

Appendix 1

The transmission mechanism of monetary policy in the Central Bank's quarterly macroeconomic model

The Central Bank of Iceland's macroeconomic model is an important instrument for evaluating economic developments and the impact of the Bank's policy measures. In this respect it is crucial that the transmission mechanism of monetary policy is well defined in the model. The following is an overview of the of the transmission mechanism in the Central Bank's new Quarterly Macroeconomic Model (QMM).¹

The transmission mechanism describes how changes in the Central Bank's policy interest rate affect market interest rates, asset prices, the exchange rate, consumption and investment decisions of households and businesses and thereby aggregate demand, inflation expectations and, ultimately, the rate of inflation.² QMM incorporates all the main channels of the monetary policy transmission mechanism.³ Simulations with QMM indicate that its transmission mechanism is consistent with the findings of earlier research in Iceland and experience in other countries.

Monetary policy rules

The policy rate follows a simple monetary policy rule in QMM.⁴ In most cases this involves a Taylor rule (see Taylor, 1993, 1999) in which the policy rate deviates from the equilibrium interest rate as inflation deviates from the inflation target and demand deviates from potential output.⁵ The policy rate in QMM can also follow an Orphanides rule (see Orphanides et al., 2000), which is a version of the Taylor rule based on the deviation of output growth from potential output growth instead of the output gap itself. On first impression this may not seem an important distinction, but research indicates less uncertainty in estimates of the growth of potential output than its level (see Orphanides,

1. A brief comparison of the QMM with the Central Bank's earlier models is presented in Appendix 1, *Monetary Bulletin* 2006/1, 59-61. A more detailed account of the new model is given in a forthcoming Central Bank of Iceland Working Paper by Danielsson et al. (2006).
2. A detailed discussion of the transmission mechanism of monetary policy is given in Pétursson (2001).
3. The expectation channel, which describes the impact of monetary policy on market agents' expectations about the future policy rate, exchange rate and inflation, is nonetheless subject to certain limitations in the current version of the model. Nor does it incorporate financial accelerator effects, given the complications in accounting for adverse selection and moral hazard problems in a model of this type.
4. Two alternative scenarios based on different policy rate paths are also used in preparation of the forecasts published in *Monetary Bulletin*. One assumes an unchanged policy rate across the forecast horizon, and the other a path reflecting market agents' and analysts' expectations for the development of the policy rate over the forecast period. The latter scenario has replaced the former as the Central Bank's baseline forecast since *Monetary Bulletin* 2006/2 in July.
5. Taylor rules are discussed further in Box 5, *Monetary Bulletin* 2002/2, 23-25.

2003). Erceg and Levin (2003) estimate a monetary policy rule of this type and argue that it provides a more accurate description of the behaviour of the US Federal Reserve than a conventional Taylor rule.

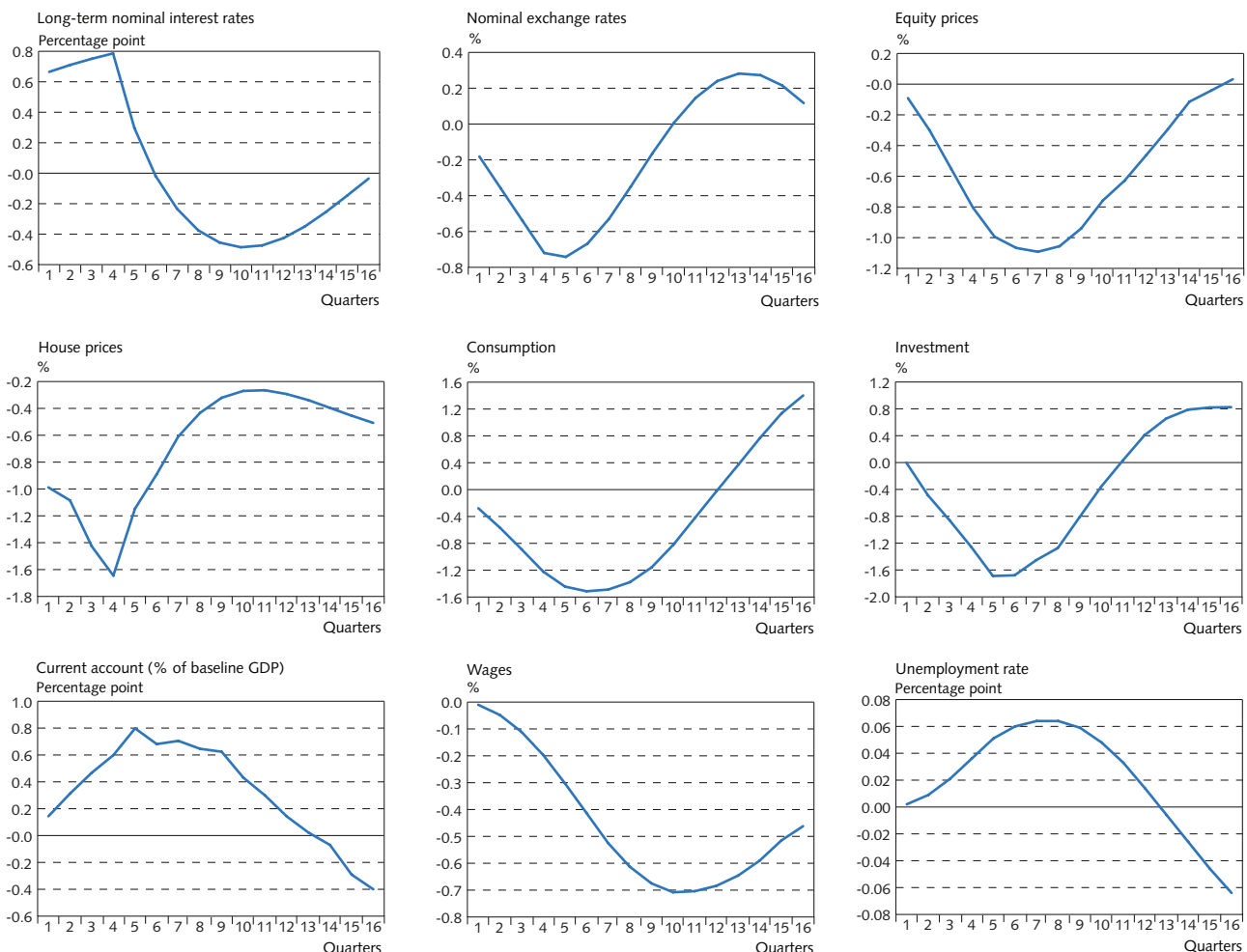
Interest rate channel

The transmission mechanism in QMM may be portrayed by simulation results on the effects of an unanticipated 1 percentage-point rise in the policy rate lasting for one year. Thus the policy rate follows the monetary policy rule but is 1 percentage point higher for one year than the rule states.⁶

The impact of the policy rate on market interest rates is often said to be the main transmission channel of monetary policy. QMM

6. It should be borne in mind that the charts are only intended to present a simple illustration of the real impact of monetary policy, which may vary on a case-by-case basis. Therefore they cannot be used for mechanical forecasting of how the economy will react to changes in monetary policy.

Chart 1
Responses of key variables to a 1 percentage-point rise in the policy rate lasting for one year (deviations from baseline)



makes no distinction between the policy rate and short-term interest rates on money market securities.⁷ In the model, a policy rate rise immediately drives up long-term nominal interest rates by 0.7 percentage points then continues to filter through until the impact peaks after just over one year at 0.8 percentage points.

A policy rate hike temporarily raises long-term real rates in the model, if this effect is not outweighed by changed inflation expectations. Real interest rates are most important for household and business expenditure and investment decisions. An increase in them gradually reduces both private consumption and investment in the model. Aggregate demand contracts as a result, with a corresponding easing of pressure on the utilisation of factors of production, which is measured by the output gap. Contracting aggregate demand also results in lower demand for imported goods and services, higher unemployment and lower demand for housing. Eventually, the smaller output gap eases inflationary pressures on prices of consumer goods, housing and labour (i.e. wages).

The model also takes into account the second-round effects on businesses and households which did not feel the direct impact of the interest rate hike. An example of these second-round effects is that the contraction in aggregate demand reduces households' wage income and thereby their disposable income.

Asset price channel

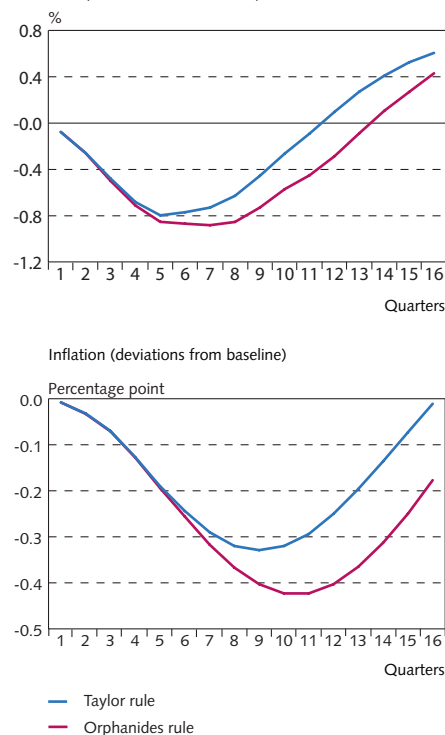
As Chart 2 shows, raising the policy rate by 1 percentage point causes both equity prices and housing prices to fall in QMM. Simulations indicate that the impact of a policy rate hike peaks after roughly one year for housing prices, but after two years for equity prices. The decrease in equity prices and market value of long-term bonds reduces household wealth. Lower housing prices lead to less residential investment and both factors cause household housing wealth to contract. Thus total household wealth is reduced by the higher policy rate, causing a contraction in private consumption and thereby aggregate demand.

Exchange rate channel

The impact of policy rate changes on the exchange rate is crucial to the transmission of monetary policy in a small open economy such as Iceland. In QMM, raising the policy rate by 1 percentage point contributes to an appreciation of the króna which will lead to a temporary real exchange rate appreciation, as domestic prices adjust slowly. The króna appreciates immediately by 0.2% and continues to do so until it peaks at 0.8% stronger than before the policy rate hike. This development is not consistent with uncovered interest rate parity, in which the króna appreciates immediately by 1% then gradually weakens to ensure that the expected yield on foreign and domestic assets is equal. However, it is consistent with international evidence and earlier studies of the transmission mechanism in Iceland (see e.g. Eichenbaum and Evans, 1995, and Pétursson, 2001).

7. Studies of the relationship between the policy rate and short-term market interest rates indicate that a policy rate change causes an almost immediate change in interbank and Treasury bill rates, although not always proportionally.

Chart 2
Responses to a 1 percentage-point rise
in the policy rate lasting for one year
GDP (deviations from baseline)



The króna appreciation reduces export volume and export prices denominated in domestic currency decline. Demand for domestic traded goods also falls relative to imports, which are priced lower. This channels demand out of the economy and eases inflationary pressures. The model also attempts to include second-round effects reflected in less ability of businesses to raise credit and to finance investment and wage rises. Finally, the appreciation has a direct impact on prices of imported goods and services, and thereby on inflation in the model.

Impact on economic activity and inflation

The 1 percentage-point rise in the policy rate starts to affect output after roughly one quarter, with peak effects after five quarters when output is 0.8% lower than otherwise. The impact on private consumption and investment is even stronger than is reflected in the aggregate output level, because of the positive impact on the current account balance. A policy rate hike is passed through to inflation with further delays, which is consistent with international findings. Prices are sticky and inflation remains broadly unchanged for the first three quarters after the policy shock. After that, disinflation begins and peaks after nine quarters at 0.3-0.4 percentage points lower than in the base-line scenario, depending upon which monetary policy rule is applied. These findings are also well consistent with those of previous research on the transmission mechanism in Iceland and findings from other economies.

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