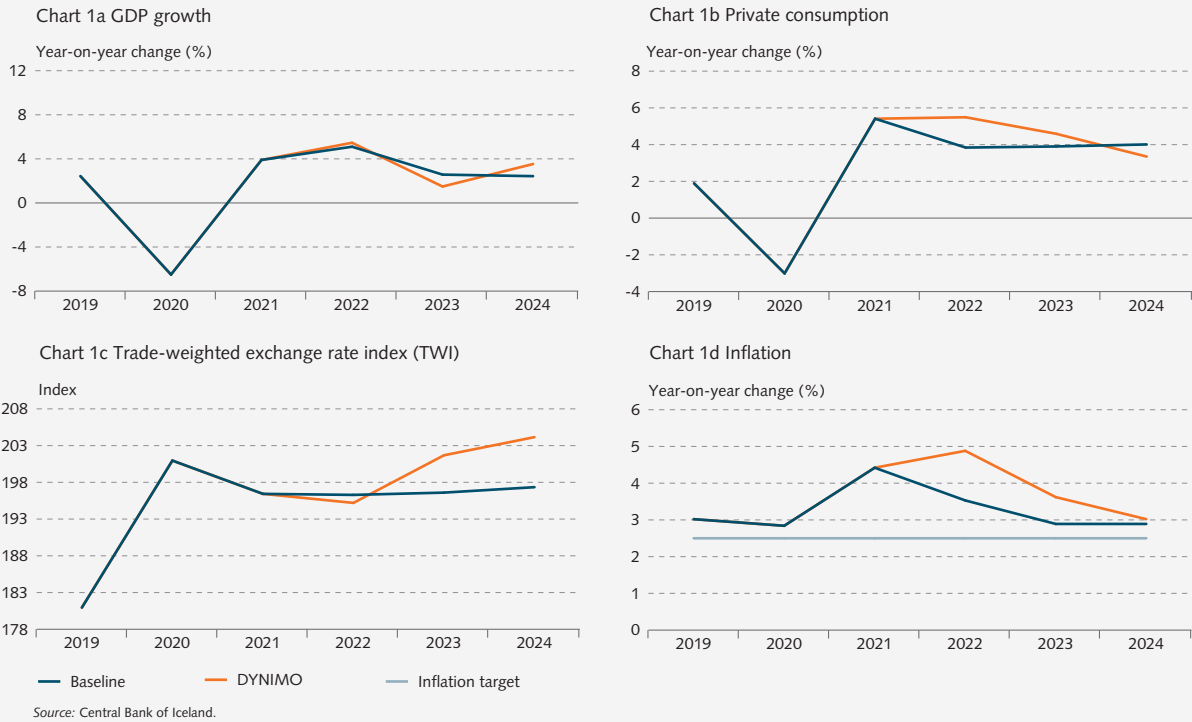


Chart 1

Comparison of the baseline forecast and the forecast obtained from the Bank's DYNIMO model



2017/4). As the chart shows, DYNIMO forecasts slightly stronger GDP growth in 2022 than is assumed in the baseline forecast, reflecting greater optimism about growth in private consumption and business investment, albeit partially offset by a bleaker outlook for exports. The more pessimistic outlook for exports can be attributed in part to the fact that DYNIMO forecasts a larger rise in the real exchange rate during the year. This reverses, however, as the forecast horizon advances.

Although DYNIMO forecasts a higher exchange rate in 2022 and a smaller rise in wages than are assumed in the baseline forecast, the outlook for stronger activity causes DYNIMO to forecast higher inflation than in the baseline forecast in 2022 and 2023. By the end of the forecast horizon, inflation is broadly similar according to both models.

References

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