CENTRAL BANK OF ICELAND

WORKING PAPERS No. 32

QMM
A Quarterly Macroeconomic Model of the Icelandic Economy

by
Ágeir Daníelsson, Lúdvík Elíasson, Magnús F. Gudmundsson,
Björn A. Hauksson, Ragnhildur Jónsdóttir, Thorvardur T. Ólafsson
and Thórarinn G. Pétursson

December 2006

CENTRAL BANK OF ICELAND

Economics Department

Central Bank of Iceland Working Papers are published by the Economics Department of the Central Bank of Iceland. The views expressed in them are those of their authors and not necessarily the views of the Central Bank of Iceland.

Also available on the Central Bank of Iceland World Wide Web site (http://www.sedlabanki.is)

ISSN: 1028-9445

QMM
A Quarterly Macroeconomic Model of the Icelandic Economy*

Ásgeir Daníelsson
Central Bank of Iceland

Lúdvík Elíasson
Landsbanki Research

Magnús F. Gudmundsson
Central Bank of Iceland

Björn A. Hauksson
Intercontinental Exchange

Ragnhildur Jónsdóttir
Central Bank of Iceland

Thorvardur T. Ólafsson
Central Bank of Iceland

Thórarinn G. Pétursson
Central Bank of Iceland and Reykjavík University

Version 1.0
December 2006

Abstract

This paper documents and describes the new Quarterly Macroeconomic Model of the Central Bank of Iceland (QMM). QMM and the underlying quarterly database have been under construction since 2001 at the Research and Forecasting Division of the Economics Department at the Bank. QMM is used by the Bank for forecasting and various policy simulations and therefore plays a key role as an organisational framework for viewing the medium-term future when formulating monetary policy at the Bank. This paper is mainly focused on the short and medium-term properties of QMM. Analysis of the steady state properties of the model are currently under way and will be reported in a separate paper in the near future.

*QMM was originally developed by Ásgeir Daníelsson, Lúdvík Elíasson (who has since left the Central Bank), Magnús F. Gudmundsson, Björn Hauksson (who has since left the Central Bank) and Thórarinn G. Pétursson. Ragnhildur Jónsdóttir and Thorvardur T. Ólafsson joined the project in 2005. A number of people have assisted with the data. Their help, along with comments and suggestions from Gudmundur Gudmundsson, Már Gudmundsson, Markús Möller, Arnór Sighvatsson, Jón Steinsson and participants at a seminar at the Central Bank of Iceland on 14 November 2006 are gratefully acknowledged. None of them is, however, responsible for any errors or omissions in this study.

Contents

Part I
Model Overview

1. Introduction to QMM

This paper documents and describes the Quarterly Macroeconomic Model of the Central Bank of Iceland (QMM). QMM and the underlying quarterly database have been under construction since 2001 at the Research and Forecasting Division of the Economics Department at the Bank. QMM is used by the Bank for forecasting and various policy simulations and therefore plays a key role as an organisational framework for viewing the medium-term future when formulating monetary policy at the Bank.

Those familiar with the models used by the Bank of England will immediately see the close likeness of QMM and the Medium-term Macro Model (MTMM) of the Bank of England (1999, 2000).[1] This is no coincidence as the MTMM was extensively used as a role model when constructing QMM. We would like to thank the Bank of England for making their work public and for their hospitality during a visit to the Bank in February 2001. The Bank of England is, however, in no way responsible for any part of QMM or this paper.

1.1. The role of QMM

QMM's role is to assist the Central Bank of Iceland with analysing the current economic situation, making economic projections, assessing the effects of alternative policies and shocks, evaluating risks, handling uncertainty and communicating both within and outside the Bank. No single model can fulfill all these roles. All models are imperfect as they are unavoidably a simplification of reality. Forecasts at the Central Bank of Iceland are therefore a result of a thorough procedure which involves a combination of judgement and projections from various models. QMM represents the core model of the Central Bank's forecasting system shown in Figure 1.1, which illustrates the relationship between models, judgement, forecasts and policy advice. The functioning of the system is very dependant on having a well-suited core model which can serve as a primary organisational framework to change mechanical model projections and judgement into forecasts and policy advice. In order to fulfill this role the core model must incorporate the Bank's assessments of the most important relationships in the economy and capture the essence of the transmission mechanism of monetary policy. In this respect, QMM marks a significant improvement from the larger annual model the Bank used before.

[1] Other macroeconomic models that influenced the construction of QMM include the AQM of the Austrian Nationalbank, the MEP of the Central Bank of Chile, Christopher Murphy's Model (MM) and the Swedish Riksbank's BASMOD.

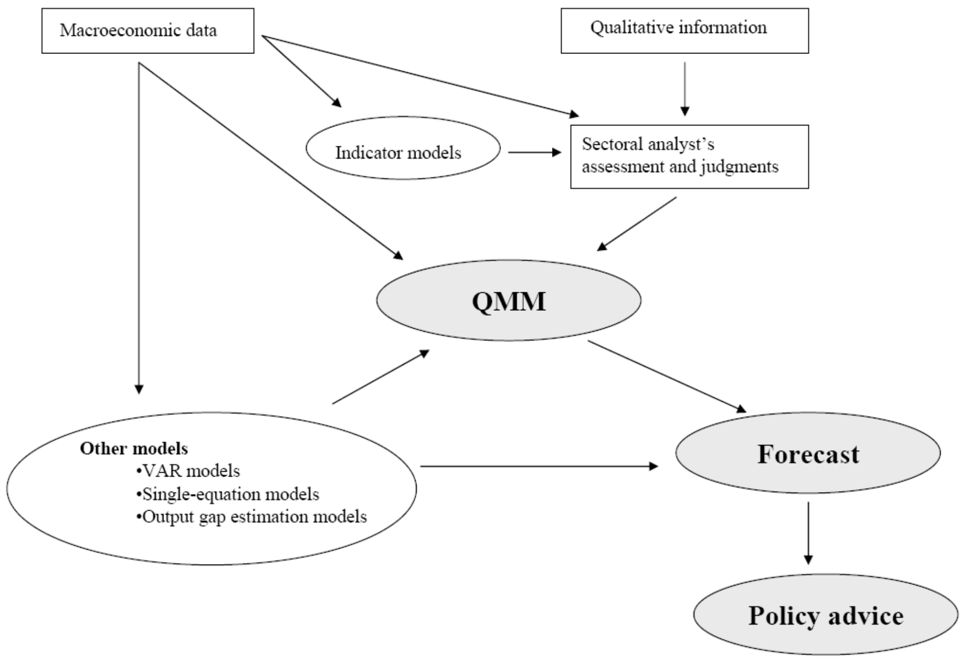


Figure 1.1. Overview of QMM's role in the Central Bank of Iceland's forecasting process

1.2. The structure of the paper

The remainder of this paper is organised as follows. **Chapter 2** gives a short overview of QMM, discussing the demand and supply sides of the model, the nominal and real dichotomy of the model and its dynamic behaviour. Future developments of QMM and a new dynamic stochastic general equilibrium model (DSGE) are also discussed. **Chapter 3** discusses the data used in QMM and the general approach to estimation of individual equations of the model.

The second part of the paper describes QMM in detail. **Chapter 4** contains the financial system in the model, describing how interest rates and other asset prices are determined. The demand for money and the definition of household wealth are also described. **Chapter 5** describes the determination of the major demand compononents, i.e. consumption, investment, stockbuilding and net trade. The chapter concludes with a description of potential output and the output gap. **Chapter 6** describes the labour market in QMM, covering wage determination, labour demand and supply, and unemployment. **Chapter 7** describes price determination and inflation in QMM, covering the implicit price deflators of the national accounts components and other important prices. The chapter also describes the formulation of inflation expectations. **Chapter 8** discusses fiscal policy and **Chapter 9** the household income accounts in the model.

The third part of the paper reports some important model properties. **Chapter 10** discusses how monetary policy works in QMM, highligting the main transmission channels in the model. The chapter concludes with an illustrative example of the

the transmission lags and the size of the effects of an unanticipated monetary policy shock. **Chapter 11** analysis how the model matches historical data, especially how the model is able to match important business cycle regularities in the actual data.

The fourth and final part of the paper contains appendices. **Chapter 12** lists all the variables in QMM and cross-references of all variables to each equation they enter. The final chapter, **Chapter 13**, contains a detailed description of the data, its sources and methods used to generate it.

2. Overview of QMM

2.1. The level of aggregation

QMM is a one-sector representation of the Icelandic economy, containing 20 empirically estimated behavioural relations and over 80 other equations, such as accounting identities and definitions. In total QMM contains 148 variables. This is therefore a medium-sized macroeconomic model with a high level of aggregation, although sufficiently detailed to describe the most important parts of the macrostructure of the Icelandic economy.

This high level of aggregation has many benefits but also some drawbacks. The main benefit is the fact that the model is much easier to manage and understand than older generation macro models with hundreds or even thousands of variables and equations. This allows concentrating on explaining the interactions of aggregate demand and supply and how that drives inflation, on the one hand, and how monetary policy responds to these developments and affects them, on the other hand. It is therefore no coincidence that the trend in central bank modelling has been to move away from such monstrous models to smaller and better specified ones. The main drawback is, however, the obvious loss of information on the finer details of the economy. However, within the context of doing forecasts and simulations for conducting monetary policy this drawback is generally thought to be small. QMM contains all the key transmission mechanisms of monetary policy and has a standard description of all the main components of aggregate demand and supply and their interactions over the medium and long-run. Thus, information and assumptions on specific prices or sectors of the economy can easily be handled outside the model and fed into QMM in each forecasting round.

2.2. The overall structure of QMM

The model is constructed in such a way as to be consistent with standard macroeconomic theory. This implies, e.g. that the long-run path for the real economy is independent of nominal variables. Hence, QMM displays both nominal neutrality (the long-run real equilibrium is independent of the nominal price level) and inflation neutrality (the long-run real equilibrium is independent of the rate of inflation). The nominal equilibrium is determined by monetary policy which determines the path for nominal prices and the rate of inflation. Finally, QMM displays nominal and real inertia, thus allowing a short-run trade-off between the real economy and inflation.

2.2.1. The supply side

The supply side of QMM is characterised by a constant-returns-to-scale Cobb-Douglas production function with diminishing marginal returns on the factor inputs, labour and capital, plus exogenous technological progress, (5.41).

The constant factor shares property of the Cobb-Douglas production function imposes long-run restrictions on wage developments and capital formation. The marginal product condition with respect to capital gives the capital-output share as a function of the real cost of capital, which imposes a long-run restriction on business investment (5.9). The marginal product condition with respect to labour gives real unit labour costs equal to the constant labour share in value added, which imposes a long-run restriction on wage developments (6.1). Short-run wage developments are given by a Phillips curve relationship, with real unit labour costs determined by deviations of the unemployment rate from its natural rate (NAIRU), a price wedge between output and consumer prices and deviations from the steady state wage share (6.2).

Developments of the unemployment rate in QMM are given by an Okun's type relation between devitiations of unemployment from NAIRU and output growth (6.5). Labour supply is determined by an exogenously given population at working age and the participation rate, which is given by a simple dynamic adjustment process towards an exogenously given steady state participation rate (6.7). Finally, labour demand is given as a residual series (6.9).

2.2.2. The demand side

The demand side of QMM reflects the open economy nature of the Icelandic economy. Its full detail comes from aggregating the separate expenditure components of GDP:

- In the long-run, private consumption (5.1) is given by real disposable income, real household wealth and the real long-term interest rate, capturing intertemporal substitution effects and interest rate effects on household debt burden. In the short-run (5.2) there are also effects from the unemployment rate, capturing influences of precautionary saving.

- Real government consumption is assumed to be exogenous in QMM. This implies that nominal government consumption is given by real government consumption and the endogenous development of the implicit price deflator for government consumption (see below), (5.4).

- Long-run business investment (excluding the aluminium sector), through the standard stock-flow condition (5.8), is consistent with the marginal product condition (5.7) which determines the stock of capital. Short-run fluctuations in business investment (5.10) also display accelerating properties, with output growth affecting investment growth.

- Residential housing investment (5.14) is given as a function of a Q-type ratio between house prices and the cost of building a house.

- Total fixed investment (5.5) is the sum of business investment, housing investment and exogenous government investment.
- With stockbuilding in the Icelandic national account mainly consisting of marine and aluminium products, inventories (5.21) are given as a simple function of exports of aluminium and marine products.
- Exports of Icelandic goods and services (excluding marine and aluminium products) (5.26) depend on world trade volumes and the real exchange rate. Total exports adds the exogenously given exports of marine and aluminium products (5.27).
- Imports of goods and services (5.30) depend on domestic demand and a measure of the real exchange rate which reflects the price competitiveness of domestic importers. The rising share of imports to domestic demand is modelled as a function of increasing globalisation of trade, proxied as the share of world trade in world GDP.

2.2.3. Nominal variables, inflation and monetary policy

In QMM, the rate of inflation in the long run is tied down by monetary policy. Hence, monetary policy provides the nominal anchor in the model. This again implies that in the long run, inflation is a "monetary phenomena", i.e. that sustained increases in prices cannot occur without excessively loose monetary policy.

In simulations QMM uses a simple Taylor (1993) rule where the short-term interest rate reacts to deviations of inflation from the Central Bank of Iceland inflation target and deviation of actual output from potential output (the output gap), (4.1). An alternative policy rule, sometimes used, is based on Orphanides et al. (2000) which uses the difference in the growth rate of actual and potential ouput instead of the output gap.[2] For forecasting, different interest rate assumptions are also possible. The three assumptions currently used by the Central Bank of Iceland are an unchanged interest rate, a policy rate path derived from market expectations (using market analysts' survey responses and forward rates) and a policy rate path that ensures that forecasted inflation is in line with the inflation target in the forecasting period.

Since the Central Bank uses the short-term interest rate as its policy instrument, money demand determines the quantity of money in circulation rather than money supply. In QMM, real money holdings (4.25) are given as a function of output, real net financial wealth and the nominal short-term interest rate (the opportunity cost of holding money). It should be noted that this formulation of monetary policy implies that money has no causal role in QMM. However, in the absense of persistent shocks to velocity, the money supply will move in line with nominal output in the long-run nominal equilibrium.

[2] It should be emphasised that neither of these policy rules is meant to describe actual policy formulation at the Central Bank of Iceland.

Consumer price inflation is given by a standard expectations-augmented Phillips curve, allowing for temporary exchange rate and wage cost shocks (7.1). The specification imposes dynamic homogeneity to ensure a vertical long-run Phillips curve.

Other prices are determined by mark-up pricing over marginal costs:

- Import prices are given as a function of domestic currency international prices (non-oil commodity prices, oil prices and world export prices) and a domestic component given by unit labour costs (7.2).
- Export prices (excluding aluminium and marine exports) are given as a function of domestic and international consumer prices (7.3). Aggregate export prices are also influenced by the exogenously given international prices of marine and aluminium goods (7.4).
- The private consumption deflator (7.5) is assumed to grow at the same rate as consumer prices (allowing for different seasonal patterns).
- The government consumption deflator (7.6) is assumed to evolve in line with unit labour costs and consumer prices.
- Prices of investment goods are given as a function of building costs and import prices in domestic currency, reflecting the large share of imported capital goods in Iceland (7.7).
- Housing investment costs are assumed to grow in line with general building costs (7.8).
- The government investment deflator evolves in line with general building costs and investment prices (7.9).
- The domestic output deflator is the residual price series and is given as the ratio between nominal and real GDP (7.10).
- Residential house prices are determined by an inverted housing demand function, with real house prices given as a function of the ratio of the housing stock to disposable income and the real interest rate (7.12).
- Building costs are given as a function of consumer prices and unit labour costs (7.13).
- The nominal exchange rate is given as a hybrid between a simple risk adjusted uncovered interest rate parity (UIP) condition and an error correction term in the real exchange rate (4.8).

2.2.4. Dynamic adjustment

In the long-run, real prices, such as the real exchange rate and the real interest rate, should ensure that in the real long-run equilibrium, aggregate demand grows in line with trend output growth along a balanced growth path, which in turn, is determined by technological progress and available factor supplies. The long-run nominal equilibrium on the other hand is determined by monetary policy.

As discussed above, there is a complete long-run dichotomy between the paths of nominal and real variables. Hence, there is no long-run trade-off between inflation, on the one hand, and unemployment or output, on the other hand. The long-run Phillips curve is vertical and it is impossible to achive persistently higher output or lower unemployment by tolerating higher inflation.[3]

In the short to medium term there is however sluggish adjustment to the long-run equilibrium. It therefore takes time for the economy to respond to exogenous shocks that move it away from equilibrium.[4] There are two types of inertia:

- Real inertia, where real variables respond sluggishly. This could involve costs of adjusting employment and stock levels. This type of sluggish behaviour is reflected in all the expenditure equations of QMM.

- Nominal inertia, where nominal variables respond sluggishly. This could involve prices (price inertia), e.g. due to menu costs, and wages (wage inertia), e.g. due to overlapping wage contracts. The wage-price dynamics in QMM reflect both types of inertia.

The sluggish behaviour of real and nominal variables in QMM imply that aggregate demand can deviate from potential output in the short to medium term. This is captured in QMM by the output gap which measures capacity utilisation in the economy, or the level of goods market pressure (5.43), and the deviations of the unemployment rate from an exogenous NAIRU, for measuring labour market pressures, (6.5).

This property of QMM also implies that there is a short-run trade-off between inflation and the real economy: Inflation will generally rise as pressures of demand on capacity built up and fall when these pressures dwindle. Hence, although the long-run Phillips curve is vertical, the short-run curve is upward sloping (in inflation output gap space), thus offering the possibility that monetary policy can try to reduce fluctuations in the real economy over the business cycle at the same time it attempts to anchor inflation expectations to the inflation target.

2.3. Future developments of QMM and a new DSGE model

QMM is not derived from fully specified optimisation problems of private agents in the economy but is mainly based on empirically estimated error correction relationships.

[3] Although not captured in QMM, empirical evidence suggests that high inflation is more likely to be damaging to the real economy and economic welfare.

[4] There are many reasons possible for this sluggish behaviour, including physical adjustment costs, information costs, learning and institutional factors.

The degree of empirical coherence is therefore given precedence over the degree of full theoretical coherence in Pagan's terms (2003). It therefore follows that the model may not automatically converge to a steady-state solution in the long run. To ensure convergence to steady state three conditions must be fulfilled. First, all nominal variables must grow in line with the Central Bank's inflation target. Second, real variables must converge to a balanced growth path equal to the growth rate of potential output (equal to the sum of the growth rates of population and technology). Finally, the long-run dichotomy between nominal and real variables must be fulfilled. The current version of QMM fulfills the first and last condition but some further restrictions on constants, expenditure ratios and relative prices are needed in order to meet the second requirement. Current research efforts are aimed at developing these restrictions and this work will be documented in a forthcoming paper. When the steady state version of the model is completed, expectations in QMM can be made forward-looking (model consistent) instead of backward-looking as in the current version. Expectations play a vital role in e.g. inflation and exchange rate dynamics and increased forward–looking behaviour should improve the overall dynamics of the model. The fact that QMM is basically an estimated error correction model makes it also exposed to the Lucas critique which somewhat limits its use for policy and welfare analysis.

Given the lack of fully specified microeconomic foundations for the behavioural relations in QMM, the next logical step in the Bank's modelling work would be to build a small DSGE model as many central banks have been working on lately.[5] These models represent an ambitious attempt to combine the latest progress in macroeconomic theory, structural forecasting and practical monetary policy making. Although many issues remain unsolved,[6] preparations have begun and a prototype model in Hunt (2006) is already available. These types of models are usually small-scale and provide a quite stylised view of the economy. Hence, by using both a more detailed model like QMM and the smaller scale DSGE model, the Bank should be able to improve its forecasting and analytical abilities with direct benefits for policy making.

3. Data and estimation approach

3.1. The data

Quarterly national accounts data for Iceland only exists since 1997. Some other data, such as many balance sheet variables, are officially only available annually. This means that quarterly data had to be generated further back in time to allow for meaningful empirical estimation. However, given the substantial structural changes in the Icelandic economy in the last two decades, using long time spans may in some

[5] These include the new Bank of England BEQM, Bank of Canada's TOTEM, Bank of Norway's NEMO, Bank of Finland's AINO, and MAS from the Central Bank of Chile.

[6] These include the microeconomic foundations of imperfections in various markets, price setting, expectations and open-economy issues. Another issue relates to estimation approaches, where some prefer classical or Bayesian estimation approaches, while others favour calibrating methods. Finally, forecast performance of these models needs more testing. For further detail, see Ólafsson (2006).

cases not be feasible. This implies that the estimation period usually starts in 1992, when the disinflation process is completed, even though quarterly data was generated back to the beginning of the 1980s in most cases.[7]

A substantial effort has been put into generating quarterly data for all the variables entering QMM. This usually involves sampling higher frequency data from different sources to use as auxiliary information for generating disaggrated, quarterly data using the ECOTRIM software. In some cases no such auxiliary information is available and smooth disaggregation of the annual data over the quarterly observations using ECOTRIM is the only available option. A detailed description of the data, its sources and, where applicable, the methods used for generating the quarterly observations is given in Chapter 13 in the Appendix.

3.2. Estimation of long-run relations

A detailed analysis of the long-run properties of each economic relationship in QMM is beyond the scope of this paper. It suffices to say that the long-run solutions reported are estimated using the simple Engle-Granger approach for estimating cointegrating relationships. Although more sophisticated estimation methods are available it should be pointed out that most of the long-run estimation results in QMM are based on well established empirical findings in Iceland, generally using these more sophisticated methods. Table 3.1 reports the most important references.

Table 3.1. Papers analysing long-run properties of economic relations in QMM

Money demand	Pétursson (2000)
Consumption	Baldursson (1993), Central Bank of Iceland (2004)
Investment	Hauksson (2005)
Housing market	Central Bank of Iceland (2004), Elíasson and Pétursson (2006)
Imports	Meacci and Turner (2001)
Wages	Pétursson (2002)

The long-run solutions in QMM typically define the particular quantity variable as a ratio to aggregate output, with this long-run path possibly affected by relative prices. Given these long-run paths, the short-run dynamics are estimated within the standard error correction framework as mentioned above. This reflects the underlying inertia in the economy, where the long-run relationships only assert themselves gradually in the face of shocks to demand or supply. To highlight this interaction between the long-run equilibrium and the short-run dynamics, long-run solutions are given in square-brackets.

It is important to note that equations of the model are developed as a part of the overall structure of QMM. Hence, the particular choice of empirically estimated equations and the variables entering those equations have all been dictated by the overall

[7]Some of the data go even further back: 60 data series start in 1970:Q1 (40% of the whole database), 93 series from 1980:Q1 or earlier (63% of the total database), 145 series from 1990:Q1 or earlier (99% of the total database) and all the database covers the period from 1994:Q1.

structure of the model. Furthermore, the selection of a particular equation and the short-run and long-run restrictions imposed in that equation is based not only on statistical inference and economic logic but also on its impact on the overall simulation properties of QMM. Each equation of the model does therefore not necessarily represent the "best" single-equation estimate of the particular variable, but should rather be interpreted within the context of QMM. This also implies that equations or parts of QMM may regularly be replaced by something that is viewed to better represent the current structure of the Icelandic economy. A macroeconomic model can therefore never be viewed as final, but rather as an ongoing project. Updated versions of QMM will therefore regularly be made available to the public.

3.3. Notational conventions

Several conventions are used in this paper to present the empirical results of QMM. Upper-case letters denote the original variables, while lower-case letters denote natural logarithms of the same variables. The subscript t denotes time, while upper-case T denotes a linear time trend (set equal to zero in 1970:Q1). $Q1$, $Q2$, $Q3$ and $Q4$ denote quarterly centered seasonal dummies (equal to 3/4 in the relevant quarter and -1/4 otherwise), while dummy variables are denoted by D and the relevant time period for which the dummy variable equals unity (see Table 12.3 in the Appendix for a summary of dummy variables in QMM). Finally, year-on-year changes are denoted as Δ_4, i.e. $\Delta_4 x_t = x_t - x_{t-4}$ and quarterly differences as Δ, i.e. $\Delta x_t = x_t - x_{t-1}$. Δ^2 denotes double differences, i.e. $\Delta^2 x_t = \Delta x_t - \Delta x_{t-1}$.

3.4. Statistical information

T-values for the null hypothesis that a given variable is statistically significant from zero are given in brackets below each parameter estimate. Information on empirical fit (using degrees of freedom adjusted R^2) and equation standard error is given with empirical results on the most important equations. Also shown are standard diagnostic tests for first-order residual autocorrelation (the Breusch-Godfrey F-test), residual normality (the Jarque-Bera χ^2-test) and a general form of residual heteroskedasticity (the White F-test). Where relevant, a F-test for the static long-run restriction imposed is also presented. To account for the non-stationarity properties of the data, the dynamic OLS method (DOLS) is used with the long-run test statistics corrected as described in Hamilton (1994). Finally, a F-test for dynamic homogeneity is also presented where relevant. The test statistics values are given with probability values in square brackets.

For the most important equations the empirical fit is also shown graphically, along with single-equation impulse response analysis and the steady-state solution to the equation. In all cases are the variables entering a given equation explicitly documented with cross-references to equations. An overview of all the variables and the cross-references to equations is given in Chapter 12 in the Appendix.

Part II
Model Details

4. Financial markets

This part of QMM describes the financial sector of the economy and the formulation of monetary policy. This includes interest rate setting and asset price determination, the demand for financial assets and definitions of wealth.

4.1. Interest rates and asset prices

4.1.1. Short-term interest rates (RS)

Monetary policy in QMM is described by a simple monetary policy rule. The standard assumption is to use a simple Taylor (1993) rule with interest rate smoothing:

$$RS_t = \lambda_{rs} RS_{t-1} + (1 - \lambda_{rs}) \left[(RRN_t + IT_t) + \beta_{rs}(INF_t - IT_t) + \phi_{rs} GAPAV_t \right] \quad (4.1)$$

where:

RS	Short-term interest rate (4.1).
RRN	Real neutral interest rate (exogenous).
IT	Central Bank of Iceland 2.5% inflation target (exogenous).
INF	Four-quarter CPI inflation rate (7.15).
$GAPAV$	Annual average of output gap (5.44).

An alternative policy rule sometimes used, suggested by Orphanides et al. (2000), relates the policy rate to the difference in the rate of growth of actual and potential output instead of the level as in the Taylor rule:

$$\begin{aligned} RS_t &= \lambda_{rs} RS_{t-1} + (1 - \lambda_{rs}) \left[(RRN_t + IT_t) + \beta_{rs}(INF_t - IT_t) \right. \\ &\quad \left. + \phi_{rs}(\Delta_4 gdp_t - \Delta_4 gdpt_t) \right] \end{aligned} \quad (4.2)$$

where:

RS	Short-term interest rate (4.1).
RRN	Real neutral interest rate (exogenous).
IT	Central Bank of Iceland 2.5% inflation target (exogenous).
INF	Four-quarter CPI inflation rate (7.15).
GDP	GDP (5.39).
$GDPT$	Potential output (5.42).

The parameters of both policy rules are user-defined. In QMM the following parameters are usually chosen:

$\beta_{rs} = 1.5$
$\phi_{rs} = 0.5$
$\lambda_{rs} = 0.5$

4.1.2. Long-term interest rates (RL)

Long-term interest rates can be viewed as the sum of the current and expected future short-term rates, reflecting expected future inflation. A simple approximation gives the long rate as a distributed lag of long and short rates, imposing a unit long-run elasticity:[8]

$$RL_t = \underset{(0.3)}{0.00029} + \underset{(12.9)}{0.861} RL_{t-1} + \underset{(4.1)}{0.665} RS_t + (1 - 0.861 - 0.665) RS_{t-1} \qquad (4.3)$$

Adjusted R^2	0.866
Equation standard error	0.49%
Dynamic homogeneity (F-test)	5.32 [0.03]
LM test for serial correlation (F-test)	1.08 [0.31]
Normality test (χ^2-test)	9.16 [0.01]
White test for heteroscedasticity (F-test)	2.56 [0.04]
Sample period	1996:Q1-2004:Q4 ($T = 36$)

where:

RL Long-term interest rate (4.3).
RS Short-term interest rate (4.1).

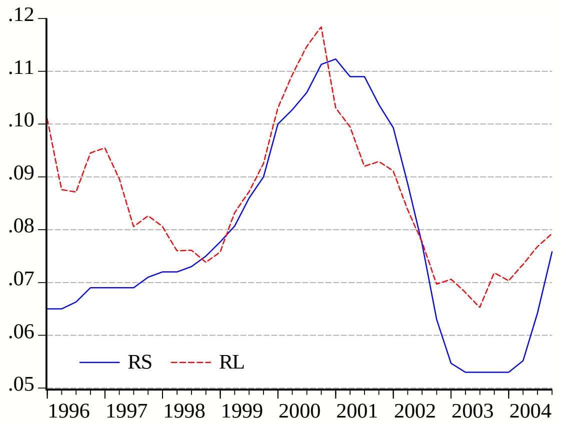


Figure 4.1. RS_t and RL_t

Single equation dynamic responses of (4.3):

[8]Equation (4.3) implies a term premium of roughly 20 basis points.

Table 4.1. Responses of RL to a 1% increase in RS

Quarters	RS
Simultaneous	0.66
Four quarters ahead	0.82
Eight quarters ahead	0.90
Long run	1.00
50% of long-run effect	0Q
90% of long-run effect	8Q
Steady state solution:	
$RL = const + RS$	

4.1.3. Long-term indexed interest rates (RLV)

Long-run indexed interest rates are given by the Fisher relation and an inflation risk premium of 0.5%:[9]

$$RLV_t = (RL_t - INFE_t) - PRISK_t \tag{4.4}$$

where:

RLV	Long-term indexed interest rate (4.4).
RL	Long-term interest rate (4.3).
$INFE$	Inflation expectations (7.16).
$PRISK$	Inflation risk premium (exogenous).

4.1.4. Real cost of capital (RCC)

Investment is effected by the real cost of capital, RCC, which in turn is given by the long-term real interest rate (RLV), the depreciation rate of capital ($DELTAB$) and a corporate risk premium ($PRBUS$). However, in the official data from Statistics Iceland, the perpetuity identity (5.19) ceases to hold after 1997. To retain that relation in QMM database, $DELTAB$ has to be adjusted accordingly. This, however, leads to a strong upward trend in $DELTAB$ after 1997 which would not be appropriate to be allowed to affect the cost of capital. Therefore, RCC includes a constant rate of 1.5%, which equals the average of $DELTAB$ over the period 1992 (the start of the estimation period for the investment equation) to 1996. RCC is therefore defined as:

[9] This corresponds to an estimate of the risk premium from a simple state space model for the period 1996-2004, assuming that the risk premium can be given by an AR(1) process. A simple average based on equation (4.4), using (7.17) to obtain inflation expectations, gives a slightly higher estimate.

$$RCC_t = \frac{1}{4}\left[RLV_t + PRBUS_t + (1-(1-0.015)^4)\right] \tag{4.5}$$

where:

RCC	Real cost of capital (4.5).
RLV	Long-term indexed interest rate (4.4).
$PRBUS$	Business premium on risk-free interest rate (exogenous).

4.1.5. Nominal exchange rate (EER, EUS, $FEER$ and RD)

The UIP condition is given as:

$$eer_t = feer_t - \log RD_t \tag{4.6}$$

where eer is the current spot exchange rate, $feer$ is the expected exchange rate and RD is the gross interest rate differential.

The exchange rate equation used in QMM is given as a hybrid formulation between (4.6) and an error correction for the real exchange rate. The error correction part reflects a long-run PPP behaviour of the nominal exchange rate:

$$\Delta eer_t = \underset{(2.6)}{0.021} + \underset{(3.5)}{0.386} rex_{t-4} \tag{4.7}$$

Adjusted R^2	0.289
Equation standard error	2.96%
LM test for serial correlation (F-test)	0.02 [0.89]
Normality test (χ^2-test)	2.35 [0.31]
White test for heteroscedasticity (F-test)	3.64 [0.04]
Sample period	1998:Q1-2004:Q4 (T = 28)

The hybrid model is given as:

$$eer_t = \omega_e(feer_t - \log RD_t) + (1-\omega_e)(0.021 + eer_{t-1} + 0.386 rex_{t-4}) \tag{4.8}$$

where:

EER	Exchange rate index of foreign currency (4.6).
$FEER$	Expected exchange rate index (4.9).
RD	Short-term interest rate differential (4.11).
REX	Real exchange rate (4.15).

The parameter ω_e is user defined. $\omega_e = 1$ gives the pure UIP condition (4.6), whereas $\omega_e = 0$ gives the PPP condition (4.7). $\omega_e = 0.75$ is the standard value usually applied.

The current assumption on $FEER$ in QMM is that expectations are backward looking so:

$$feer_t = eer_{t-1} \tag{4.9}$$

The preferable assumption would be to assume that expectations are forward looking so:

$$feer_t = eer_{t+1} \tag{4.10}$$

However, this assumption is not currently feasible as the steady state of the model has not yet been fully developed. When that is done, the current setup will be revised and (4.10) become the standard assumption in QMM.[10]

The quarterly gross interest rate differential is adjusted for an exchange rate risk premium:

$$RD_t = \left(\frac{(1 + RS_t/4)}{(1 + WRS_t/4)(1 + RISK_t/4)} \right) \tag{4.11}$$

where:

RD	Short-term interest rate differential (4.11).
RS	Short-term interest rate (4.1).
WRS	Foreign short-term interest rate (exogenous).
$RISK$	Exchange rate risk premium, user determined (exgogenous).

The US dollar exchange rate is simply given as:

$$\Delta eus_t = \Delta eer_t \tag{4.12}$$

where:

EUS	USD exchange rate (4.12).
EER	Exchange rate index of foreign currency (4.8).

4.1.6. Real exchange rate ($REXX$, $REXM$ and REX)

The competitive position of the exporting industry is measured by the exporters' real exchange rate:

$$REXX_t = \frac{PX_t}{EER_t \times WPX_t} \tag{4.13}$$

where:

$REXX$	Exporters' real exchange rate (4.13).
PX	Export price deflator (7.4).
EER	Exchange rate index of foreign currency (4.8).
WPX	World export prices (exogenous).

[10] With the weight of $\omega_e = 0.75$ the following exchange rate equation is obtained: $eer_t = const + 0.75feer_t + 0.25eer_{t-1} - 0.75 \log RD_t + 0.097rex_{t-4}$. With the additional assumption that expectations are purely backward-looking one obtaines: $eer_t = const + eer_{t-1} - 0.75 \log RD_t + 0.097rex_{t-4}$.

The competitive position of domestic competitive industry is measured by the importers' real exchange rate:

$$REXM_t = \frac{PM_t}{PGDP_t} \tag{4.14}$$

where:

$REXM$	Importers' real exchange rate (4.14).
PM	Import price deflator (7.2).
$PGDP$	GDP price deflator (7.10).

A general measure of the real exchange rate is given by relative consumer prices:

$$REX_t = \frac{CPI_t}{EER_t \times WCPI_t} \tag{4.15}$$

where:

REX	Real exchange rate (4.15).
CPI	Consumer price index (7.1).
EER	Exchange rate index of foreign currency (4.8).
$WCPI$	World consumer prices (exogenous).

4.1.7. Equity prices (EQP)

Equity prices are simply assumed to grow in line with nominal GDP:

$$\Delta eqp_t = \Delta gdpn_t \tag{4.16}$$

where:

EQP	Equity prices (4.16).
$GDPN$	Nominal GDP (5.40).

4.2. Money and wealth

4.2.1. Household sector wealth (WEL, HW, NFW, GFW, DH, $REVA$ and $REVD$)

Household sector wealth (WEL) consists of housing wealth (HW) and net financial wealth (NFW):

$$WEL_t = HW_t + NFW_t \tag{4.17}$$

where:

WEL	Household sector wealth (4.17).
HW	Housing wealth (4.18).
NFW	Net financial wealth (4.19).

Housing wealth is defined as:

$$HW_t = PH_t \times KH_t \tag{4.18}$$

where:

HW	Gross housing wealth (4.18).
PH	House prices (7.12).
KH	Private sector housing stock (5.20).

Net financial wealth is given as the difference between gross financial wealth and household debt:

$$NFW_t = GFW_t - DH_t \tag{4.19}$$

where:

NFW	Net financial wealth (4.19).
GFW	Gross financial wealth (4.20).
DH	Household debt (4.21).

Assuming a stable gross financial wealth-to-debt ratio equal to ω_w, gives gross financial wealth as (over the period 1987 to 2004 this ratio remains stable around 0.5):

$$\begin{aligned} GFW_t &= REVA_t \times GFW_{t-1} + \left(\frac{\omega_w}{\omega_w - 1}\right)[PC_t \times RHPI_t - CN_t \\ &\quad -PH_t \times (IH_t - DELTAH_t \times KH_{t-1})] \end{aligned} \tag{4.20}$$

and household debt as:

$$\begin{aligned} DH_t &= REVD_t \times DH_{t-1} + \left(\frac{1}{\omega_w - 1}\right)[PC_t \times RHPI_t - CN_t \\ &\quad -PH_t \times (IH_t - DELTAH_t \times KH_{t-1})] \end{aligned} \tag{4.21}$$

where:

GFW	Gross financial wealth (4.20).
DH	Household debt (4.21).
PC	Private consumption deflator (7.5).
$RHPI$	Real household post-tax income (9.5).
CN	Nominal private consumption (5.3).
PH	House prices (7.12).
IH	Private sector housing investment (5.14).
KH	Private sector housing stock (5.20).
$DELTAH$	Deprecation rate for housing stock (exogenous).
$REVA$	Household assets revaluation term (4.22).
$REVD$	Household debt revaluation term (4.23).

The revaluation terms are given as:

$$\begin{aligned} REVA_t &= 0.70\left(\frac{CPI_t}{CPI_{t-1}}\right) + 0.28\left(\frac{EQP_t}{EQP_{t-1}}\right) \\ &\quad +0.02\left(\frac{EER_t}{EER_{t-1}}\right)\left(\frac{WEQP_t}{WEQP_{t-1}}\right) \end{aligned} \tag{4.22}$$

and

$$REVD_t = \left(\frac{CPI_t}{CPI_{t-1}}\right) \tag{4.23}$$

where:

$REVA$	Household assets revaluation term (4.22).
$REVD$	Household debt revaluation term (4.23).
CPI	Consumer price index (7.1).
EQP	Equity prices (4.16).
EER	Exchange rate index of foreign currency (4.8).
$WEQP$	World equity prices (exogenous).

The weights are derived from the household balance sheet and reflect the weight of assets and debt in bonds, interest bearing deposits, stocks and foreign assets.[11]

[11] The weights in the revaluation terms are based on the average shares of the different types of financial assets and liabilities of households according to data obtained from tax returns for the year 2003 (collected in 2004). Of the households' assets, 44% had variable nominal interest rates and 26% were index-linked with fixed or variable real interest rates. Hence, 70% of household assets were interest rate linked and are therefore assumed to fluctuate in line with inflation. Of the remainder of household assets, 28% was in domestic equity (declared at nominal value), and 2% was in foreign equity. On the liability side, 30% was non-index-linked with variable nominal interest rates while 70% was index-linked with fixed real interest rates. Both the revaluation terms ignore, however, the direct capital gains from interest rate changes for two reasons. First, it can be argued that households do not incorportate these effects when making consumption decisions, at least when they are expected to be temporary. Second, incorporating these capital gains can lead to large and implausable swings in the revaluation terms when measured from low interest rate levels.

4.2.2. Broad money demand ($M3$)

Steady state money demand gives real money balances as a function of output, net wealth and the opportunity cost of holding money, given by the short-run interest rate, with money demand homogenous with respect to output and wealth. The long-run relation also allows for a linear time trend, capturing the effects of financial innovations on money holdings in the recent years:[12]

$$(m3 - pgdp) = \alpha_m + \beta_m gdp + (1 - \beta_m)(wel - pgdp) - \phi_m RS \tag{4.24}$$

where $m3 - pgdp$ are real money holdings, gdp is the scale variable, $wel - pgdp$ is real wealth and RS is the short-term interest rate. The short-run dynamics of real money balances are also negatively affected by the acceleration of inflation:

$$\begin{aligned}
\Delta(m3_t - pgdp_t) \quad = \quad & -\underset{(2.2)}{0.067} - \underset{(0.1)}{0.0003}Q1 + \underset{(4.6)}{0.026}Q2 + \underset{(3.2)}{0.022}Q3 \\
& +\underset{(3.0)}{0.021}D03 + \underset{(3.0)}{0.310}\Delta(m3_{t-2} - pgdp_{t-2}) + \underset{(2.3)}{0.130}\Delta gdp_{t-4} \\
& +\underset{(2.0)}{0.107}\Delta(wel_t - pgdp_t) - \underset{(7.5)}{0.675}\Delta^2 pgdp_t - \underset{(4.9)}{0.495}\Delta^2 pgdp_{t-1} \\
& -\underset{(2.5)}{0.078}[(m3 - pgdp) - 0.409gdp - 0.591(wel - pgdp) \\
& +0.172RS - 0.0063T]_{t-1}
\end{aligned} \tag{4.25}$$

Adjusted R^2	0.832
Equation standard error	1.18%
Long-run restrictions (F-test)	0.74 [0.39]
LM test for serial correlation (F-test)	0.18 [0.67]
Normality test (χ^2-test)	3.87 [0.14]
White test for heteroscedasticity (F-test)	0.53 [0.92]
Sample period	1990:Q1-2004:Q4 (T = 60)

where:

$M3$	Broad money (4.25).
$PGDP$	GDP price deflator (7.10).
GDP	GDP (5.39).
RS	Short-term interest rate (4.1).
WEL	Household sector wealth (4.17).
T	Linear time trend.
$Q1$-$Q3$	Centered seasonal dummies.
$D03$	Dummy variable: 1 2003:Q1-2003:Q4 and zero otherwise.

[12] This trend is not included in long-run simulations of QMM.

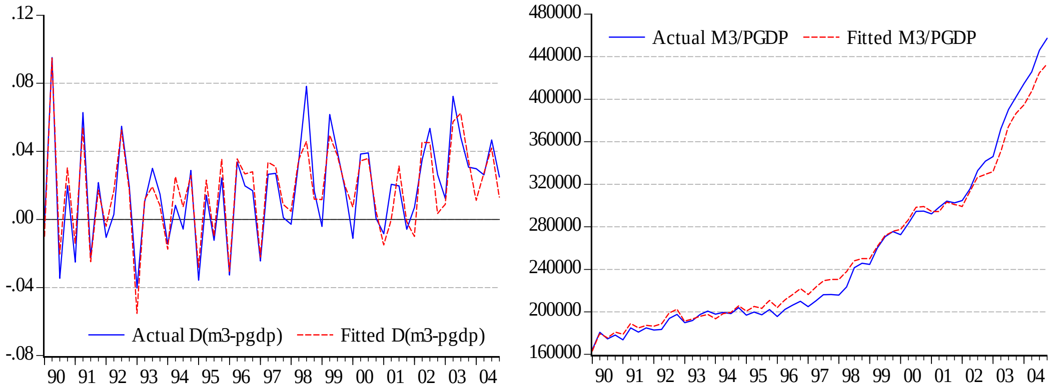


Figure 4.2. Fitted and actual $\Delta(m3 - pgdp)_t$ and $M3_t/PGDP_t$

Single equation dynamic responses of (4.25):

Table 4.2. Responses of $(m3 - pgdp)$ to a 1% increase in RHS variables

Quarters	$pgdp$	gdp	$wel - pgdp$	RS
Simultaneous	-0.67	0.00	0.11	0.00
Four quarters ahead	0.06	0.26	0.30	-0.06
Eight quarters ahead	0.11	0.38	0.43	-0.10
Long run	0.00	0.41	0.59	-0.17
50% of long-run effect	-	4Q	4Q	7Q
90% of long-run effect	-	8Q	15Q	15Q

Steady state solution:
$(m3 - pgdp - gdp) = const + 0.591(wel - pgdp - gdp) - 0.172RS + 0.0063T$

5. Demand and output

This part of QMM describes the expenditure and production side of the model. This includes public and private demand, net trade and the evolution of the production possibilities of the economy.

5.1. Private and public consumption

5.1.1. Private consumption (C and CN)

In accordance with the permanent income hypothesis, private consumption expenditure is determined in the long-run by household disposable income, wealth and the real interest rate:

$$c = \alpha_c + \beta_c rhpi + (1 - \beta_c)(wel - pc) - \phi_c RLV \tag{5.1}$$

where c is consumption, $rhpi$ is real disposable income, $wel - pc$ is real wealth and RLV is the real long-term interest rate. The short-run dynamics also allow for effects from the unemployment rate, reflecting precautionary saving effects:

$$\begin{aligned}
\Delta c_t \quad = \quad & \underset{(2.8)}{-0.038} - \underset{(3.1)}{0.050}Q1 - \underset{(2.5)}{0.040}Q2 - \underset{(4.0)}{0.059}Q3 + \underset{(3.0)}{0.054}D031 \\
& \underset{(6.5)}{+0.615}\Delta c_{t-4} + \underset{(2.7)}{0.290}\Delta rhpi_t - \underset{(2.7)}{1.579}\Delta UR_t \\
& \underset{(2.9)}{-0.134}[c - 0.794 rhpi - 0.206(wel - pc) + 1.458 RLV]_{t-1}
\end{aligned} \tag{5.2}$$

Adjusted R^2	0.957
Equation standard error	1.63%
Long-run restrictions (F-test)	2.70 [0.11]
LM test for serial correlation (F-test)	0.08 [0.77]
Normality test (χ^2-test)	2.11 [0.35]
White test for heteroscedasticity (F-test)	2.10 [0.04]
Sample period	1992:Q1-2004:Q4 (T = 52)

where:

C	Private consumption (5.2).
$RHPI$	Real household post-tax income (9.5).
WEL	Household sector wealth (4.17).
PC	Private consumption deflator (7.5).
RLV	Long-term indexed interest rate (4.4).
UR	Unemployment rate (6.5).
$Q1$-$Q3$	Centered seasonal dummies.
$D031$	Dummy variable: 1 2003:Q1 and zero elsewhere.

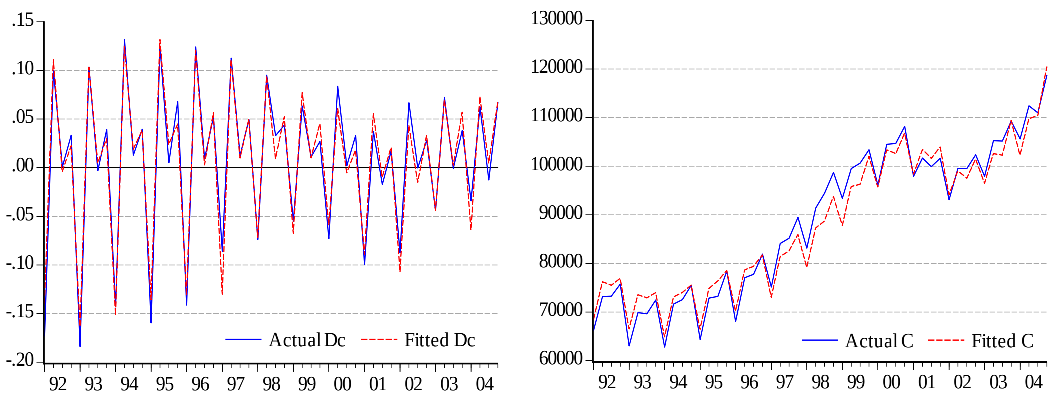


Figure 5.1. Fitted and actual Δc_t and C_t

Single equation dynamic responses of (5.2):[13]

Table 5.1. Responses of c to a 1% increase in RHS variables

Quarters	$rhpi$	$wel - pc$	UR	RLV
Simultaneous	0.29	0.00	-1.58	0.00
Four quarters ahead	0.69	0.09	-1.86	-0.64
Eight quarters ahead	0.95	0.19	-1.30	-1.31
Long run	0.79	0.21	0.00	-1.46
50% of long-run effect	Overshoots	Overshoots	-	Overshoots
90% of long-run effect	Overshoots	Overshoots	-	Overshoots

Steady state solution:
$(c - rhpi) = const + 0.206(wel - pc - rhpi) - 1.458RLV$

Nominal private consumption is given as:

$$CN_t = PC_t \times C_t \tag{5.3}$$

where:

CN	Nominal private consumption (5.3).
PC	Private consumption deflator (7.5).
C	Private consumption (5.2).

5.1.2. Government consumption (GN)

In forecasting with QMM, real government consumption is given exogenously. Nominal government consumption is therefore obtained as:

$$GN_t = PG_t \times G_t \tag{5.4}$$

where:

GN	Nominal government consumption (5.4).
G	Government consumption (exogenous).
PG	Government consumption deflator (7.6).

5.2. Fixed investment and the capital stock

5.2.1. Fixed investment (I and IN)

Fixed investment consists of business investment, housing investment and government investment:

[13] Note that a permanent increase in income will eventually boost wealth. Hence, a permanent 1% increase in income will eventually lead to a 1% rise in consumption.

$$I_t = IBUS_t + IH_t + IG_t \tag{5.5}$$

where:

I	Fixed investment (5.5).
$IBUS$	Business investment (5.11).
IH	Private sector housing investment (5.14).
IG	Government investment (exogenous).

Nominal investment is given by:

$$IN_t = PI_t \times I_t \tag{5.6}$$

where:

IN	Nominal fixed investment (5.6).
PI	Investment goods price deflator (7.7).
I	Fixed investment (5.5).

5.2.2. Business investment ($IBREG$, $IBUS$ and $IBUSN$)

Profit maximisation and constant-returns-to-scale imply a long-run relationship between the capital-output ratio and the user cost of capital:

$$(kbus - gdp) = \alpha_{ib} - \sigma_{ib} rcc \tag{5.7}$$

where σ_{ib} is the elasticity of substitution between capital and labour, $kbus$ is the capital stock, gdp is output and rcc is the real cost of capital. Assuming a Cobb-Douglas production technology (cf. 5.41) implies that $\sigma_{ib} = 1$ and $\alpha_{ib} = \log(1 - \beta_g)$, where β_g is the labour share in the production function. Furthermore from the stock-flow idendity (5.19), a long-run stable capital-investment ratio is obtained (where ζ_{ib} is the log of the sum of the constant rate of depreciation and the long-run growth rate of capital):

$$kbus - ibus = -\zeta_{ib} \tag{5.8}$$

where $ibus$ is investment. Taken together these two long-run relations give a steady state condition for business investment of the form:

$$ibus = (\alpha_{ib} + \zeta_{ib}) + gdp - rcc \tag{5.9}$$

This steady state investment-output relation is applied for business investment excluding the aluminium sector, $IBREG$, with the short-run dynamics given as:[14]

[14] The dummy variable $D9395$ accounts for a potential measurement problem in the capital stock in the national accounts data, see Hauksson (2005). The second dummy variable $D9801$ proxies the effects of a substantial shift in capital gearing (leverage effect) in the late 1990s, which probably reflects a reduction in credit rationing. See Hauksson (2005) for a discussion and a direct estimation of this effect.

$$\begin{aligned}
\Delta ibreg_t \;=\; & \underset{(4.6)}{-1.910} - \underset{(3.6)}{0.103}D9395 + \underset{(3.6)}{0.235}D981 + \underset{(2.5)}{0.070}D9801 \\
& -\underset{(4.4)}{0.273}D021 + \underset{(1.9)}{0.044}Q1 + \underset{(2.9)}{0.072}Q2 + \underset{(2.3)}{0.068}Q3 \\
& +\underset{(2.5)}{0.211}\Delta ibreg_{t-3} + \underset{(3.1)}{0.727}\Delta gdp_{t-2} - \underset{(4.6)}{0.326}[ibreg - gdp + rcc]_{t-1}
\end{aligned} \tag{5.10}$$

Adjusted R^2	0.697
Equation standard error	5.63%
Long-run restrictions (F-test)	2.78 [0.08]
LM test for serial correlation (F-test)	0.50 [0.48]
Normality test (χ^2-test)	5.14 [0.08]
White test for heteroscedasticity (F-test)	0.89 [0.11]
Sample period	1992:Q1-2004:Q4 ($T = 52$)

where:

$IBREG$	Business investment excluding the aluminium sector (5.10).
GDP	GDP (5.39).
RCC	Real cost of capital (4.5).
$D9395$	Dummy variable: 1 1993:Q1-1995:Q4 and zero elsewhere.
$D981$	Dummy variable: 1 1998:Q1 and zero elsewhere.
$D9801$	Dummy variable: 1 1998:Q1-2001:Q4 and zero elsewhere.
$D021$	Dummy variable: 1 2002:Q1 and zero elsewhere.
$Q1$-$Q3$	Centered seasonal dummies.

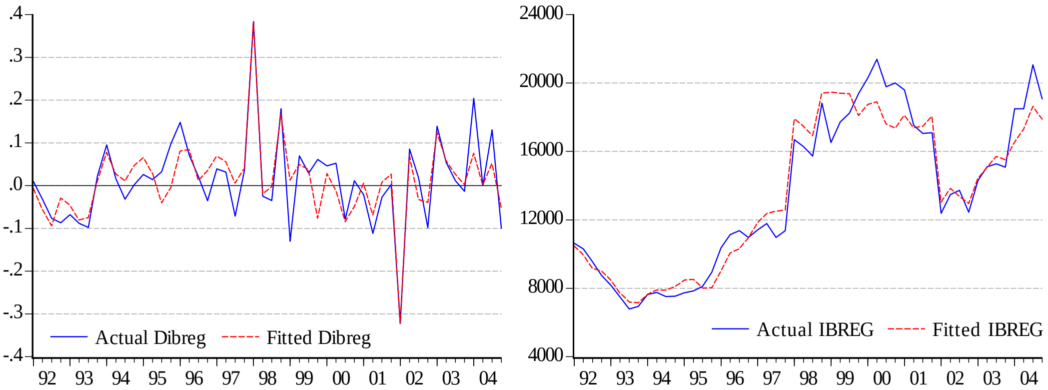


Figure 5.2. Fitted and actual $\Delta ibreg_t$ and $IBREG_t$

Single equation dynamic responses of (5.10):

Table 5.2. Responses of $ibreg$ to a 1% increase in RHS variables

Quarters	gdp	rcc
Simultaneous	0.00	0.00
Four quarters ahead	1.06	−0.72
Eight quarters ahead	1.02	−0.90
Long run	1.00	−1.00
50% of long-run effect	Overshoots	2Q
90% of long-run effect	Overshoots	8Q
Steady state solution:		
$(ibreg - gdp) = const - rcc$		

Total business sector investment is given by:

$$IBUS_t = IBREG_t + IBOTH_t \tag{5.11}$$

where:

$IBUS$	Business investment (5.11).
$IBREG$	Business investment excluding the aluminium sector (5.10).
$IBOTH$	Aluminium sector investment (exogenous).

Nominal business investment is given by:

$$IBUSN_t = IN_t - IGN_t - IHN_t \tag{5.12}$$

where:

$IBUSN$	Nominal business investment (5.12).
IN	Nominal fixed investment (5.6).
IGN	Nominal government investment (5.16).
IHN	Nominal housing investment (5.15).

5.2.3. Private sector housing investment (IH and IHN)

Using the same argument as for $IBREG$ above, the housing investment-output ratio can be written a function of the opportunity cost of investment, which in this case is given by a Tobin's Q price ratio between house prices (PH) and the cost of housing construction, given by the housing investment deflator (PIH):

$$(ih - gdp) = \alpha_{ih} + \beta_{ih}(ph - pih) \tag{5.13}$$

where ih is housing investment, gdp is output and $(ph - pih)$ is the logarithm of the Q ratio. This gives the following dynamic equation for housing investment:[15]

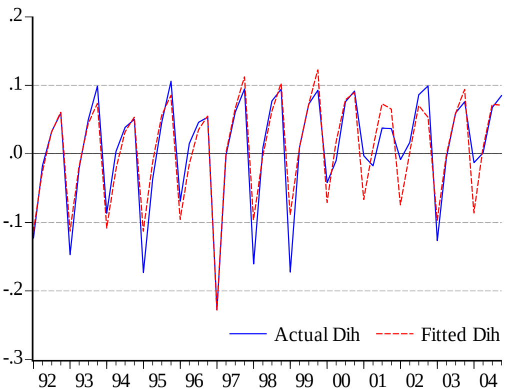
[15] Due to the apparent residual heteroscedasticity, the equation reports White heteroscedasticity-consistent t-values in brackets. The long-run restrictions implied by the long-run solution of the

$$\Delta ih_t = \underset{(3.7)}{-0.219} - \underset{(6.3)}{0.138}Q1 - \underset{(1.7)}{0.035}Q2 + \underset{(1.3)}{0.030}Q3 - \underset{(7.4)}{0.118}D971 \qquad (5.14)$$
$$-\underset{(2.6)}{0.282}\Delta ih_{t-3} - \underset{(3.8)}{0.079}[(ih - gdp) - 1.395(ph - pih)]_{t-1}$$

Adjusted R^2	0.852
Equation standard error	3.15%
Long-run restrictions (F-test)	10.4 [0.00]
LM test for serial correlation (F-test)	0.07 [0.80]
Normality test (χ^2-test)	2.74 [0.25]
White test for heteroscedasticity (F-test)	6.87 [0.00]
Sample period	1992:Q1-2004:Q4 ($T = 52$)

where:

IH	Private sector housing investment (5.14).
GDP	GDP (5.39).
PH	House prices (7.12).
PIH	Housing investment deflator (7.8).
$Q1$-$Q3$	Centered seasonal dummies.
$D971$	Dummy variable: 1 1997:Q1 and zero elsewhere.



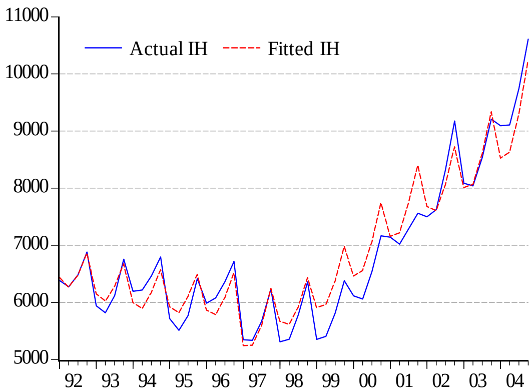


Figure 5.3. Fitted and actual Δih_t and IH_t

Single equation dynamic responses of (5.14):

investment equation are rejected by the data. The restriction rejected is the homogeneity restriction between IH and GDP, but the restriction on PH and PIH (equal coefficient but with opposite sign) is not rejected.

Table 5.3. Responses of ih to a 1% increase in RHS variables

Quarters	gdp	$ph - pih$
Simultaneous	0.00	0.00
Four quarters ahead	0.26	0.36
Eight quarters ahead	0.41	0.57
Long run	1.00	1.40
50% of long-run effect	11Q	11Q
90% of long-run effect	37Q	37Q
Steady state solution:		
$(ih - gdp) = const + 1.395(ph - pih)$		

Nominal housing investment is given by:

$$IHN_t = PIH_t \times IH_t \tag{5.15}$$

where:

IHN	Nominal housing investment (5.15).
PIH	Housing investment deflator (7.8).
IH	Private sector housing investment (5.14).

5.2.4. Government investment (IGN and $IGNNET$)

Real government investment in QMM is given exogenously. Nominal government investment is therefore given as:

$$IGN_t = PIG_t \times IG_t \tag{5.16}$$

where:

IGN	Nominal government investment (5.16).
IG	Government investment (exogenous).
PIG	Government investment inflator (7.9).

As expenditure on depreciation is included in government consumption, government investment net of depreciation is needed in the equation on public sector net borrowing (8.18). Hence, nominal net government investment is given as:

$$IGNNET_t = IGN_t - PIG_t \times DELTAG_t(K_{t-1} - KBUS_{t-1} - KH_{t-1}) \tag{5.17}$$

where:

$IGNNET$	Nominal net government investment (5.17).
IGN	Nominal government investment (5.16).
PIG	Government investment inflator (7.9).
$DELTAG$	Depreciation rate for government capital stock (exgogenous).
K	Total capital stock (5.18).
$KBUS$	Business capital stock (5.19).
KH	Private sector housing stock (5.20).

5.2.5. Capital stock (K, $KBUS$ and KH)

The capital stock is the previous period's stock, allowing for depreciation, plus the current investment:

$$K_t = (1 - DELTA_t)K_{t-1} + I_t \tag{5.18}$$

$$KBUS_t = (1 - DELTAB_t)KBUS_{t-1} + IBUS_t \tag{5.19}$$

$$KH_t = (1 - DELTAH_t)KH_{t-1} + IH_t \tag{5.20}$$

where:

K	Total capital stock (5.18).
$KBUS$	Business capital stock (5.19).
KH	Private sector housing stock (5.20).
I	Fixed investment (5.5).
$IBUS$	Business investment (5.11).
IH	Private sector housing investment (5.14).
$DELTA$	Depreciation rate for total capital stock (exgogenous).
$DELTAB$	Depreciation rate for business capital stock (exgogenous).
$DELTAH$	Deprecation rate for housing stock (exogenous).

5.2.6. Stockbuilding (II and IIN)

Measured inventories in the Icelandic national accounts are predominantly from the marine and aluminium export sectors. Assuming a constant ratio between inventories and the exports of marine and aluminium products, and that inventories amount to roughly 2-3 months of sales, implies the following relationship for stockbuilding:[16]

$$II_t = 0.21[\Delta EXMAR_t + \Delta EXALU_t] \tag{5.21}$$

where:

[16] Assuming that inventories amount to 2-3 months of sales gives a constant equal to $(2/12 + 3/12)/2 = 0.21$.

II	Net stockbuilding (5.21).
$EXMAR$	Exports of marine products (exogenous).
$EXALU$	Exports of aluminium products (exogenous).

Nominal stockbuilding is similarily given as:[17]

$$\begin{aligned} IIN_t &= 0.21[EER_t \times (1.002 \times PXMAR_t) \times \Delta EXMAR_t \\ &\quad +EUS_t \times (1.011 \times PXALU_t) \times \Delta EXALU_t] \end{aligned} \tag{5.22}$$

where:

IIN	Nominal net stockbuilding (5.22).
EER	Exchange rate index of foreign currency (4.8).
$PXMAR$	Price of marine products in foreign currency (exogenous).
$EXMAR$	Exports of marine products (exogenous).
EUS	USD exchange rate (4.12).
$PXALU$	Price of aluminium products in US dollars (exogenous).
$EXALU$	Exports of aluminium products (exogenous).

5.3. Domestic demand (DD and DDN)

Domestic demand is determined by an accounting identity, as the sum of private and government consumption, investment and stockbuilding:

$$DD_t = C_t + G_t + I_t + II_t \tag{5.23}$$

where:

DD	Domestic demand (5.23).
C	Private consumption (5.2).
G	Government consumption (exogenous).
I	Fixed investment (5.5).
II	Net stockbuilding (5.21).

Nominal domestic demand is given by a corresponding accounting identity:

$$DDN_t = CN_t + GN_t + IN_t + IIN_t \tag{5.24}$$

where:

DDN	Nominal domestic demand (5.24).
CN	Nominal private consumption (5.3).
GN	Nominal government consumption (5.4).
IN	Nominal fixed investment (5.6).
IIN	Nominal net stockbuilding (5.22).

[17] The scaling factors in (5.22) are due to the re-normalisation of the $PXREG$, $PXALU$ and $PXMAR$ price indices in the QMM database.

5.4. Net trade

5.4.1. Export volume of goods and services ($EXREG$, EX and EXN)

In the long-run, exports of goods and services (excluding marine and aluminium products) are determined by international demand (proxied by world trade) and relative prices, with unit income elasticity:

$$exreg = \alpha_{ex} + trade - \beta_{ex} rex \tag{5.25}$$

where $exreg$ are exports of goods and services excluding marine and aluminium products, $trade$ is world trade and rex is the real exchange rate. This gives the following dynamic equation:

$$\begin{aligned} \Delta exreg_t \;=\; & \underset{(6.3)}{8.254} - \underset{(3.4)}{0.189}Q1 - \underset{(0.7)}{0.046}Q2 + \underset{(2.9)}{0.142}Q3 - \underset{(2.5)}{0.280}D981 \\ & + \underset{(3.6)}{0.308}\Delta exreg_{t-4} - \underset{(6.3)}{0.813}[exreg - trade + 0.480rex]_{t-1} \end{aligned} \tag{5.26}$$

Adjusted R^2	0.847
Equation standard error	10.65%
Long-run restrictions (F-test)	5.66 [0.02]
LM test for serial correlation (F-test)	1.19 [0.28]
Normality test (χ^2-test)	1.18 [0.56]
White test for heteroscedasticity (F-test)	2.22 [0.04]
Sample period	1990:Q1-2004:Q4 (T = 60)

where:

$EXREG$	Exports, excluding aluminium and marine goods (5.26).
$TRADE$	World trade (exogenous).
REX	Real exchange rate (4.15).
$Q1$-$Q3$	Centered seasonal dummies.
$D981$	Dummy variable: 1 1998:Q1 and zero elsewhere.

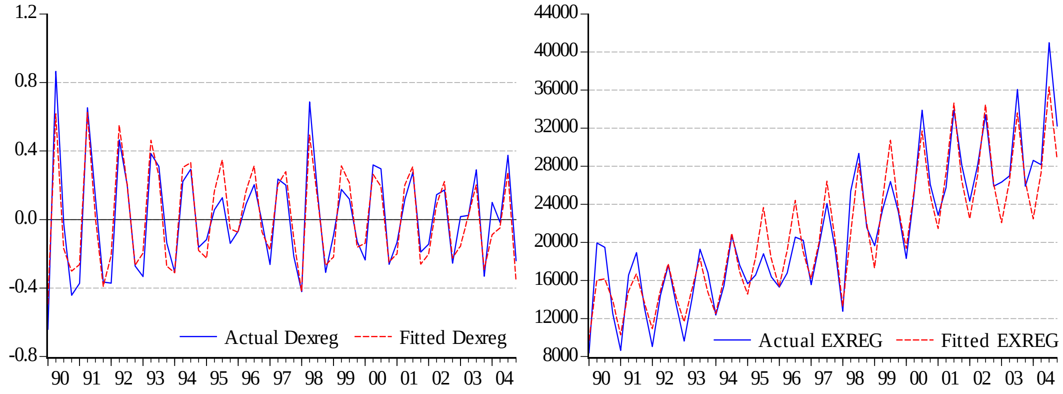


Figure 5.4. Fitted and actual $\Delta exreg_t$ and $EXREG_t$

Single equation dynamic responses of (5.26):

Table 5.4. Responses of $exreg$ to a 1% increase in RHS variables

Quarters	$trade$	rex
Simultaneous	0.00	0.00
Four quarters ahead	1.00	-0.48
Eight quarters ahead	1.01	-0.48
Long run	1.00	-0.48
50% of long-run effect	Overshoots	Overshoots
90% of long-run effect	Overshoots	Overshoots
Steady state solution:		
$(exreg - trade) = const - 0.480rex$		

Total exports are given as:

$$EX_t = EXREG_t + EXALU_t + EXMAR_t \tag{5.27}$$

where:

EX	Exports of goods and services (5.27).
$EXREG$	Exports, excluding aluminium and marine goods (5.26).
$EXALU$	Exports of aluminium products (exogenous).
$EXMAR$	Exports of marine products (exogenous).

Nominal exports of goods and services are given as:[18]

[18] The scaling factors in (5.28) are due to the re-normalisation of the $PXREG$, $PXALU$ and $PXMAR$ price indices in the QMM database.

$$
\begin{aligned}
EXN_t &= PXREG_t \times EXREG_t \\
&\quad + EUS_t \times (1.011 \times PXALU_t) \times EXALU_t \\
&\quad + EER_t \times (1.002 \times PXMAR_t) \times EXMAR_t
\end{aligned} \tag{5.28}
$$

where:

EXN	Nominal exports of goods and services (5.28).
$PXREG$	Export prices excluding aluminium and marine products (7.3).
EUS	USD exchange rate (4.12).
$EXREG$	Exports, excluding aluminium and marine goods (5.26).
$PXALU$	Price of aluminium products in US dollars (exogenous).
EER	Exchange rate index of foreign currency (4.8).
$EXALU$	Exports of aluminium products (exogenous).
$PXMAR$	Price of marine products in foreign currency (exogenous).
$EXMAR$	Exports of marine products (exogenous).

5.4.2. Import volume of goods and services (IMP, $IMPN$ and $SPEC$)

In the long-run, imports of goods and services are determined by domestic demand and relative prices, with unit income elasticity. The long-run relationship also allows for an upward trend, reflecting increased trade specialisation in international trade (captured by the ratio between world trade and world output):

$$
imp = \alpha_{im} + dd - \beta_{im} rexm + \phi_{im} spec \tag{5.29}
$$

where imp are the imports of goods and services, dd is domestic demand, $rexm$ is the real exchange rate, and $spec$ is the trade specialisation term. This gives the following dynamic equation:

$$
\begin{aligned}
\Delta imp_t &= -\underset{(6.4)}{0.824} + \underset{(0.9)}{0.029}Q1 + \underset{(1.1)}{0.023}Q2 + \underset{(2.1)}{0.040}Q3 \\
&\quad + \underset{(6.0)}{1.332}\Delta dd_t + \underset{(1.9)}{0.419}\Delta dd_{t-4} \\
&\quad - \underset{(6.4)}{0.841}[imp - dd + 0.336 rexm - 0.513 spec]_{t-1}
\end{aligned} \tag{5.30}
$$

Adjusted R^2	0.894
Equation standard error	4.89%
Long-run restrictions (F-test)	5.69 [0.02]
LM test for serial correlation (F-test)	0.18 [0.28]
Normality test (χ^2-test)	1.01 [0.60]
White test for heteroscedasticity (F-test)	1.60 [0.14]
Sample period	1990:Q1-2004:Q4 ($T = 60$)

where:

IMP	Imports of goods and services (5.30).
DD	Domestic demand (5.23).
$REXM$	Importers' real exchange rate (4.14).
$SPEC$	Trade specialisation (5.32).
$Q1$-$Q3$	Centered seasonal dummies.

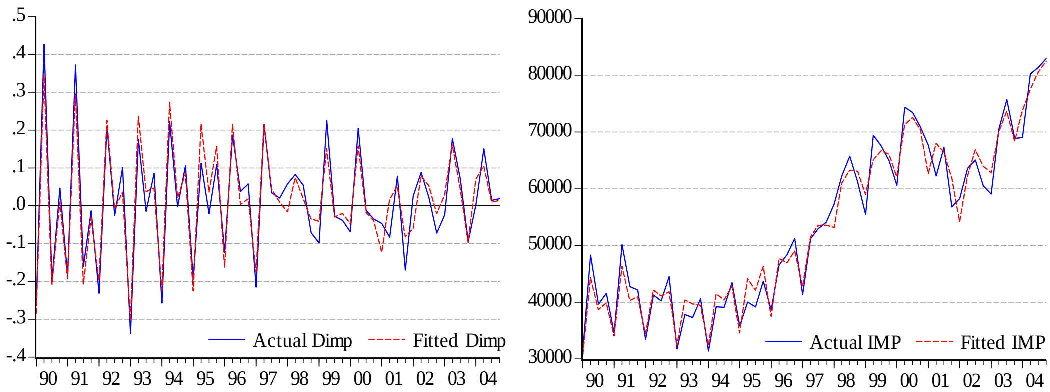


Figure 5.5. Fitted and actual Δimp_t and IMP_t

Single equation dynamic responses of (5.30):

Table 5.5. Responses of imp to a 1% increase in RHS variables

Quarters	dd	$rexm$	$spec$
Simultaneous	1.33	0.00	0.00
Four quarters ahead	1.00	-0.34	0.43
Eight quarters ahead	1.00	-0.34	0.51
Long run	1.00	-0.34	0.51
50% of long-run effect	Overshoots	1Q	1Q
90% of long-run effect	Overshoots	2Q	2Q
Steady state solution:			
$(imp - dd) = const - 0.336rexm + 0.513spec$			

Nominal imports are given as:

$$IMPN_t = PM_t \times IMP_t \tag{5.31}$$

where:

$IMPN$	Nominal imports of goods and services (5.31).
IMP	Imports of goods and services (5.30).
PM	Import price deflator (7.2).

The trade specialisation variable is defined as:

$$SPEC_t = TRADE_t / WGDP_t \tag{5.32}$$

where:

$SPEC$	Trade specialisation (5.32).
$TRADE$	World trade (exogenous).
$WGDP$	World GDP (exogenous).

5.4.3. Balance of payments (BAL, $BALT$ and $BIPD$)

The balance of trade is given as

$$BALT_t = EXN_t - IMPN_t \tag{5.33}$$

where:

$BALT$	Balance of trade (5.33).
EXN	Nominal exports of goods and services (5.28).
$IMPN$	Nominal imports of goods and services (5.31).

The balance of interest payments, dividends and profits ($BIPD$) is proxied by the product of the exogenous foreign nominal interest rate (WRS) and the average net foreign assets (NFA) over the current and past quarter:

$$BIPD_t = \left(\frac{WRS_t}{4}\right)\left(\frac{NFA_t + NFA_{t-1}}{2}\right) \tag{5.34}$$

where:

$BIPD$	Balance of interest, salaries, dividends and profits (5.34).
WRS	Foreign short-term interest rate (exogenous).
NFA	Net foreign assets (5.36).

The current account balance is determined by an accounting identity:

$$BAL_t = BALT_t + BIPD_t + BTRF_t \tag{5.35}$$

where:

BAL	Current account balance (5.35).
$BALT$	Balance of trade (5.33).
$BIPD$	Balance of interest, salaries, dividends and profits (5.34).
$BTRF$	Balance of transfers (exogenous).

5.4.4. Net foreign assets (NFA, ISA and FOH)

Net foreign assets are defined as the difference between gross Icelandic holdings of foreign assets and foreign holdings of Icelandic assets:

$$NFA_t = ISA_t - FOH_t \tag{5.36}$$

where:

NFA	Net foreign assets (5.36).
ISA	Icelandic holdings of foreign assets (5.37).
FOH	Foreign holdings of Icelandic assets (5.38).

Both Icelandic and foreign asset holdings are modelled using a simple stock-flow framework. Domestic holdings of foreign assets is revalued according to changes in world equity prices, with the stock growing at an annual rate of 20%, which is the average growth rate for the period 1992-2002:[19]

$$ISA_t = ISA_{t-1}\frac{EER_t}{EER_{t-1}}\left(0.8 + 0.2\frac{WEQP_t}{WEQP_{t-1}}\right)(1+0.2)^{(1/4)} \tag{5.37}$$

Foreign holdings of domestic assets are given as (the revalue term reflects that foreign holdings of domestic assets is in the form of loans in foreign currency):

$$\begin{aligned} FOH_t \quad = \quad & FOH_{t-1}\left(\frac{EER_t}{EER_{t-1}}\right) - BAL_t + ISA_{t-1} \times [(1+0.2)^{(1/4)} - 1] \\ & \times \left[0.8\left(\frac{EER_t}{EER_{t-1}}\right) + 0.2\left(\frac{EER_t}{EER_{t-1}} \times \frac{WEQP_t}{WEQP_{t-1}}\right)\right] \end{aligned} \tag{5.38}$$

where:

ISA	Icelandic holdings of foreign assets (5.37).
FOH	Foreign holdings of Icelandic assets (5.38).
EER	Exchange rate index of foreign currency (4.8).
$WEQP$	World equity prices (exogenous).
BAL	Current account balance (5.35).

5.5. Output

5.5.1. Gross domestic production (GDP and $GDPN$)

Expenditure-based GDP is an accounting identity including domestic demand, exports and imports:

$$GDP_t = DD_t + EX_t - IMP_t \tag{5.39}$$

[19] The weight 20% reflects the weight of equity in Icelander's foreign portfolios.

where:

GDP	GDP (5.39).
DD	Domestic demand (5.23).
EX	Exports of goods and services (5.27).
IMP	Imports of goods and services (5.30).

Nominal GDP is similarily given as:

$$GDPN_t = DDN_t + EXN_t - IMPN_t \tag{5.40}$$

where:

$GDPN$	Nominal GDP (5.40).
DDN	Nominal domestic demand (5.24).
EXN	Nominal exports of goods and services (5.28).
$IMPN$	Nominal imports of goods and services (5.31).

5.5.2. Potential output and demand pressure ($GDPT$, GAP and $GAPAV$)

Potential output is described with a constant-returns-to-scale Cobb-Douglas production function and an exogenous labour-augmenting technical progress:

$$gdpt_t = \log \alpha_g + \beta_g(\gamma_g T) + \beta_g empt_t + (1 - \beta_g)k_t \tag{5.41}$$

where *gdpt* is potential output, *empt* is trend employment, k is the capital stock, β_g is the labour share, and $\gamma_g T$ is the labour-augmenting technical progress, captured with a linear time trend. The capital stock is assumed to be fully employed and trend employment is given by (6.10). By setting the shares of production factors exogenously according to historical income shares, the estimated equation reduces to (estimated for the period 1981:Q1-2004:Q4):[20]

$$gdpt_t = -\underset{(59.6)}{1.172} + 0.64 \times \underset{(15.4)}{0.0049}T + 0.64empt_t + 0.36k_t \tag{5.42}$$

where:

$GDPT$	Potential output (5.42).
$EMPT$	Trend employment (6.10).
K	Capital stock (5.18).
T	Linear time trend.

The output gap is defined as the difference between actual and potential output:

[20] A shortcoming of this estimate of potential output is that it is based on a linear trend for the labour augmented technological progress, which tends to amplify the cyclical component of output. Therefore, in the forecasting round the potential output estimate also includes HP-filtered trending based on the same Cobb-Douglas production function and some attempt to capture the cyclical movements of temporary foreign labour that moves in and out of the economy over the business cycle but does not seem to be fully captured in the official employment data.

$$GAP_t = GDP_t/GDPT_t - 1 \tag{5.43}$$

where:

GAP	Output gap (5.43).
GDP	GDP (5.39).
$GDPT$	Potential output (5.42).

An annual average of the output gap is used as a measure of demand pressure in the inflation equation (7.1) and as the measure of future inflation pressures in the monetary policy rule (4.1) and (4.2):

$$GAPAV_t = \left(\frac{GAP_t + GAP_{t-1} + GAP_{t-2} + GAP_{t-3}}{4} \right) \tag{5.44}$$

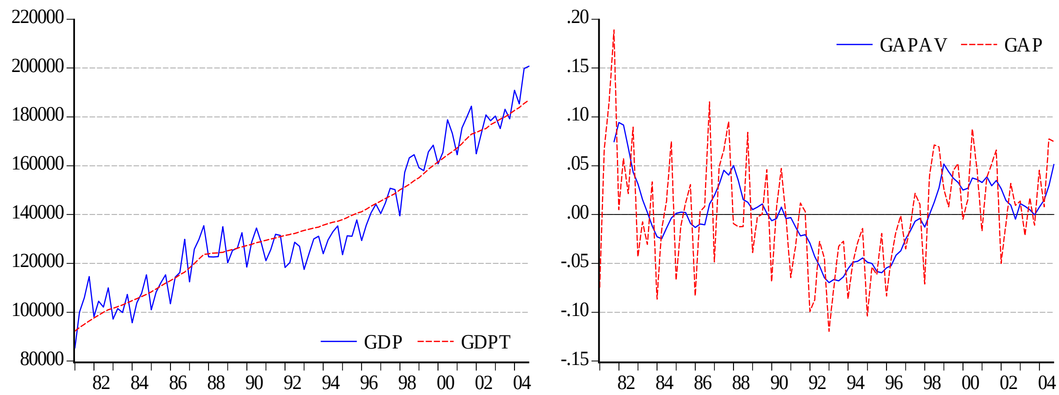


Figure 5.6. Actual and potential output and the output gap

6. Labour market

This section describes the labour market in QMM. Wage setting is assumed to take place in a monopolistic competition setting, with cyclically sensitive labour supply and long-run labour demand derived from the production function of the economy.

6.1. Wages and labour costs

6.1.1. Wages (W)

It follows from profit maximisation and the production function (5.41) that the wage share should be constant in the long run:[21]

[21] The firm's maximisation problem is given as maximising $GDPT - (W \times REM/PGDP) \times EMPT - RCC \times K$, which gives the first order condition (6.1).

$$(w + rem - prodt - pgdp) = (ulct - pgdp) = \log \beta_g \tag{6.1}$$

The wage share (or real unit labour costs, see equation (6.4)) has, however, been trending upwards in Iceland since the middle of the 1990s. A potential explanation for this could be the increasing share of the public sector in this period. If the wage share in the public sector is larger than the share in the private sector, a growing share of the public sector in nominal output will lead to a rise in the economy-wide wage share in (6.1). The trending behaviour of the wage share could also reflect a small-sample problem as the wage share rebounded from a temporary decline in the late 1980s together will cyclical effects reflecting the extremely tight labour market in the last few years, or the effects of missing, unobservable structural variables such as union power and the replacement ratio.[22]

The wage equation is specified in terms of real unit labour costs (or the wage share), $(W \times REM/PRODT)/PGDP = ULCT/PGDP$ (see equation 6.4), with the short run dynamics characterised by a Phillips curve where the wage share is affected by its deviations from its steady state value, deviations of unemployment from a constant $NAIRU$ and the price wedge between $PGDP$ and CPI:

$$\begin{aligned}\Delta(ulct_t - pgdp_t) = & -\underset{(5.9)}{0.234} + \underset{(5.7)}{0.030}Q1 + \underset{(2.8)}{0.012}Q2 + \underset{(0.6)}{0.003}Q3 \\ & -\underset{(3.2)}{0.036}D971 - \underset{(7.8)}{0.930}\Delta(pgdp_t - cpi_t) \\ & -\underset{(4.5)}{1.002}(UR_t - NAIRU_t) + \underset{(2.1)}{0.367}(UR_{t-4} - NAIRU_{t-4}) \\ & -\underset{(6.0)}{0.442}[ulct - pgdp]_{t-1} + \underset{(5.9)}{0.0017}T\end{aligned} \tag{6.2}$$

Adjusted R^2	0.701
Equation standard error	1.03%
Long-run restrictions (F-test)	5.06 [0.01]
LM test for serial correlation (F-test)	1.21 [0.28]
Normality test (χ^2-test)	0.51 [0.77]
White test for heteroscedasticity (F-test)	0.98 [0.49]
Sample period	1992:Q1-2004:Q4 (T = 52)

where:

[22] Long-run simulations assume that the wage share is constant in line with the underlying supply side of QMM.

W	Wages (6.2).
REM	Employers' wage-related cost (exogenous).
$PRODT$	Trend labour productivity (6.12).
$PGDP$	GDP price deflator (7.10).
CPI	Consumer price index (7.1).
UR	Unemployment rate (6.5).
$NAIRU$	Natural rate of unemployment (exogenous).
$D971$	Dummy variable: 1 1997:Q1 and zero elsewhere.
$Q1$-$Q3$	Centered seasonal dummies.
T	Linear time trend.

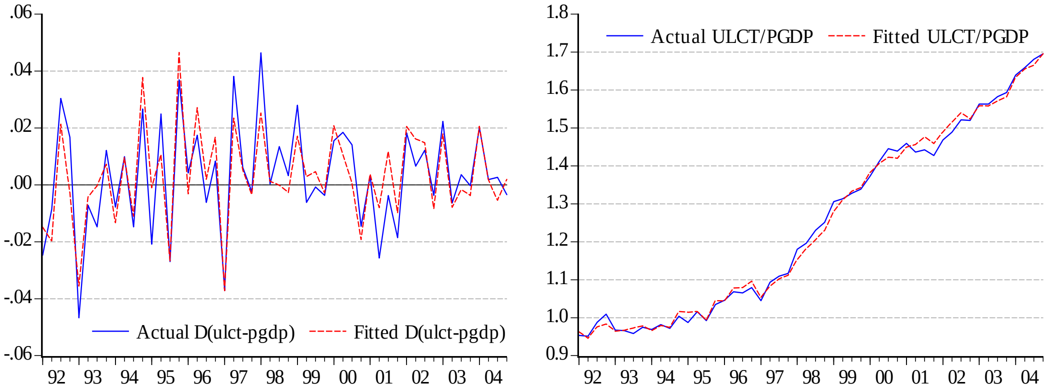


Figure 6.1. Fitted and actual $\Delta(ulct - pgdp)_t$ and $ULCT_t/PGDP_t$

Single equation dynamic responses of (6.2):[23]

Table 6.1. Responses of w to a 1% increase in RHS variables

Quarters	rem	$prodt$	$pgdp$	cpi	$UR - NAIRU$
Simultaneous	−1.00	1.00	0.07	0.93	−1.00
Four quarters ahead	−1.00	1.00	0.91	0.09	−1.78
Eight quarters ahead	−1.00	1.00	0.99	0.01	−1.47
Long run	−1.00	1.00	1.00	0.00	−1.44
50% of long-run effect	0Q	0Q	2Q	-	Overshoots
90% of long-run effect	0Q	0Q	4Q	-	Overshoots
Steady state solution:					
$(w + rem - prodt - pgdp) = const + 0.0039T$					

[23] Note that the equation is dynamically homogenous as the sum of the $PGDP$ and CPI impacts is always unity. Note also that in a steady state $UR = NAIRU$. Hence, although the table reports "long-run" effects of $UR - NAIRU$, the effects on inflation are only temporary.

6.1.2. Unit labour costs (ULC and $ULCT$)

Overall unit labour costs are given by the following identity:

$$ULC_t = \frac{W_t \times REM_t}{PROD_t} \tag{6.3}$$

where:

ULC	Unit labour costs (6.3).
W	Wages (6.2).
REM	Employers' wage-related cost (exogenous).
$PROD$	Labour productivity (6.11).

Unit labour costs in the business sector are given by the following identity:

$$ULCT_t = \frac{W_t \times REM_t}{PRODT_t} \tag{6.4}$$

where:

$ULCT$	Trend unit labour costs (6.4).
W	Wages (6.2).
REM	Employers' wage-related cost (exogenous).
$PRODT$	Trend labour productivity (6.12).

6.2. Unemployment and labour participation

6.2.1. Unemployment (UN and UR)

The unemployment rate is modelled as a fairly persistent Okun-type relation with output growth:

$$\begin{aligned} \Delta_4 UR_t \;=\;& \underset{(1.6)}{0.001} + \underset{(9.5)}{1.254}\Delta_4 UR_{t-1} - \underset{(4.5)}{0.861}\Delta_4 UR_{t-2} + \underset{(3.6)}{0.462}\Delta_4 UR_{t-3} \\ & - \underset{(2.0)}{0.024}\Delta_4 gdp_t - \underset{(2.8)}{0.100}[UR - NAIRU]_{t-4} \end{aligned} \tag{6.5}$$

Adjusted R^2	0.890
Equation standard error	0.30%
LM test for serial correlation (F-test)	0.15 [0.70]
Normality test (χ^2-test)	3.68 [0.16]
White test for heteroscedasticity (F-test)	1.48 [0.18]
Sample period	1992:Q1-2004:Q4 ($T = 52$)

where:

UR	Unemployment rate (6.5).
$NAIRU$	Natural rate of unemployment (exogenous).
GDP	GDP (5.39).

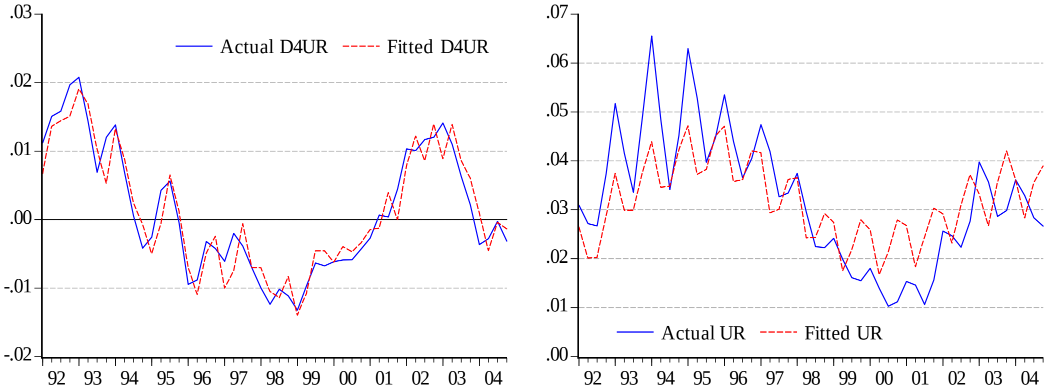


Figure 6.2. Fitted and actual $\Delta_4 UR_t$ and UR_t

Single equation dynamic responses of (6.5):[24]

Table 6.2. Responses of UR to a 1% increase in RHS variables

Quarters	$NAIRU$	gdp
Simultaneous	0.00	-0.02
Four quarters ahead	0.10	-0.11
Eight quarters ahead	0.45	-0.20
Long run	1.00	-0.24
50% of long-run effect	Overshoots	5Q
90% of long-run effect	Overshoots	9Q
Steady state solution:		
$UR = NAIRU$		

The level of unemployment is defined as:

$$UN_t = PA_t \times POWA_t - EMP_t \tag{6.6}$$

where:

UN	Level of unemployment (6.6).
PA	Participation rate (6.7).
$POWA$	Population at working age (16-64 years old) (exogenous).
EMP	Level of employment in man-years (6.9).

[24] Although the table reports the "long-run" effects of an output shock, UR equals $NAIRU$ in steady state when the constant is constrained to equal $4\theta_{ur}\gamma_y$ where θ_{ur} is the coefficient on output growth and γ_y is the quarterly steady state output growth rate.

6.2.2. Participation rate (PA and PAT)

The labour participation rate is assumed to adjust gradually towards its steady state value consistent with a constant $NAIRU$. From equation (6.10), this can be obtained as a participation rate just under 79%, which is also close to the average value of PA for the sample period:

$$\Delta_4 PA_t = \underset{(2.8)}{-0.006}Q1 + \underset{(3.3)}{0.008}Q2 + \underset{(5.0)}{0.018}Q3 + \underset{(5.2)}{0.418}\Delta_4 PA_{t-4} - \underset{(6.3)}{0.440}[PA - 0.7882]_{t-4} \quad (6.7)$$

Adjusted R^2	0.524
Equation standard error	0.58%
LM test for serial correlation (F-test)	3.57 [0.06]
Normality test (χ^2-test)	1.21 [0.55]
White test for heteroscedasticity (F-test)	1.00 [0.44]
Sample period	1990:Q1-2004:Q4 ($T = 60$)

where:

PA	Participation rate (6.7).
$Q1$-$Q3$	Centered seasonal dummies.

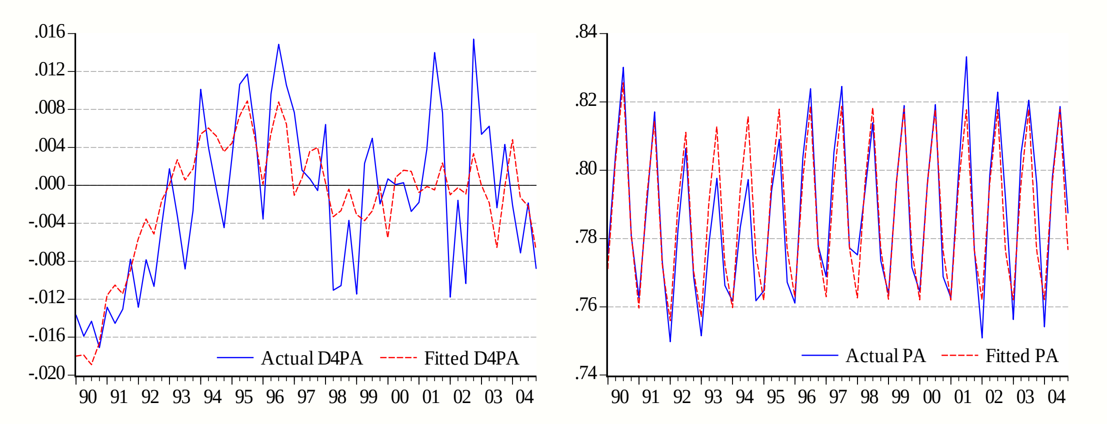


Figure 6.3. Fitted and actual $\Delta_4 PA_t$ and PA_t

Trend participation rate smoothes out the seasonal fluctuations in PA and serves as an input in trend employment (6.10). It is given as a four-quarter moving average of PA:

$$PAT_t = \left(\frac{PA_t + PA_{t-1} + PA_{t-2} + PA_{t-3}}{4} \right) \quad (6.8)$$

where:

PAT	Trend participation rate (6.8).
PA	Participation rate (6.7).

6.3. Employment and labour productivity

6.3.1. Employment in man-years (EMP and $EMPT$)

Employment in man-years is defined as:

$$EMP_t = PA_t \times POWA_t \times (1 - UR_t) \tag{6.9}$$

where:

EMP	Level of employment in man-years (6.9).
PA	Participation rate (6.7).
$POWA$	Population at working age (16-64 years old) (exogenous).
UR	Unemployment rate (6.5).

Trend employment is given as:

$$EMPT_t = PAT_t \times POWA_t \times (1 - NAIRU_t) \tag{6.10}$$

where:

$EMPT$	Trend employment (6.10).
PAT	Trend participation rate (6.8).
$POWA$	Population at working age (16-64 years old) (exogenous).
$NAIRU$	Natural rate of unemployment (exogenous).

6.3.2. Labour productivity ($PROD$ and $PRODT$)

Labour productivity is given by the following identity:

$$PROD_t = \frac{GDP_t}{EMP_t} \tag{6.11}$$

where:

$PROD$	Labour productivity (6.11).
GDP	GDP (5.39).
EMP	Level of employment in man-years (6.9).

Trend productivity is used to approximate business sector productivity and is similarily defined from the production function (5.41) as:

$$PRODT_t = \frac{GDPT_t}{EMPT_t} \tag{6.12}$$

where:

$PRODT$	Trend labour productivity (6.12).
$GDPT$	Potential output (5.42).
$EMPT$	Trend employment (6.10).

7. Price setting and inflation

This section describes price setting in QMM. Overall inflation is modelled as an expectations-augmented Phillips curve and other prices as a mark-up over marginal costs, with marginal costs in each case reflecting the inputs relevant for each sector.

7.1. Different price indices

7.1.1. Consumer price index (CPI)

Consumer price inflation is given by an expectations-augmented Phillips curve, also allowing for a temporary exchange rate and labour costs shocks. The equation imposes dynamic homogeneity on the coefficients (which is not rejected by the data) to ensure a vertical long-run Phillips curve and, hence, that no long-run tradeoff between inflation and output exists:

$$\begin{aligned}\Delta cpi_t &= \underset{(11.7)}{0.741} INFE_t/4 + \underset{(1.9)}{0.059} \Delta pm_t + \underset{(2.5)}{0.080} \Delta pm_{t-1} \\ &\quad + (1 - 0.741 - 0.059 - 0.080) \Delta ulct_{t-1} + \underset{(3.6)}{0.072} GAPAV_{t-1}\end{aligned} \tag{7.1}$$

Adjusted R^2	0.548
Equation standard error	0.46%
Dynamic homogeneity (F-test)	0.18 [0.67]
LM test for serial correlation (F-test)	0.40 [0.53]
Normality test (χ^2-test)	3.39 [0.18]
White test for heteroscedasticity (F-test)	2.52 [0.02]
Sample period	1994:Q1-2004:Q4 ($T = 44$)

where:

CPI	Consumer price index (7.1).
$INFE$	Inflation expectations (7.16).
$GAPAV$	Annual average of output gap (5.44).
PM	Import price deflator (7.2).
$ULCT$	Trend unit labour costs (6.4).

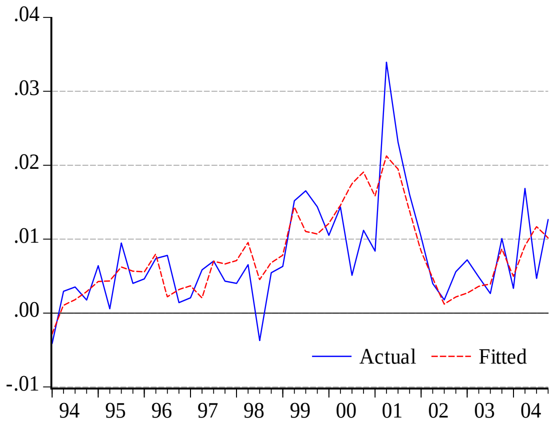


Figure 7.1. Fitted and actual Δcpi_t

Single equation dynamic responses of (7.1):[25]

Table 7.1(a). Responses of Δcpi to a 1% increase in RHS variables

Conditional on $INFE$

Quarters	$INFE/4$	Δpm	$\Delta ulct$	$GAPAV$
Simultaneous	0.74	0.06	0.00	0.00
Four quarters ahead	0.74	0.14	0.12	0.07
Eight quarters ahead	0.74	0.14	0.12	0.07
Long run	0.74	0.14	0.12	0.07
50% of long-run effect	0Q	1Q	1Q	1Q
90% of long-run effect	0Q	1Q	1Q	1Q

Steady state solution:
$\Delta cpi = 0.741INFE/4 + 0.139\Delta pm + 0.120\Delta ulct$

[25] Table 7.1(a) reports simulations conditional on unchanged inflation expectations. Table 7.1(b) solves equations (7.1) and (7.17) jointly, thus also allowing for responses in $INFE$. Note also that the steady state solution for $GAPAV$ is zero. Hence, although the table reports "long-run" effects of the output gap, its effects on inflation are only temporary. Note also that solving jointly for the steady states of Δcpi, $INFE$, Δpm and $\Delta ulct$, gives $\Delta cpi = IT/4$. Hence, all nominal prices will grow at IT on an annual basis.

Table 7.1(b). Responses of Δcpi to a 1% increase in RHS variables

Jointly with $INFE$ equation (7.17)

Quarters	$IT/4$	Δpm	$\Delta ulct$	$GAPAV$
Simultaneous	0.30	0.06	0.00	0.00
Four quarters ahead	0.52	0.24	0.21	0.12
Eight quarters ahead	0.53	0.25	0.22	0.13
Long run	0.53	0.25	0.22	0.13
50% of long-run effect	0Q	1Q	1Q	1Q
90% of long-run effect	2Q	3Q	3Q	3Q

Steady state solution:
$\Delta cpi = 0.534IT/4 + 0.250\Delta pm + 0.216\Delta ulct$

7.1.2. Import price deflator (PM)

Import prices are determined by the main components of imports, i.e. general goods and services, oil and non-oil commodities. There are also affects of domestic labour costs, reflecting effects of domestic price pressures:[26]

$$\begin{aligned}\Delta pm_t &= \underset{(6.6)}{0.636}\Delta(wpx_t + eer_t) + \underset{(2.0)}{0.123}\Delta(wpx_{t-1} + eer_{t-1}) \\ &\quad + \underset{(1.3)}{0.069}\Delta(pcom_t + eus_t) + \underset{(2.8)}{0.159}\Delta ulct_{t-2} \\ &\quad + (1 - 0.636 - 0.123 - 0.069 - 0.159)\Delta(poil_{t-1} + eus_{t-1})\end{aligned} \tag{7.2}$$

Adjusted R^2	0.769
Equation standard error	1.12%
Dynamic homogeneity (F-test)	1.66 [0.20]
LM test for serial correlation (F-test)	1.00 [0.32]
Normality test (χ^2-test)	8.03 [0.02]
White test for heteroscedasticity (F-test)	6.36 [0.00]
Sample period	1992:Q1-2004:Q4 (T = 52)

where:

PM	Import price deflator (7.2).
WPX	World export prices (exogenous).
$POIL$	Oil prices in USD (exogenous).
$PCOM$	Non-oil commodity prices in USD (exogenous).
$ULCT$	Trend unit labour costs (6.4).
EUS	USD exchange rate (4.12).
EER	Exchange rate index of foreign currencies (4.8).

[26] The t-values reported are based on the White heteroscedasticity consistent standard errors.

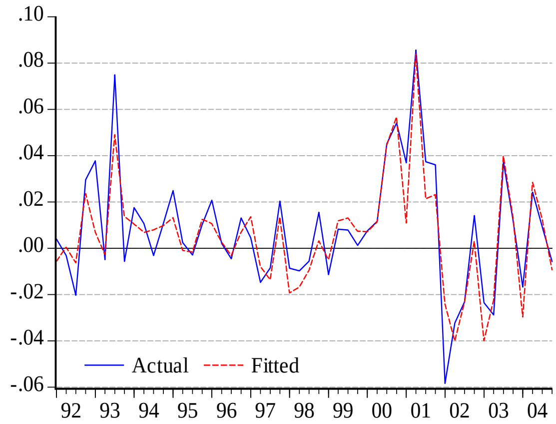


Figure 7.2. Fitted and actual Δpm_t

Single equation dynamic responses of (7.2):

Table 7.2. Responses of Δpm to a 1% increase in RHS variables

Quarters	$\Delta ulct$	Δwpx	$\Delta poil$	$\Delta pcom$	Δeer	Δeus
Simultaneous	0.00	0.64	0.00	0.07	0.64	0.07
Four quarters ahead	0.16	0.76	0.01	0.07	0.76	0.08
Eight quarters ahead	0.16	0.76	0.01	0.07	0.76	0.08
Long run	0.16	0.76	0.01	0.07	0.76	0.08
50% of long-run effect	2Q	0Q	1Q	0Q	0Q	0Q
90% of long-run effect	2Q	1Q	1Q	0Q	1Q	0Q

Steady state solution:
$\Delta pm = 0.16\Delta ulct + 0.76\Delta(wpx + eer) + 0.01\Delta(poil + eus) + 0.07\Delta(pcom + eus)$

7.1.3. Export price deflators ($PXREG$ and PX)

The variable $EXREG$ excludes aluminium and marine products. The largest remaining component is exports of services, which price is assumed to be determined by domestic and foreign consumer prices:

$$\begin{aligned}\Delta pxreg_t &= \underset{(1.8)}{0.126}\Delta cpi_{t-2} + \underset{(15.1)}{0.754}\Delta(wcpi_t + eer_t) \\ &\quad +(1 - 0.126 - 0.754)\Delta(wcpi_{t-2} + eer_{t-2}) \\ &\quad +\underset{(9.6)}{0.089}D971 - \underset{(5.9)}{0.055}D981 \end{aligned} \tag{7.3}$$

Adjusted R^2	0.927
Equation standard error	0.93%
Dynamic homogeneity (F-test)	0.04 [0.85]
LM test for serial correlation (F-test)	1.40 [0.25]
Normality test (χ^2-test)	0.20 [0.91]
White test for heteroscedasticity (F-test)	1.20 [0.41]
Sample period	1997:Q1-2004:Q4 ($T = 32$)

where:

$PXREG$	Export prices excluding aluminium and marine products (7.3).
CPI	Consumer price index (7.1).
$WCPI$	World consumer prices (exogenous).
EER	Exchange rate index of foreign currencies (4.8).
$D971$	Dummy variable: 1 1997:Q1 and zero elsewhere.
$D981$	Dummy variable: 1 1998:Q1 and zero elsewhere.

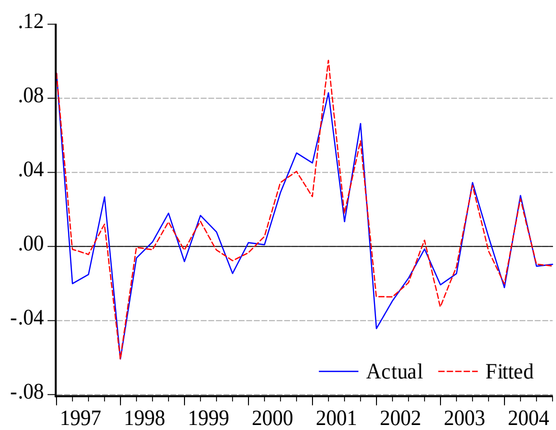


Figure 7.3. Fitted and actual $\Delta pxreg_t$

Single equation dynamic responses of (7.3):

Table 7.3. Responses of $pxreg$ to a 1% increase in RHS variables

Quarters	cpi	$wcpi + eer$
Simultaneous	0.00	0.75
Four quarters ahead	0.13	0.87
Eight quarters ahead	0.13	0.87
Long run	0.13	0.87
50% of long-run effect	2Q	0Q
90% of long-run effect	2Q	2Q
Steady state solution:		
$\Delta pxreg = 0.126\Delta cpi + 0.874\Delta(wcpi + eer)$		

Export prices for goods and services are given as

$$PX_t = \frac{EXN_t}{EX_t} \tag{7.4}$$

PX	Export price deflator (7.4).
EXN	Nominal exports of goods and services (5.28).
EX	Exports of goods and services (5.27).

7.1.4. Private consumption deflator (PC)

The growth rate of the private consumption deflator is simply given by CPI inflation, adjusted for seasonal fluctuations:

$$\Delta pc_t = \Delta cpi_t + \underset{(3.0)}{0.0065}Q1 + \underset{(1.7)}{0.0036}Q2 + \underset{(0.3)}{0.0007}Q3 \tag{7.5}$$

Adjusted R^2	0.729
Equation standard error	0.43%
Dynamic homogeneity (F-test)	1.58 [0.22]
LM test for serial correlation (F-test)	0.01 [0.91]
Normality test (χ^2-test)	4.32 [0.12]
White test for heteroscedasticity (F-test)	0.69 [0.68]
Sample period	1997:Q1-2004:Q4 ($T = 32$)

where:

PC	Private consumption deflator (7.5).
CPI	Consumer price index (7.1).
$Q1$-$Q3$	Centered seasonal dummies.

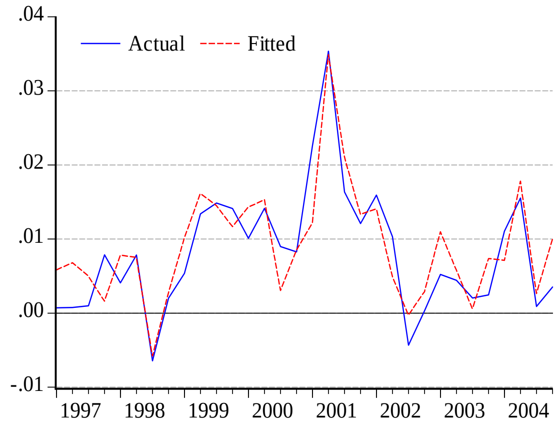


Figure 7.4. Fitted and actual Δpc_t

Equation (7.5) implies that in a steady state $\Delta pc = \Delta cpi$.

7.1.5. Government consumption deflator (PG)

The government consumption deflator is determined by unit labour costs and consumer prices:

$$\begin{aligned} \Delta pg_t &= \underset{(2.5)}{0.006}Q1 - \underset{(5.8)}{0.014}Q2 - \underset{(2.0)}{0.004}Q3 + \underset{(6.2)}{0.028}D012 \\ &\quad + \underset{(4.9)}{0.351}\Delta pg_{t-1} + \underset{(8.3)}{0.451}\Delta ulct_t + (1 - 0.351 - 0.451)\Delta cpi_t \end{aligned} \tag{7.6}$$

Adjusted R^2	0.889
Equation standard error	0.40%
Dynamic homogeneity (F-test)	0.59 [0.45]
LM test for serial correlation (F-test)	4.02 [0.06]
Normality test (χ^2-test)	2.04 [0.36]
White test for heteroscedasticity (F-test)	2.07 [0.08]
Sample period	1997:Q1-2004:Q4 ($T = 32$)

where:

PG	Government consumption deflator (7.6).
$ULCT$	Trend unit labour costs (6.4).
CPI	Consumer price index (7.1).
$Q1$-$Q4$	Centered seasonal dummies.
$D012$	Dummy variable: 1 2001:Q2 and zero elsewhere.

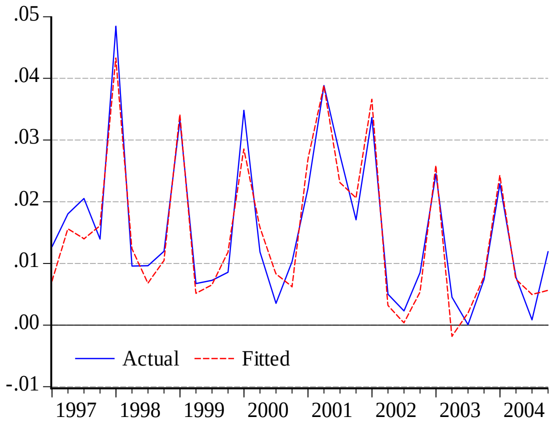


Figure 7.5. Fitted and actual Δpg_t

Single equation dynamic responses of (7.3):

Table 7.4. Responses of pg to a 1% increase in RHS variables

Quarters	$ulct$	cpi
Simultaneous	0.45	0.20
Four quarters ahead	0.69	0.30
Eight quarters ahead	0.69	0.31
Long run	0.69	0.31
50% of long-run effect	0Q	0Q
90% of long-run effect	2Q	1Q
Steady state solution:		
$\Delta pg = 0.694\Delta ulct + 0.306\Delta cpi$		

7.1.6. Investment goods price deflator (PI)

The price of investment goods is determined by building costs and import prices, the latter reflecting the large share of imported capital goods:

$$\Delta pi_t = \underset{(0.2)}{0.001}Q1 - \underset{(3.3)}{0.012}Q2 - \underset{(4.4)}{0.016}Q3 + \underset{(13.9)}{0.660}\Delta bc_t + (1 - 0.660)\Delta pm_t \tag{7.7}$$

Adjusted R^2	0.600
Equation standard error	0.91%
Dynamic homogeneity (F-test)	0.26 [0.62]
LM test for serial correlation (F-test)	0.42 [0.52]
Normality test (χ^2-test)	1.58 [0.45]
White test for heteroscedasticity (F-test)	1.66 [0.12]
Sample period	1992:Q1-2004:Q4 ($T = 52$)

where:

PI	Investment goods price deflator (7.7).
BC	Building costs (7.13).
PM	Import price deflator (7.2).
$Q1$-$Q3$	Centered seasonal dummies.

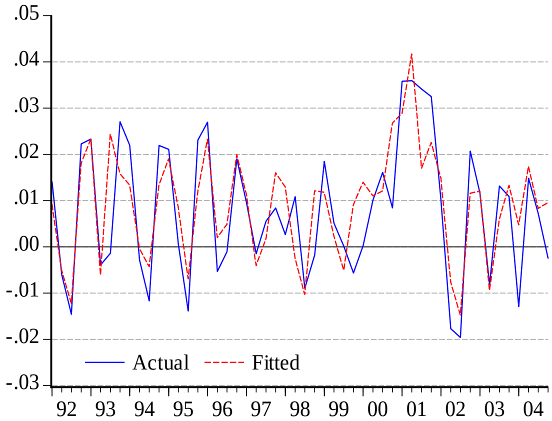


Figure 7.6. Fitted and actual Δpi_t

Equation (7.7) implies that in a steady state $\Delta pi = 0.66\Delta bc + 0.34\Delta pm$.

7.1.7. Housing investment deflator (PIH)

The housing investment deflator is simply given as:

$$\Delta pih_t = \Delta bc_t \tag{7.8}$$

where:

PIH	Housing investment deflator (7.8).
BC	Building costs (7.13).

7.1.8. Government investment deflator (PIG)

The price of government investment is determined by building costs and the general price of investment goods:

$$\Delta pig_t = \underset{(0.9)}{0.0017}Q1 - \underset{(2.8)}{0.0064}Q2 - \underset{(2.4)}{0.0054}Q3 + \underset{(10.5)}{0.582}\Delta bc_t + (1 - 0.582)\Delta pi_t \quad (7.9)$$

Adjusted R^2	0.815
Equation standard error	0.51%
Dynamic homogeneity (F-test)	1.23 [0.27]
LM test for serial correlation (F-test)	2.57 [0.12]
Normality test (χ^2-test)	1.35 [0.51]
White test for heteroscedasticity (F-test)	1.24 [0.30]
Sample period	1992:Q1-2004:Q4 ($T = 52$)

where:

PIG	Government investment deflator (7.9).
BC	Building costs (7.13).
PI	Investment goods price deflator (7.7).
$Q1$-$Q3$	Centered seasonal dummies.

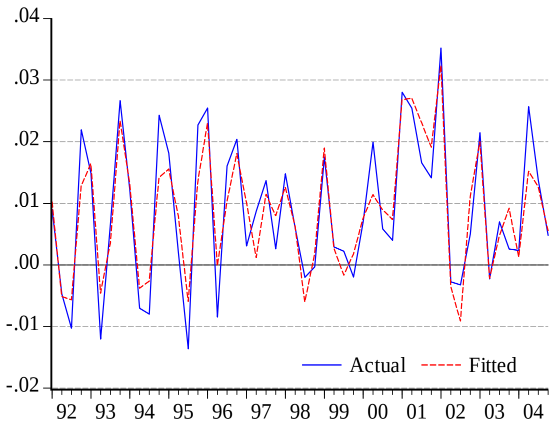


Figure 7.7. Fitted and actual Δpig_t

Equation (7.9) implies that in a steady state $\Delta pig = 0.58\Delta bc + 0.42\Delta pi$.

7.1.9. GDP price deflator ($PGDP$)

The GDP price deflator is the residual price level from the income accounting identity and is given as:

$$PGDP_t = \frac{GDPN_t}{GDP_t} \tag{7.10}$$

where:

$PGDP$	GDP price deflator (7.10).
$GDPN$	Nominal GDP (5.40).
GDP	GDP (5.39).

7.1.10. House prices (PH)

The demand for housing can be written as a positive function of household income and a negative function of real house prices and interest rates. By inverting the demand function a long-run solution for real house prices can be written as:

$$(ph - cpi) = \alpha_{ph} - \beta_{ph}(kh - ly) - \phi_{ph} RLV \tag{7.11}$$

where ph are house prices, cpi is the general price level, kh is the housing stock, ly is real household disposable labour income and RLV is the real long-term interest rate:[27]

$$\begin{aligned} \Delta(ph_t - cpi_t) \;&=\; \underset{(3.5)}{0.283} - \underset{(5.4)}{0.096} D894 + \underset{(4.4)}{0.044} D04 \\ &\quad + \underset{(1.8)}{0.165} \Delta(ph_{t-2} - cpi_{t-2}) + \underset{(2.5)}{0.113} \Delta ly_{t-4} - \underset{(2.8)}{1.482} \Delta RLV_t \\ &\quad - \underset{(3.4)}{0.133} [(ph - cpi) + 0.870(kh - ly) + 2.230 RLV]_{t-2} \end{aligned} \tag{7.12}$$

Adjusted R^2	0.530
Equation standard error	1.72%
Long-run restrictions (F-test)	1.05 [0.36]
LM test for serial correlation (F-test)	0.17 [0.68]
Normality test (χ^2-test)	1.41 [0.49]
White test for heteroscedasticity (F-test)	0.81 [0.62]
Sample period	1989:Q1-2004:Q4 (T = 64)

where:

PH	House prices (7.12).
CPI	Consumer price index (7.1).
KH	Private sector housing stock (5.20).
LY	Real post-tax labour income (9.6)
RLV	Long-term indexed interest rate (4.4).
$D894$	Dummy variable: 1 1989:Q4 and zero elsewhere.
$D04$	Dummy variable: 1 2004:Q1-2004:Q4 and zero elsewhere.

[27] The dummy variable for 2004 captures the effects of the structural change in the domestic housing market on housing prices, analysed in Elíasson and Pétursson (2006).

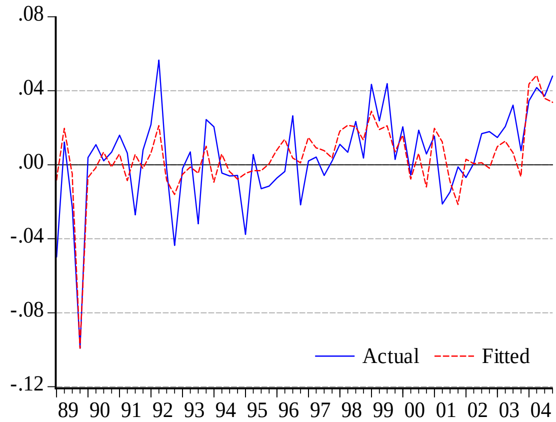


Figure 7.8. Fitted and actual $\Delta(ph_t - cpi_t)$

Single equation dynamic responses of (7.12):

Table 7.5. Responses of $ph - cpi$ to a 1% increase in RHS variables

Quarters	kh	ly	RLV
Simultaneous	0.00	0.00	−1.48
Four quarters ahead	−0.35	0.46	−2.04
Eight quarters ahead	−0.67	0.76	−2.18
Long run	−0.87	0.87	−2.23
50% of long-run effect	5Q	4Q	0Q
90% of long-run effect	11Q	9Q	4Q

Steady state solution:
$(ph - cpi) = const - 0.870(kh - ly) - 2.230RLV$

7.1.11. Building costs (BC)

Building costs are determined by consumer prices and unit labour costs:

$$\Delta bc_t = \underset{(3.9)}{0.303}\Delta bc_{t-1} + \underset{(5.2)}{0.472}\Delta cpi_t + (1 - 0.303 - 0.472)\Delta ulct_t + \underset{(4.0)}{0.025}D021 \quad (7.13)$$

Adjusted R^2	0.501
Equation standard error	0.60%
Dynamic homogeneity (F-test)	0.28 [0.60]
LM test for serial correlation (F-test)	0.09 [0.76]
Normality test (χ^2-test)	5.65 [0.06]
White test for heteroscedasticity (F-test)	0.34 [0.98]
Sample period	1992:Q1-2004:Q4 ($T = 52$)

where:

BC	Building costs (7.13).
CPI	Consumer price index (7.1).
$ULCT$	Trend unit labour costs (6.4).
$D021$	Dummy variable: 1 2002:Q1 and zero elsewhere.

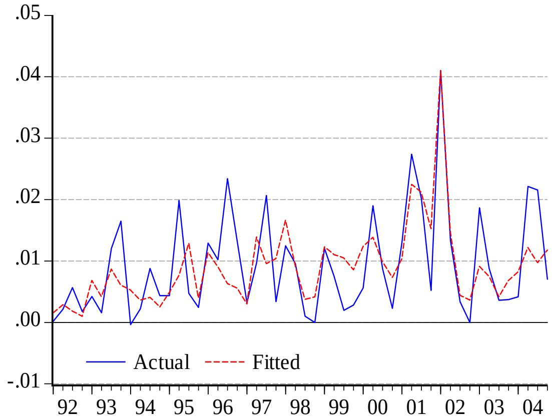


Figure 7.9. Fitted and actual Δbc_t

Single equation dynamic responses of (7.13):

Table 7.6. Responses of Δbc to a 1% increase in RHS variables

Quarters	Δcpi	$\Delta ulct$
Simultaneous	0.47	0.22
Four quarters ahead	0.68	0.32
Eight quarters ahead	0.68	0.32
Long run	0.68	0.32
50% of long-run effect	0Q	0Q
90% of long-run effect	1Q	1Q
Steady state solution:		
$\Delta bc = 0.677\Delta cpi + 0.323\Delta ulct$		

7.2. Inflation and inflation expectations

7.2.1. Quarterly and annual inflation rate ($INFQ$ and INF)

Quarterly inflation is calculated as:

$$INFQ_t = CPI_t/CPI_{t-1} - 1 \tag{7.14}$$

and year-on-year inflation as:

$$INF_t = CPI_t/CPI_{t-4} - 1 \tag{7.15}$$

where:

$INFQ$	Quarterly CPI inflation rate (7.14).
INF	Four-quarter CPI inflation rate (7.15).
CPI	Consumer price index (7.1).

7.2.2. Inflation expectations ($INFE$)

Historical data on inflation expectations in QMM are obtained from the interest rate spread between nominal and indexed bonds (so-called break even inflation expectations), taking account of an inflation risk premium, see equation (4.4):[28]

$$INFE_t = (RL_t - RLV_t) - PRISK_t \tag{7.16}$$

where:

$INFE$	Inflation expectations (7.16).
RL	Long-term interest rate (4.3).
RLV	Long-term indexed interest rate (4.4).
$PRISK$	Inflation risk premium (exogenous).

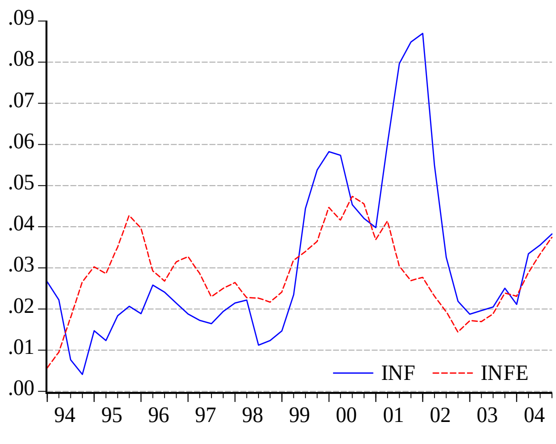


Figure 7.10. Inflation and inflation expectations

[28]Note that since these bonds have several years to maturity, the break-even inflation rate measures the average inflation rate expected over these years.

In the forecasting round, inflation expectations can be generated in two ways in QMM. The first approach is to assume inflation expectations given as a weighted average of past inflation and the inflation target, with the standard value of the weight on past inflation, ω_{pe}, equal to 0.6:[29]

$$INFE_t = \omega_{pe} INF_{t-1} + (1 - \omega_{pe}) IT_t \tag{7.17}$$

where:

$INFE$	Inflation expectations (7.16).
INF	Four-quarter CPI inflation rate (7.15).
IT	Central Bank of Iceland 2.5% inflation target (exogenous).

An alternative approach is to assume that expectations are formed rationally, using model consistent expectations. This will be the standard assumption in QMM once the steady state version of the model is fully developed.

8. Fiscal policy

The fiscal part mainly comprises accounting identities and adding-up constraints using exogenous tax rates.

8.1. Government income

8.1.1. Taxation receipts (TAX)

Total taxation receipts are an accounting identity:

$$TAX_t = TJ_t + TC_t + TE_t \tag{8.1}$$

where:

TAX	Total tax receipts (8.1).
TJ	Household tax payments (8.2).
TC	Corporate tax payments (8.6).
TE	Total taxes on production and imports (8.11).

8.1.2. Household tax payments (TJ, TJY, TI and TJO)

Household tax payments are given by the sum of receipts from taxes on household income, interest rate income and other taxes paid by households:

$$TJ_t = TJY_t + TI_t + TJO_t \tag{8.2}$$

[29] The weight on past inflation has probably been declining over time. Estimating (7.17) for the period 1995-2004 gives a weight just below 0.9, but since the introduction of inflation targeting in 2001 the weight is estimated just under 0.75.

where:

TJ	Household tax payments (8.2).
TJY	Household income tax (8.3).
TI	Household interest rate income tax (8.4)
TJO	Other household tax payments (8.5).

Household income tax payments are given as:

$$TJY_t = RJY_t \times (YE_t + CJ_t) - ALLOW_t \times POWA_t \tag{8.3}$$

where:

TJY	Household income tax (8.3).
RJY	Household income tax rate (exogenous).
YE	Wages, salaries and self-employed income (9.2).
CJ	Current grants to the household sector (8.16).
$ALLOW$	Personal allowances (exogenous).
$POWA$	Population at working age (16-64 years old) (exogenous).

Tax payments on interest rate income are given as:[30]

$$\begin{aligned} TI_t = {} & RI_t \times \frac{1}{4} [0.14 (RLV_t + 4 \times INFQ_t) \\ & + 0.12 (RLV_t + 4 \times INFQ_t + 0.013) + 0.44 (RS_t - 0.035)] \, GFW_{t-1} \end{aligned} \tag{8.4}$$

where:

TI	Household interest rate income tax (8.4)
RI	Interest rate income tax rate (exogenous).
RLV	Long-term indexed interest rate (4.4).
$INFQ$	Quarterly CPI inflation rate (7.14).
RS	Short-term interest rate (4.1).
GFW	Gross financial wealth (4.20).

Other household direct taxes are given as:

$$TJO_t = RJO_t \times GDPN_t \tag{8.5}$$

where:

TJO	Other household tax payments (8.5).
RJO	Household other tax rate (exogenous).
$GDPN$	Nominal GDP (5.40).

[30] The constants in (8.4), 1.3% and 3.5%, reflect the average interest rate differential between RLV and indexed long-term deposit rates and between RS and short-term deposit rates, respectively, since 1994.

8.1.3. Corporate tax payments (TC, TCI, TCP, TIC and TWC)

Corporate tax payments are given by the sum of receipts from corporate income and property taxes:

$$TC_t = TCI_t + TCP_t + TIC_t + TWC_t \tag{8.6}$$

where:

TC	Corporate tax payments (8.6).
TCI	Corporate income tax payments (8.7).
TCP	Corporate property tax payments (8.8).
TIC	Corporate finance income tax payments (8.9).
TWC	Corporate wage cost tax payments (8.10).

Corporate income tax receipts are given as:

$$TCI_t = RCI_t \times GDPN_{t-4} \tag{8.7}$$

where:

TCI	Corporate income tax payments (8.7).
RCI	Corporate income tax rate (exogenous).
$GDPN$	Nominal GDP (5.40).

Corporate property tax receipts are given as:

$$TCP_t = RCP_t \times GDPN_t \tag{8.8}$$

where:

TCP	Corporate property tax payments (8.8).
RCP	Corporate property tax rate (exogenous).
$GDPN$	Nominal GDP (5.40).

Corporate finance income tax payments are given as:

$$TIC_t = RFIC_t \times GDPN_t \tag{8.9}$$

where:

TIC	Corporate finance income tax payments (8.9).
$RFIC$	Corporate finance income tax rate (exogenous).
$GDPN$	Nominal GDP (5.40).

Corporate wage costs tax payments are given as:

$$TWC_t = RWC_t \times YE_t \tag{8.10}$$

where:

TWC	Corporate wage cost tax payments (8.10).
RWC	Corporate wage cost tax rate (exogenous).
YE	Wages, salaries and self-employed income (9.2).

8.1.4. Taxes on expenditure (TE, $TVAT$, TSD and $TIMP$)

Total taxes on production and imports are given as the sum of value-added taxation receipts, tarrifs and other import taxes, and other expenditure taxation receipts:

$$TE_t = TVAT_t + TIMP_t + TSD_t \tag{8.11}$$

where:

TE	Total taxes on production and imports (8.11).
$TVAT$	Value-added taxation receipts (8.12).
$TIMP$	Tariffs and other taxes on imports (8.13).
TSD	Other expenditure taxation receipts (8.14).

Value-added taxation receipts are given as:

$$TVAT_t = RVAT_t \times CN_t \tag{8.12}$$

where:

$TVAT$	Value-added taxation receipts (8.12).
$RVAT$	Value-added tax rate (exogenous).
CN	Nominal private consumption (5.3).

Tariffs and other taxes on imports are given as:

$$TIMP_t = RIMP_t \times IMPN_t \tag{8.13}$$

where:

$TIMP$	Tariffs and other taxes on imports (8.13).
$RIMP$	Tax rate on imports (exogenous).
$IMPN$	Nominal imports of goods and services (5.31).

Other expenditure tax receipts are given as:

$$TSD_t = RSD_t \times CN_t \tag{8.14}$$

where:

TSD	Other expenditure taxation receipts (8.14).
RSD	Other expenditure tax rate (exogenous).
CN	Nominal private consumption (5.3).

8.2. Government expenditure and net borrowing

8.2.1. Subsidies ($SUBS$)

Government subsidies on production are given as:

$$SUBS_t = RTS_t \times GDPN_t \tag{8.15}$$

where:

$SUBS$	Government subsidies (8.15).
RTS	Effective subsidies rate (exogenous).
$GDPN$	Nominal GDP (5.40).

8.2.2. Other public sector expenditure (CJ and DI)

Besides government consumption and investment, government expenditure includes current grants to the household sector (predominantly social security payments) and interest rate payments on general government debt.

Grants to the household sector are calculated as:

$$\Delta cj_t = \Delta_4 gdpn_t/4 \tag{8.16}$$

where:

CJ	Current grants to the household sector (8.16).
$GDPN$	Nominal GDP (5.40).

Interest payments on government domestic nominal and indexed debt and foreign debt grow according to:[31]

$$\begin{aligned} \Delta DI_t &= \left[0.25\left(\frac{RL_t}{4}\right) + 0.17\left(\frac{RLV_t}{4}\right)\right. \\ &\left. +0.58\left(\left(\frac{EER_t}{EER_{t-1}}\right)\left(1+\frac{USRL_t}{4}\right)-1\right)\right] PSNB_t \end{aligned} \tag{8.17}$$

where:

DI	General government debt interest payments (8.17).
RL	Long-term interest rate (4.3).
RLV	Long-term indexed interest rate (4.4).
EER	Exchange rate index of foreign currency (4.8).
$USRL$	US long-term bond rate (exogenous).
$PSNB$	Public sector net borrowing (8.18).

[31] The weights are obtained from the National Debt Management Agency and are the average weights for the end-of-year period 2002-2004.

8.2.3. Public sector net borrowing ($PSNB$)

Public sector net borrowing is the sum of expenditure items less taxation receipts:

$$PSNB_t = (GN_t + IGNNET_t + CJ_t + DI_t + SUBS_t) - TAX_t \tag{8.18}$$

where:

$PSNB$	Public sector net borrowing (8.18).
GN	Nominal government consumption (exogenous).
$IGNNET$	Nominal net government investment (5.17).
CJ	Current grants to the household sector (8.16).
DI	General government debt interest payments (8.17).
$SUBS$	Government subsidies (8.15).
TAX	Total tax receipts (8.1).

9. Household income accounting

This final section closes QMM by defining the household income accounting identities.

9.1. Total household pre-tax income (YJ, YE, YIC and $YDIJ$)

Total household sector pre-tax income is given by the identity:

$$YJ_t = YE_t + CJ_t + YIC_t + YDIJ_t \tag{9.1}$$

where:

YJ	Total household pre-tax income (9.1).
YE	Wages, salaries and self-employed income (9.2).
CJ	Current grants to the household sector (8.16).
YIC	Households' other income (9.3).
$YDIJ$	Other household non-labour income (9.4).

Total wages, salaries and self-employed income is given as the following identity:

$$\Delta ye_t = \Delta w_t + \Delta emp_t \tag{9.2}$$

where:

YE	Wages, salaries and self-employed income (9.2).
W	Wages (6.2).
EMP	Level of employment in man-years (6.9).

Households' other income is given as a constant ration to wage income:

$$YIC_t = RIC_t \times YE_t \tag{9.3}$$

where:

YIC	Households' other income (9.3).
RIC	Ratio of households' other income to YE (exogenous).
YE	Wages, salaries and self-employed income (9.2).

Households' net financial income is given as:[32]

$$\begin{aligned} YDIJ_t &= \frac{1}{4}\left[0.14 \times RLV_t + 0.12\left(RLV_t + 0.013\right)\right. \\ &\quad \left. +0.44\left(RS_t - 0.035 - 4 \times INFQ_t\right)\right] GFW_{t-1} \\ &\quad -\frac{1}{4}\left[0.70 \times RLV_t + 0.30\left(RS_t + 0.065 - 4 \times INFQ_t\right)\right] DH_{t-1} \end{aligned} \tag{9.4}$$

where:

$YDIJ$	Other household non-labour income (9.4).
RLV	Long-term indexed interest rate (4.4).
$INFQ$	Quarterly CPI inflation rate (7.14).
RS	Short-term interest rate (4.1).
GFW	Gross financial wealth (4.20).
DH	Household debt (4.21).

9.2. Real household post-tax income ($RHPI$ and LY)

Real household post-tax income is defined as total household sector pre-tax income less tax deductions from household income, all deflated with the private consumption price deflator:[33]

$$RHPI_t = \left[\frac{(YJ_t - TJ_t)/PC_t}{(YJ_{t-1} - TJ_{t-1})/PC_{t-1}}\right] RHPI_{t-1} \tag{9.5}$$

where:

$RHPI$	Real household post-tax income (9.5)
YJ	Total household pre-tax income (9.1).
TJ	Household tax payments (8.2).
PC	Private consumption deflator (7.5).

Real post-tax labour income is defined as:

[32] The first two constants in (9.4) are the same as in (8.4), with an addtional 6.5% constant on the interest rate expenditure side, reflecting the average differential between RS and short-term credit rates from 1994.

[33] Available data on household income, assets and debt indicate that the income data has underestimated household income by roughly 25% on average for the period 1990-2004. Historical data on $RHPI$ (given as $(YJ - TJ)/PC$) is therefore scaled by 1.25 so that the income data corresponds to the development of savings and net wealth accumulation. Equation (9.5) therefore gives the development of $RHPI$ in similations and forecasts.

$$LY_t = \frac{(YJ_t - YDIJ_t) - (TJ_t - TI_t)}{PC_t} \tag{9.6}$$

where:

LY	Real post-tax labour income (9.6)
YJ	Total household pre-tax income (9.1).
$YDIJ$	Other household non-labour income (9.4).
TJ	Household tax payments (8.2).
TI	Household interest rate income tax (8.4)
PC	Private consumption deflator (7.5).

Part III
Model Properties

10. Monetary policy transmission mechanism in QMM

The propagation of monetary policy shocks throughout the economy is fairly standard in QMM. The model incorporates all the main channels of monetary policy, i.e. an interest rate channel, an asset price channel, an exchange rate channel, and an expectations channel. Through these channels the monetary policy shock propagates to aggregate demand, and from there to inflation. Figure 10.1 gives a simplified overview over these main transmission channels.[34]

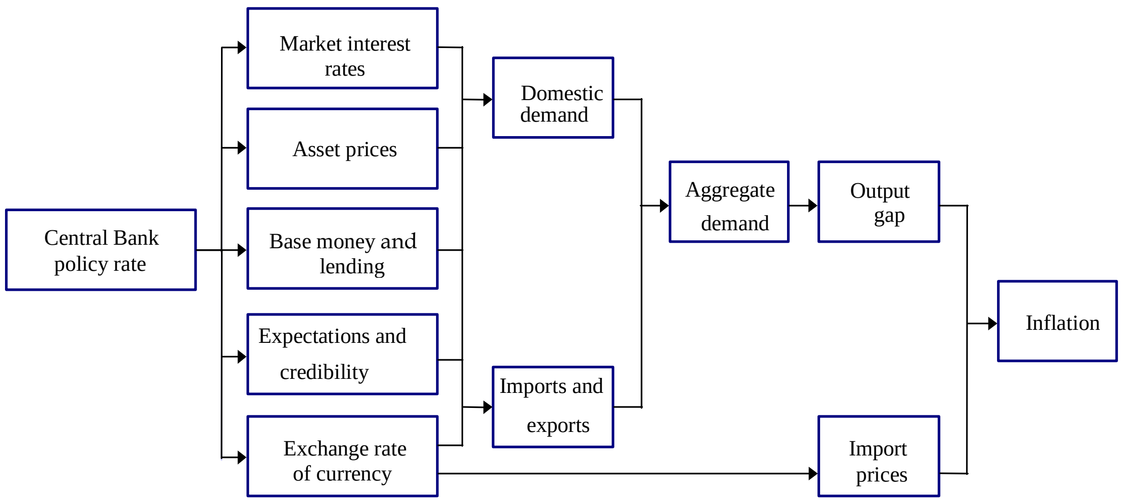


Figure 10.1. The transmission mechanism of monetary policy (Pétursson, 2001b)

10.1. Interest rate channel

In QMM, monetary policy actions are conducted through changes in the short-term interest rate (4.1) or (4.2). A rise in the policy rate affects the slope of the yield curve through long-term interest rates (4.3). In as much as inflation expectations do not adjust completely, this will also raise the long-term real interest rates (4.4) and the real cost of capital (4.5). This has a first round effect on various expenditure items, such as consumption (5.2) and business investment (5.10), thus dampening domestic demand and easing capacity pressures as measured by the output gap (5.43). This further dampens demand for imported goods and services (5.30), increases unemployment (6.5), and reduces the demand for housing (7.12). Easing demand pressures reduces pressure on prices of goods, such as (7.1) and (7.2), nominal assets, such as housing (7.12), and labour (6.2).

The second round effects are equally important (if not more so). As demand in the goods and labour markets falls, household labour income also falls (9.6), leading to a fall in total household disposable income (9.5). This further reduces private consumption and aggregate demand in the economy.

[34] From Pétursson (2001b), which gives a detailed discussion of these channels, with some structural VAR estimation results for Iceland.

10.2. Asset price channel

Through its effect on asset prices, the monetary policy shock will also affect household wealth and private sector balance sheets. A rise in the short-term interest rate will dampen the demand for money (4.25) and the subsequent rise in long-term interest rates and fall in nominal income will lead to a fall in equity prices (4.16). The fall in equity prices and in the market value of long-term bonds will reduce the financial wealth of households (4.19) and the market value of firms. In addition, the fall in house prices will reduce housing investment (5.14), and both will reduce the housing wealth of households (4.18). Total household wealth (4.17) will therefore fall, reducing private consumption and aggregate demand further.

10.3. Exchange rate channel

An important channel for monetary policy in small open economies like Iceland is the working of monetary policy through changes in the exchange rate. The rise in short-term interest rates will usually lead to a currency appreciation (4.8), which will lead to a temporary real exchange rate appreciation (4.15) as domestic prices adjust slowly. The competitive position of the export industry (4.13) will therefore temporarily weaken with export volumes (5.26) and export prices in domestic currency falling (7.4). The competitive position of sectors competing with imported goods will also weaken as import prices in domestic currency fall (7.2), thus pushing relative import prices (4.14) down and import volumes up (5.30), hence shifting demand out of the economy. This increase in demand for imported goods will somewhat counteract the fall in imports stemming from falling domestic demand discussed above and may even lead to a temporary worsening of the trade balance (the so called J-curve effect), (5.33). The worsening of the competitive position of the export and domestic competitive sectors and the shift of demand out of the country will reduce overall demand and dampen inflationary pressures. The ability of the business sector to pay wages and offer jobs will also be hurt, dampening wage pressures with identical second round effects through falling private sector incomes and demand as discussed above.

There is also a direct, supply effect of exchange rate changes to domestic prices through import prices. As import prices fall, imported goods become cheaper, leading directly to a fall in consumer prices (7.1) and output prices for goods using imported intermediate goods for production (7.7). This further dampens wage pressures with a further second round effect on prices through falling unit labour costs (6.4).

10.4. Expectations channel

Finally, monetary policy in QMM can also affect household and business decisions through these actors expectations of future developments of monetary policy (4.3), the exchange rate (4.8) and inflation (7.16).[35]

[35] The credit channel, shown in Figure 10.1, does not realy play a role in QMM.

10.5. An illustration: A temporary 1 percentage point rise in the policy interest rate

To illustrate how monetary policy works in QMM, this section shows how an unanticipated 1 percentage point rise in the policy rate affects the economy. The shock is assumed to last for one year but beyond that the short-term interest rate is assumed to follow the given policy rule, i.e. the Taylor rule (4.1) or the Orphanides rule (4.2). Thus from quarter five, the policy rate starts declining again as inflation and output fall and moves below its baseline level from quarter six and returns to baseline in about four years.[36]

10.5.1. The effects on output and inflation

As shown in Figure 10.2, the immediate effects of the interest rate hike are rather small. However, output starts markedly to fall from baseline after about one quarter, with the maximum effect occuring after five quarters with output about 0.8% lower than in the baseline scenario using the Taylor rule and two quarters later at a sligthly lower level using the Orphanides rule, with half of the peak effect occuring after three quarters in both cases. The effects on inflation take a slightly longer time to emerge, reflecting the degree of nominal inertia in the economy. Inflation is broadly unchanged for the first three quarters, from which it gradually starts to fall, with the maximum effect occuring after about nine quarters with inflation just over 0.3 percentage points lower than in the baseline scenario using the Taylor rule and about 0.4 percentage points lower one quarter later using the Orphanides rule, with half of the effect occuring in roughly one year in both cases. Output has recovered to baseline after about three years and inflation in about four years.

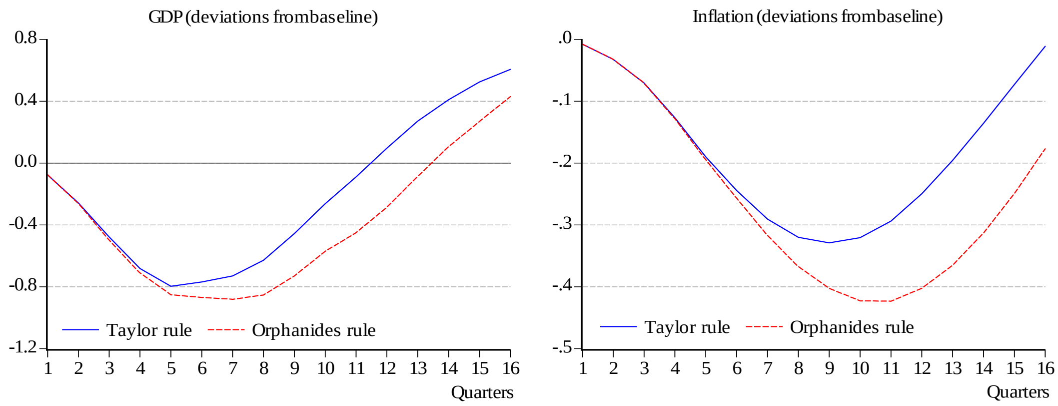


Figure 10.2. Response to 1 percentage point rise in monetary policy rate for one year

[36]The simulation results reported here only provide an illustration of the properties of QMM and cannot be used mechanically to predict how the economy reacts to monetary policy in reality, as all simulation exercises are highly stylised and are based on a number of simplifying assumptions.

10.5.2. The transmission of the shock through the economy

Figure 10.3 shows how the policy shock is transmitted through the economy and to the final effects on output and inflation described in Figure 10.2 using the Taylor rule (the effects using the Orphanides rule are basically the same). The long-term interest rate immediately rises by roughly 70 basis points (figure *a*), which is consistent with the analysis of the transmission of policy shocks to other interest rates in Pétursson (2001a), using a structural VAR analysis. Since the long rate rises by less than the policy rate, the standard inverted yield curve is obtained. The exchange rate appreciates immediately by 0.2% (figure *b*) and continues to appreciate for a few quarters and peaks at just under 0.8% stronger than in the baseline scenario before gradually returning to baseline. This profile is not consistent with the simple UIP condition, where the exchange rate should immediately appreciate by the full amount and then gradually depreciate to ensure that expected returns on foreign and domestic assets are equal. The QMM profile is however consistent with international evidence from structural VAR analysis, cf. Eichenbaum and Evans (1995) and similar structural VAR results from Pétursson (2001b).

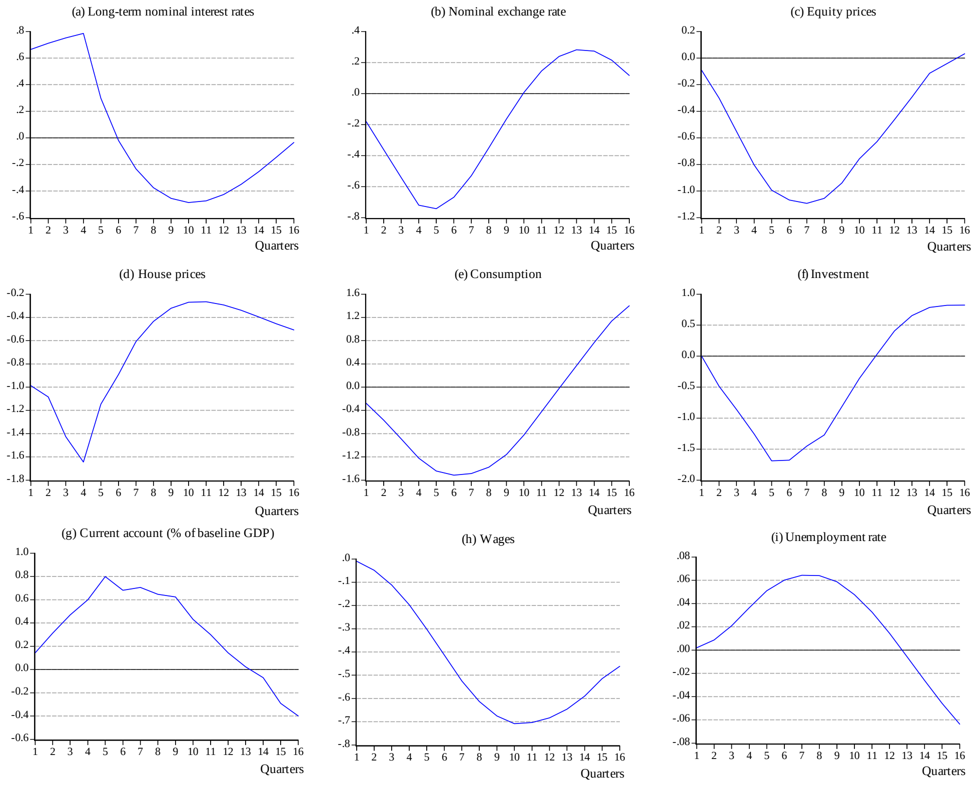


Figure 10.3. Responses of key variables to a monetary policy shock (deviations from baseline)

Asset prices also fall immediately after the policy shock (figures *c* and *d*), with the peak effects on house prices coming after four quarters (the policy shock therefore affects house prices before overall inflation) and three quarters later for equity prices. This leads to a fall in household wealth, which along with declining wages from baseline (figure h) and rising real interest rates, leads to a decline in consumption (figure e). Investment similarily falls (figure f). The peak effect on consumption and investment occurs after five quarters and is somewhat larger than the output effect in the previous figure. The reason is the offsetting effect from net trade, as both exports (due to the appreciating exchange rate) and imports (due to declining domestic demand) fall, but the contraction in imports is greater, thus leading to an improvement in the current account (figure g).[37] The final two figures show the effects of the policy shock on the labour market. As mentioned before, wages decline relative to baseline, with the peak effect occuring in ten quarters. The decline in real wages is smaller, but the impulse response is similar. Unemployment starts rising gradually after the shock, with the peak effect of roughly 0.1 percentage points occuring after seven quarters, but the effects are very small, with most of the adjustment seemingly coming through real wages. The size of the unemployment effect is, however, similar to the one reported in Harrison et al.(2005) for the new Bank of England DSGE model (BEQM).

10.5.3. Comparison with international evidence

The time lags and size of the monetary policy impulses in QMM are quite similar to the empirical findings from the structural VAR model of Pétursson (2001b) and the effects in the Bank of England MTMM model. In fact, the inflation effects in QMM and MTMM are almost identical from the peak and beyond. The size of the inflation effect is also quite similar to the size in BEQM, although the peak occurs roughly half a year earlier in BEQM. The output effect in QMM is however somewhat larger than in MTMM and BEQM (see Bank of England, 2000, p. 18 and Harrison et al., 2005, pp. 128-132).

The results are also broadly in line with general findings in the literature, cf. the survey of results given in Christiano, Eichenbaum and Evans (1999), the analysis of the Euro-Area models in Fagan and Morgan (2005) and the survey results from various inflation targeting central banks reported in Schmidt-Hebbel and Tapia (2002). The last authors compare the effect of a 1 percentage point rise in the policy rate for one quarter rather than four quarters as in Figures 10.2 and 10.3. In their sample of twelve inflation targeting countries, the maximum output decline for the median country is 0.27% compared to 0.31% in QMM (for a similar policy shock), with 50% of the output effect attained after two quarters in both cases. The maximum inflation decline for the median country is 0.14 percentage points compared to 0.12 percentage points in QMM (for a similar policy shock), with 50% of the inflation effect attained after four quarters in both cases.

[37] The negative effect from declining domestic demand therefore dominates the positive effect of falling relative import prices on the demand for imports.

10.5.4. Analysis of the relative importance of different policy channels

As a final analysis of the policy shock, Figure 10.4 shows the relative importance of the three most important transmission channels within QMM, the exchange rate, interest rate and asset price channels.[38] For the exchange rate channel, this is done by taking the exchange rate path from the policy shock discussed above (see Figure 10.3) but not allowing the long-term nominal interest rate and the asset variables equity prices, house prices and household wealth to react to the shock. Similarly, for the interest rate channel, the path for the long-term nominal interest rate from the policy shock is used but not allowing the exchange rate and the asset variables to react. Finally, for the asset price channel, the exchange rate and long-term interest rate are not allowed to react to the shock, whereas equity prices, house prices and household wealth react as in the main exercise.[39]

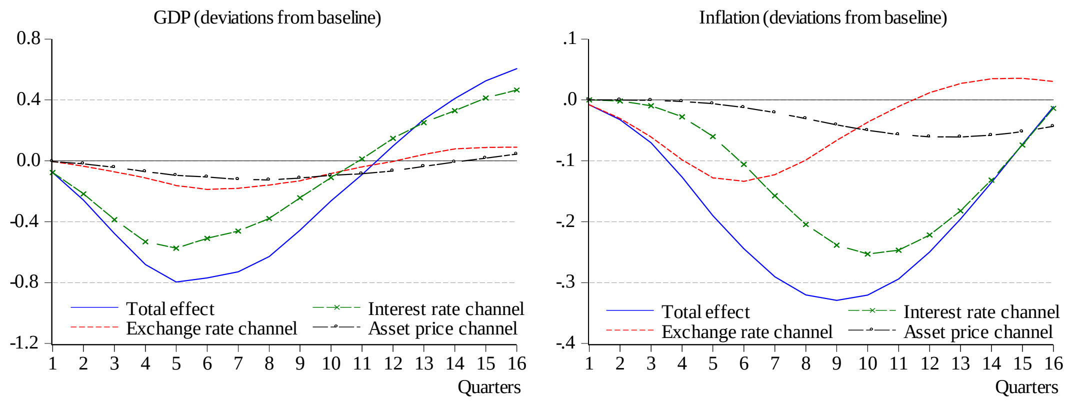


Figure 10.4. Different transmission channels of monetary policy

Looking first at how different transmission channels affect output, the figure shows that most of the monetary policy shock is transmitted through the interest rate channel, although there are some effects through the exchange rate and asset price channel in the second year. A somewhat different picture emerges for the inflation rate. For the first year and a half, the main effects of the policy shock are transmitted through the exchange rate channel. The interest rate channel only starts to play a role from there with most of the shock explained by the interest rate channel for the remainder of the period. The asset price channel plays a relatively minor role with most of its effects emerging quite late.

Although the results from this exercise should be interpreted with some caution, they are consistent with the general results from the literature: the interest rate

[38] The expectations channel feeds off these channels through inflation expectations, but in the current version of the model these expectations are completely backward looking. As previously mentioned, the final channel, through money and credit, does not really play a role in QMM.

[39] Note that these transmission channels are not independent of each other, but interact and effect each other. Therefore, the sum of the three transmission channels in this exercise does not add up to the total effect. The difference is, however, small.

channel is the key channel through which monetary policy affects the real economy, but its effects on inflation appear at quite a long lag, with most of the initial effect on inflation coming through the exchange rate channel. The asset price channel plays a less important role and at quite long lags.

11. QMM simulation results

11.1. Historical simulations

The discussion of the properties of QMM in Part II focused on the single-equation properties of each estimated equation. Such analysis can be useful as a simple check of the forecasting ability of each behavioural equation of the model, but to understand the overall forecasting ability and simulation properties of the model, one needs to analyse the system as a whole. One way to do that is to simulate the model over a historical period and compare the results with actual developments. This is done in Figure 11.1. The model is simulated from 1995:Q1 to 2005:Q4 taking the developments of exogenous variables as given. This does therefore not amount to a proper out-of-sample forecasting exercise, but it should serve to give a feeling of the general features of QMM and how successful it is in replicating actual history.

In addition to taking the exogenous variables as given, the development of the monetary policy rate, RS, is also given by actual development in the simulation excercise. The reason is that allowing RS to develop according to the simple monetary policy rule usually used in QMM (4.1) gives a very different path for RS from what actually occurred.[40] This affects other interest rates, the exchange rate and the development of other variables in QMM and reflects the fact that monetary policy until 2001 was very different from the current regime. It is hardly a sign of failure of QMM that the simple policy rule it incorporates to describe current behaviour cannot sufficiently describe historical behaviour. It therefore seems more interesting when analysing the model's properties to isolate monetary policy behaviour from other properties of the model.

Overall the model seems to be fairly successful in replicating actual developments, especially of the real economy, although the match is naturally not perfect and some deviations appear. It captures the general trends and cyclical behaviour of consumption, investment, exports, imports, the current account and output (figures d to i),[41] although the simulated consumption level is somewhat higher than the actual level (which among other things reflects the simulated lower real interest rate, see below). For example, the cyclical downturn in consumption in late 2001 is perfectly captured by the model, probably reflecting the negative effects of declining net worth on consumption. A similar cyclical downturn in imports is, however, not fully captured which reflects the fact that the model completely misses the large depreciation of the exchange rate in 2001 and the subsequent appreciation (figure

[40] It is interesting to note that the Orphanides policy rule (4.2) has more success in replicating actual montetary policy behaviour over the historical period than the Taylor rule.

[41] Although parts of investment and exports are exogenous in QMM, the model is successful in explaining the endogenous part of these expenditure items.

c). This should not come as a surprise as it is hard to imagine what type of model would have captured such an abrupt change in the exchange rate regime in a dynamic simulation over such a long period. The fact that the model does not capture the contraction in imports in 2001 is also reflected in the fact that the model misses the temporary improvement in the current account deficit that followed (figure *h*). The continued detoriation of the current account is however captured. The fact that the model captures the cyclical downturn in consumption but not in imports also generates a somewhat sharper contraction in output in late 2001 than observed in the actual data.

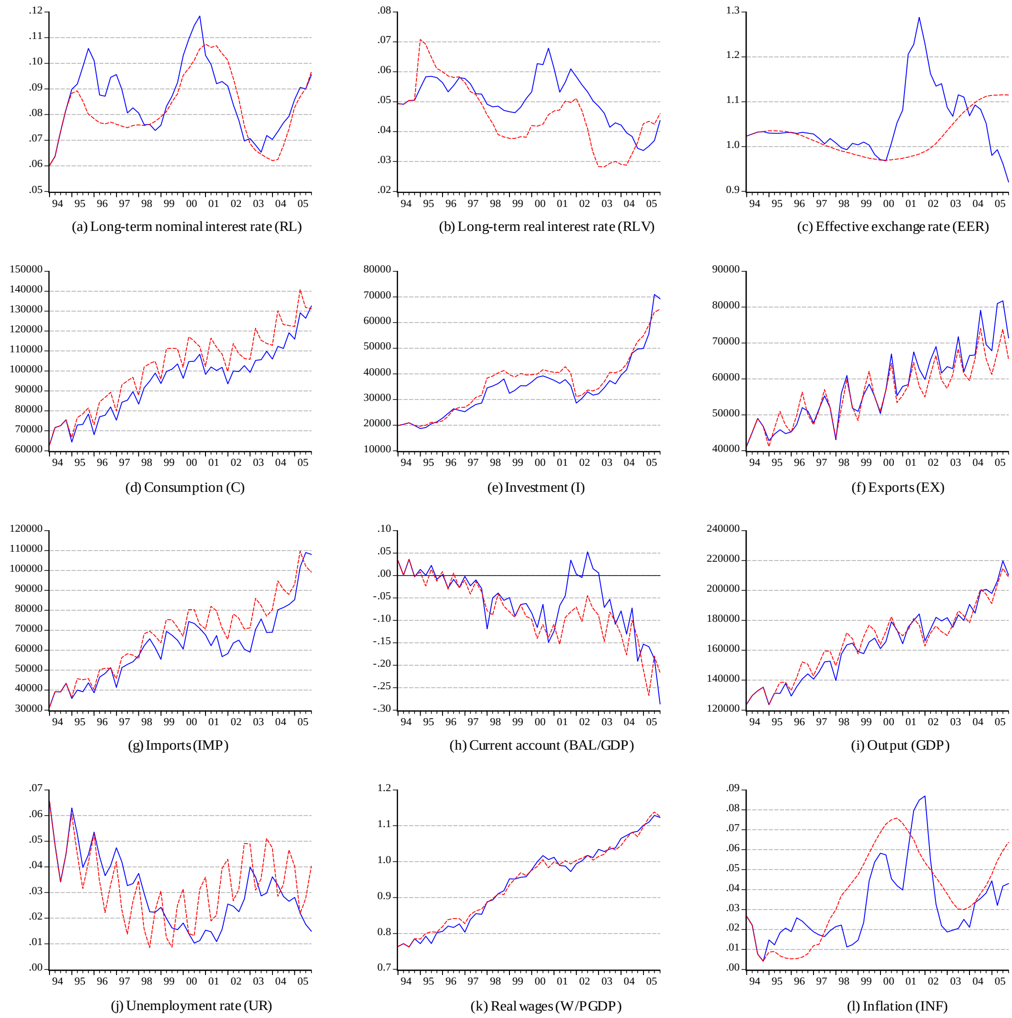


Figure 11.1. Comparison of actual (solid line) and simulated (broken line) data 1994-2005

Figure *k* suggests that the model is quite successful in replicating the behaviour of real wages over the period and is fairly successful in capturing the medium term unemployment developments (figure *j*), although the model seems to generate much stronger seasonal fluctuations in the unemployment rate than is actually observed in the data, which suggest that the unemployment equation (6.5) may need further analysis.

The model also seems to capture the development of long-term nominal interest rates (figure *a*), especially in the latter half of the period. The model is, however, less successful in replicating the behaviour of the real interest rate (figure *b*). This mainly reflects the problem the model has in describing the developments of inflation (figure *l*). QMM suggests that inflation should have risen much earlier than actually occurred, thus pushing inflation expectations up and hence the real interest rate down. The main reason for the simulated higher inflation in the late 1990s is that the model gives a somewhat higher output gap than is actually measured, which reflects the lower simulated real interest rate. The model suggests that all unused capacity disappeared at the beginning of 1997 instead of the beginning of 1998 in the data. The fact that simulated inflation is starting to decline while actual inflation is rising in 2001 has to do with the exchange rate developments and sharper contraction in simulated output mentioned above. Finally, the model suggests that inflation should be rising somewhat faster in 2005 than it actually did. This is mainly explained by a faster pick up in unit labour costs in the simulation than in the data, which feeds into higher inflation.

To summarise, although the above analysis shows that there are a few relationships in QMM that may need further analysis, the overall structure seems sufficiently successful in capturing the main features of the data, especilly when considering how long the simulation period is, which is many years beyond the usual forecasting horizon, and that many structural changes in the Icelandic economy have occurred over the historical period under investigation.

11.2. Business cycle regularities

An alternative way to analyse QMM's properties, is to look at how the model manages to replicate the correlation structure of the cyclical component of key economic variables. This is done by taking the logarithm of each series analysed (except for interest rates, the unemployment rate and inflation, which are untransformed, and stockbuilding and the current account, which are measured as a percentage of GDP) and filtering out any seasonal fluctuations using the X12 seasonal filter. To obtain the cyclical component of each series, the seasonally-adjusted data is then filtered with the Baxter-King bandpass filter, using the standard definition of a business cycle as a cycle of 6-32 quarters periodicity.[42]

[42] Only eight quarters of leads and lags are used in the centered moving-average calculations for the bandpass filter, instead of the usual twelve quarters, due to the relative short sample period available for the QMM simulation output − as the data for RL only starts in 1994. The relatively short data span suggests that the results below should be interpreted with some care. For a discussion of the Baxter-King filter and its potential superiority over the Hodrick-Prescott filter for identifying the cyclical component of economic data, see Stock and Watson (1999).

Table 11.1. Historical correlations between GDP and selected series

Cyclical component of actual data, 1994-2005

		Cross correlations of series with output lagged k periods								
Series	Std.dev.	-8	-4	-2	-1	0	1	2	4	8
GDP	1.3	0.00	-0.15	0.33	0.75	1.00	0.75	0.33	-0.15	0.00
				National accounts components						
C	2.2	0.22	-0.11	0.14	0.33	0.46	0.46	0.44	0.45	0.10
G	0.7	0.41	0.10	-0.05	-0.02	0.03	-0.03	-0.12	-0.23	-0.10
I	7.7	-0.04	-0.16	-0.05	0.20	0.52	0.72	0.76	0.39	-0.06
IBUS	9.8	-0.05	-0.19	-0.14	0.12	0.47	0.70	0.76	0.43	0.09
IH	3.2	0.17	-0.09	-0.32	-0.22	0.00	0.15	0.09	-0.40	0.06
II/GDP	0.2	0.08	0.02	-0.01	-0.07	-0.14	-0.09	0.09	0.33	-0.38
EX	2.0	-0.05	-0.18	0.12	0.44	0.66	0.44	0.06	-0.48	0.23
IMP	5.0	0.14	-0.13	-0.17	0.02	0.32	0.57	0.71	0.49	0.09
BAL/GDP	3.3	-0.20	0.25	0.12	0.00	-0.18	-0.42	-0.60	-0.56	0.11
				Labour market						
EMP	0.4	-0.05	0.15	0.35	0.42	0.47	0.30	0.17	0.04	-0.33
UR	0.3	0.01	-0.19	-0.40	-0.52	-0.64	-0.61	-0.51	-0.10	0.27
PA	0.3	-0.08	-0.19	-0.14	-0.18	-0.21	-0.31	-0.24	0.18	0.08
PRODT	0.2	0.28	0.26	0.35	0.36	0.31	0.16	-0.03	-0.36	-0.25
W	1.5	-0.07	0.40	0.25	0.19	0.19	0.21	0.17	-0.25	-0.27
W/PGDP	1.4	0.36	-0.02	-0.05	0.07	0.24	0.35	0.39	0.21	0.07
				Prices and inflation						
CPI	1.0	-0.29	0.33	0.08	-0.10	-0.20	-0.25	-0.26	-0.31	-0.36
PGDP	1.6	-0.37	0.39	0.27	0.11	-0.02	-0.11	-0.18	-0.41	-0.31
PH	2.4	0.07	0.28	0.25	0.23	0.26	0.18	0.17	0.23	-0.14
INF	1.5	-0.41	0.43	0.25	0.10	0.06	0.09	0.14	0.04	-0.32
				Financial markets and wealth						
RS	1.0	-0.06	0.16	0.33	0.44	0.53	0.47	0.37	0.06	-0.45
RLV	0.4	0.28	-0.16	-0.22	-0.08	0.06	0.13	0.14	0.01	-0.33
M3	1.4	0.05	0.33	0.27	0.14	-0.01	-0.05	-0.05	-0.02	0.00
EQP	14.4	-0.03	-0.03	-0.21	-0.16	-0.01	0.12	0.25	0.46	0.33
WEL	4.4	0.08	0.08	0.04	0.06	0.13	0.22	0.34	0.53	0.19
				Real exchange rate and international output						
REX	4.2	0.20	0.02	-0.35	-0.36	-0.25	-0.11	0.07	0.34	0.32
WGDP	0.4	0.09	0.18	0.04	0.05	0.17	0.32	0.43	0.39	-0.41

The data are seasonally adjusted using X12 and filtered using the Baxter-King bandpass filter. The second column shows the standard deviation (in percent) of the cyclical component of the data. Other columns show the cross correlations of the cyclical component of each series with the cyclical component of k-period lagged GDP.

Tables 11.1 and 11.2 report the cross-correlations of the cyclical component of actual and simulated data with the cyclical component of GDP at various leads and lags (that is, the tables report $corr(x_t, gdp_{t+k})$ for different k). Also reported is the standard deviation of the cyclical component of each series. A large positive (negative) correlation at $k = 0$ indicates contemporaneous procyclical (countercyclical) behaviour of the data. The lead-lag correlation structure also gives information on whether a series leads or lags the aggregate business cycle (as measured by the cyclical component of GDP). Hence, large positive (negative) correlations at $k > 0$ indicate that the series is procyclical (countercyclical) and leads the cycle, whereas the series would lag the cycle for $k < 0$.

11.2.1. National account components

On the whole, the results indicate that most of the common business cycle regularities found in international studies (cf. Cooley, 1995, and Stock and Watson, 1999) carry over to Icelandic data. Furthermore, the simulation results suggests that QMM is quite successful in replicating these main business cycle features.

The first part of Tables 11.1 and 11.2 reports the cross-correlations of output with individual national accounts components. The results in Table 11.1 suggest that domestic demand is procyclical and leads the cycle by 1-2 quarters. The exceptions are government consumption, stockbuilding and housing investment, where little contemporaneous co-movement is detected, although some positive co-movement between government consumption and output at lags of up to two years is found. Housing investment, however, seems to be countercyclical at leads of 5-6 quarters. The result for government consumption is consistent with other studies, but stockbuilding is usually found to be procyclical. The explanation for a lack of such a finding here probably lies in the fact that the stockbuilding series used here is exclusively from the export sector, which is largely unrelated to domestic demand. International evidence usually suggests that housing investment is procyclical (cf. Stock and Watson, 1999). One interpretation of the leading countercyclical behaviour of housing investment found in the Icelandic data could be the negative cyclical relationship between housing investment and house prices (with housing investment leading house prices), where housing investment pushes down house prices and therefore household wealth and hence consumption and overall demand.[43]

Exports are also found to be strongly procyclical (even more than consumption), unlike what Stock and Watson find for US data, reflecting the small, open economy nature of Iceland and the importance of exports for the domestic business cycle. Imports are also found to be strongly procyclical and leading the cycle by roughly two quarters. In addition, imports are found to be highly volatile, which results in a countercyclical current account which leads the general cycle by roughly three quarters. This countercyclical behaviour of external trade is a common finding in many developed economies (cf. Stock and Watson, 1999).

[43] This may also reflect a short data sample problem, as evidence of procyclical housing investment seems more evident when the data is extended to 1990.

Table 11.2. Historical correlations between GDP and selected series

Cyclical component of QMM simulated data, 1994-2005

		Cross correlations of series with output lagged k periods								
Series	Std.dev.	-8	-4	-2	-1	0	1	2	4	8
GDP	1.4	-0.12	0.30	0.73	0.92	1.00	0.92	0.73	0.30	-0.12
				National accounts components						
C	1.9	-0.11	0.18	0.55	0.74	0.87	0.91	0.86	0.56	-0.25
G	0.7	0.19	0.14	-0.21	-0.35	-0.40	-0.37	-0.25	-0.06	-0.47
I	7.8	-0.02	0.17	0.52	0.71	0.82	0.77	0.61	0.17	-0.11
IBUS	10.9	-0.06	0.11	0.49	0.71	0.85	0.81	0.67	0.28	0.01
IH	2.1	0.13	0.17	0.03	0.02	0.03	0.03	-0.06	-0.36	-0.38
II/GDP	0.1	-0.08	0.02	0.12	0.10	0.06	0.12	0.08	-0.16	0.13
EX	1.6	-0.10	0.16	0.32	0.30	0.24	0.13	0.01	-0.04	0.15
IMP	3.1	0.00	0.19	0.49	0.67	0.81	0.83	0.76	0.37	-0.23
BAL/GDP	1.7	-0.03	-0.12	-0.36	-0.54	-0.69	-0.74	-0.66	-0.18	0.57
				Labour market						
EMP	0.3	-0.04	0.76	0.89	0.82	0.68	0.44	0.22	-0.04	-0.12
UR	0.2	0.12	-0.56	-0.83	-0.88	-0.86	-0.73	-0.59	-0.36	-0.02
PA	0.1	-0.26	0.00	0.14	0.23	0.31	0.36	0.39	0.44	0.63
PRODT	0.2	0.18	0.28	0.18	0.05	-0.10	-0.27	-0.38	-0.45	-0.46
W	1.3	0.17	0.39	0.20	0.10	0.02	-0.04	-0.09	-0.20	-0.39
W/PGDP	0.9	-0.02	0.40	0.45	0.47	0.51	0.53	0.49	0.24	-0.41
				Prices and inflation						
CPI	0.8	0.26	0.17	-0.08	-0.22	-0.36	-0.49	-0.60	-0.78	-0.71
PGDP	0.9	0.25	0.16	-0.14	-0.31	-0.45	-0.55	-0.59	-0.51	-0.15
PH	1.7	0.11	0.59	0.61	0.59	0.54	0.41	0.26	-0.09	-0.63
INF	0.7	0.12	0.59	0.58	0.54	0.49	0.38	0.25	-0.09	-0.72
				Financial markets and wealth						
RS	1.0	0.04	0.70	0.75	0.62	0.43	0.17	-0.07	-0.46	-0.56
RLV	0.5	-0.02	0.58	0.55	0.35	0.07	-0.20	-0.42	-0.61	-0.25
M3	1.2	0.03	0.21	0.55	0.63	0.61	0.51	0.35	-0.03	-0.52
EQP	1.3	0.04	0.44	0.70	0.78	0.77	0.62	0.41	-0.03	-0.23
WEL	2.5	-0.02	0.43	0.59	0.67	0.74	0.74	0.66	0.36	-0.39
				Real exchange rate and international output						
REX	1.3	0.25	0.42	0.14	-0.07	-0.27	-0.48	-0.62	-0.69	-0.60
WGDP	0.4	-0.02	0.50	0.49	0.43	0.36	0.28	0.20	-0.03	-0.74

The simulated data are seasonally adjusted using X12 and filtered using the Baxter-King bandpass filter. The second column shows the standard deviation (in percent) of the cyclical component of the simulated data. Other columns show the cross correlations of the cyclical component of each series with the cyclical component of k-period lagged GDP.

As expected, investment, and its sub-components, are found to be the most volatile components of domestic demand. Unlike what is found in other countries, and what seems inconsistent with consumption smoothing implied by the permanent income hypothesis, consumption seems more volatile than output. However, it should be noted that the consumption series used here is total consumption that includes consumption of durable and non-durable goods. A large component of imported durable goods (reflected in a very high positive correlation of cyclical consumption and imports) is presumably responsable for this apparent anomaly.[44] It should be noted that Stock and Watson (1999) find that consumption of durable goods is more volatile than output.

Table 11.2 shows that QMM manages to replicate most of the above business cycle regularities found in the data. The cyclical component of output is found to be more persistent than in the actual data. Furthermore, consumption and investment are found to be more procyclical. Government consumption is found to be countercyclical in the simulated data, but the cyclical properties of stockbuilding, housing investment, imports and the current account are roughly the same as in the actual data. Exports are, however, found to be much less procyclical. The model also replicates the relative volatility of different expenditure items from the actual data, specifically the larger fluctuations in consumption than output, and the high volatility of investment and imports.

11.2.2. Labour market

The second part of the tables reports the cross-correlations of labour market series with the aggregate business cycle. As is commonly found, aggregate employment is found to be procyclical, with employment sligthly lagging the business cycle. The unemployment rate is strongly countercyclical, also consistent with international evidence. The labour participation rate is found to be more or less independent of the business cycle but labour productivity is found to be slightly contemporenously procyclical but countercyclical at longer leads.[45] No contemporenous correlation is found between nominal wages and the business cycle, but negative correlations at longer leads of wages and positive correlations at longer lags are evident. Clearer evidence of procyclical wages is, however, found between the real wage rate and the business cycle, with real wages leading the cycle by roughly two quarters.[46] The evidence for nominal wages is roughly consistent with the findings for the US in Stock and Watson (1999), but the procyclical nature of real wages is much more evident in the Icelandic data than the US data, and is more in line with standard New Keynesian models of the business cycle.

Concerning the relative variability of labour market data, some results for Iceland are found to be consistent with international evidence but others not. For example, a standard finding in the literature is that the magnitude of fluctuations in output

[44] The strong co-movement of consumption and imports, together with almost no co-movement between consumption and exports, also gives a large negative correlation between consumption and the current account, but with the consumption cycle sligthly leading the current account.

[45] The so-called Dunlop-Tashis puzzle, i.e. a weak contemporaneous relationship between employment and labour productivity when theory predicts a high correlation is also evident in the Icelandic data.

[46] The procyclicality of real wages is even more apparent when looking at the co-movement of real wages and consumption, where a large contemporenous positive correlation is found.

and employment should roughly equal. This is not the case in Iceland, where output volatility is larger than employment variability. Another common finding in the literature is that wages seem less volatile than labour productivity. This is also inconsistent with the findings here.

The simulation results from QMM are in line with the above results, except that labour participation rate is now procyclical and leads the cycle by about two years.

11.2.3. Prices and inflation

The third part of the tables reports the cross-correlation structure of output and prices. Although prices are commonly considered to be procyclical, recent studies, such as Stock and Watson (1999), suggest that aggregate price levels are in fact countercyclical and lead the cycle by a few quarters, a result that is also evident in the Icelandic data. As in Stock and Watson, however, inflation is found to be procyclical and lagging the cycle by 3-4 quarters.[47] This pattern suggests that inflation starts rising roughly one year after a business cycle upswing and continues to rise for a few quarters after the economy starts to slow down, consistent with the results from the policy shock excercise in the previous chapter. Finally, nominal house prices are found to be basically unrelated to the cycle.[48]

The correlation structure of the cyclical components of the simulated price data gives basically the same results. Prices are found to be countercyclical, although the lead-time for $PGDP$ is somewhat shorter than in the actual data, and inflation is procyclical and lagging the cycle by just under a year. The procyclicality of house prices is however much more apparent in the simulated data, with house prices lagging the cycle by 2-3 quarters.

11.2.4. Financial markets and wealth

The fourth part of the tables reports the cross-correlation structure of output and various financial variables. The short-term nominal interest rate is found to be contemporenously procyclical, consistent with international evidence and standard theory. The correlation patterns furthermore suggest that higher interest rates are usually associated with cyclical downturns 7-8 quarters in the future, consistent with the standard transmission lags of monetary policy discussed in the previous chapter. No contemporaneous correlation is found between the long-term real interest rate and the business cycle, although a similar negative correlation is found at long real interest rate leads, as were found for the short-term nominal rate, albeit weaker. It is also interesting to note that the negative co-movement between the real interest rate and the business cycle becomes much clearer when looking at domestic demand (both consumption and investment) instead of aggregate output, with the real interest rate leading the cycle by 5-7 quarters.

[47] See for example Ball and Mankiw (1994) for a discussion on the implications of these findings for economic modelling and the importance in distincting between the level and rate of change correlations of prices with output.

[48] The procyclicality of house prices becomes more evident when compared to consumption. In addition, a rise in house prices usually coincides with rising inflation about 2-3 quarters later.

Nominal money is found to be more or less unrelated to the business cycle, although a stronger link is found between the cyclical movements of money and consumption (with money lagging consumption by 2-3 quarters). Finally, equity prices and household wealth are found to be procyclical and lead the cycle by 5-6 quarters.

The simulated data also gives a procyclical short-term nominal interest rate but now slightly lagging the cycle. The real interest rate is also procyclical and lagging the cycle, but both rates are countercyclical at leads of 1-2 years. Unlike for the actual data, the model creates procyclical nominal money and changes the lead-lag structure of equity prices and household wealth. Both are found to be procyclical as in the actual data, but now wealth is found to be more or less contemporenous with the cycle and equity prices to lag the cycle by roughly two quarters. Not surprisingly, the model is not able to replicate the high volatility in equity prices.

11.2.5. Real exchange rate and international output

The final part of the tables reports the cross-correlation structure of output and external condtions. A cyclical upturn seems to be weakly related to a real exchange rate depreciation after 1-2 quarters (a decline in REX indicates a currency depreciation). However, a real exchange rate depreciation is also associatied with a cyclical downswing 5-6 quarters later. This is even more apparent when comparing the real exchange rate to the cyclical component of consumption and can presumably be explained by the high correlation between domestic demand and imports mentioned earlier.

Finally, the table finds a rather small contemporaneous co-movement between the domestic and international business cycle which is consistent with many studies, such as Gudmundsson et al. (1999), who find relatively weak links between the domestic and international business cycle. The correlation structure suggests that the international cycle leads the domestic one by two quarters.

The model roughly replicates this international link but gives different results concerning the cyclical co-movement of the real exchange and economic activity. Rather than leading a cyclical downturn, as in the data, a real exchange rate depreciation is actually associated with a cyclical upturn in the simulated data. The model, therefore, does not seem to be able to fully replicate the interaction of the expenditure switching and income effects of real exchange rate movements in the historical Icelandic data and suggests an avenue for future research.

11.2.6. Correlations of actual and simulated cyclical components

Finally, Table 11.3 gives the contemporaneous correlations between the cyclical components of the actual and simulated data, therefore giving an additional sense for the ability of QMM to replicate actual economic developments in the period under investigation, but concentrading on the business cycle frequency rather than the raw data as in Figure 11.1.

The results are, however, more or less the same as discussed earlier. QMM is quite successful in replicating the cyclical movements of most of the real economy, such as consumption, investment, imports, the current account, real wages and productivity and nominal variables such as house prices, the output price deflator, wages and wealth. The model captures the cyclical developments of output fairly well, but as mentioned earlier the model predicts a sharpter downturn in late 2001 than observed in the data due to its failure to predict the large exchange rate cycle in the actual data, which reduces the correlation between the actual and simulated cyclical component of output. This is also important for explaining why the export correlation is not higher.[49]

Table 11.3. Correlations between
cyclical components of actual and simulated data

Series	Correlation	Series	Correlation	Series	Correlation
GDP	0.58	BAL/GDP	0.95	PH	0.84
C	0.90	EMP	0.67	INF	0.28
G	1.00	UR	0.65	RS	1.00
I	0.92	PA	0.52	RLV	0.57
IBUS	0.84	PRODT	0.87	M3	0.75
IH	0.57	W	0.89	EQP	-0.13
II/GDP	-0.18	W/PGDP	0.72	WEL	0.81
EX	0.47	CPI	0.52	REX	-0.26
IMP	0.83	PGDP	0.73	WGDP	1.00

As previously discussed, QMM has difficulties replicating the developments of asset prices such as equity prices and the exchange rate. The model is also not very successful in replicating the cyclical movements of inflation in the period. As discussed above this has mainly to do with the failure of the model to replicate the exchange rate cycle and the fact that the model gives a real interest rate path lower than in the actual data, therefore creating greater inflation pressures from the output gap.

[49]Note that the policy rate, RS, government consumption, G, and world output, $WGDP$, are treated as exogenous in the simulation, hence the perfect positive correlation between the actual and simulated data.

Part IV
Appendices

12. Variables listing

Table 12.1. List of variables

Name	Description	Type	Equations
ALLOW	Personal allowances	X	(8.3)
BAL	Current account balance	I	(**5.35**), (5.38)
BALT	Balance of trade	I	(**5.33**), (5.35)
BC	Building costs	E	(7.7), (7.8), (7.9) (**7.13**)
BIPD	Balance of interest, salaries, dividends and profits	T	(**5.34**), (5.35)
BTRF	Balance of transfers	X	(5.35)
C	Private consumption	E	(**5.2**), (5.3), (5.23)
CJ	Current grants to the household sector	T	(8.3), (**8.16**), (8.18) (9.1)
CN	Nominal private consumption	D	(4.20), (4.21), (**5.3**) (5.24), (8.12), (8.14)
CPI	Consumer price index	E	(4.15), (4.22), (4.23) (6.2), (**7.1**), (7.3) (7.5), (7.6), (7.12), (7.13), (7.14), (7.15)
DD	Domestic demand	I	(**5.23**), (5.30), (5.39)
DDN	Nominal domestic demand	I	(**5.24**), (5.40)
DELTA	Depreciation rate for total capital stock	X	(5.18)
DELTAB	Depreciation rate for business capital stock	X	(5.19)
DELTAG	Depreciation rate for government capital stock	X	(5.17)
DELTAH	Depreciation rate for housing stock	X	(4.20), (4.21), (5.20)
DH	Financial debt of households	T	(4.19), (**4.21**), (9.4)
DI	General government debt interest payments	T	(**8.17**), (8.18)
EER	Exchange rate index of foreign currency	E	(**4.8**), (4.12), (4.13) (4.15), (4.22), (5.22) (5.28), (5.37), (5.38) (7.2), (7.3), (8.17)
EMP	Level of employment in man-years	I	(6.6), (**6.9**), (6.11), (9.2)
EMPT	Trend employment	D	(5.42), (**6.10**), (6.12)
EQP	Equity prices	E	(**4.16**), (4.22)
EUS	US dollar exchange rate	E	(**4.12**), (5.22), (5.28) (7.2)

Table 12.1. List of variables (continued)

Name	Description	Type	Equations
EX	Exports of goods and services	I	(**5.27**), (5.39), (7.4)
EXALU	Exports of aluminium products	X	(5.21), (5.22), (5.27) (5.28)
EXMAR	Exports of marine products	X	(5.21), (5.22), (5.27) (5.28)
EXN	Nominal exports of goods and services	I	(**5.28**), (5.33), (5.40) (7.4)
EXREG	Exports, excluding aluminium and marine goods	E	(**5.26**), (5.27), (5.28)
FEER	Expected exchange rate index	E	(4.8), (**4.9**)
FOH	Foreign holdings of Icelandic assets	T	(5.36), (**5.38**)
G	Government consumption	X	(5.4), (5.23)
GAP	Output gap	D	(**5.43**), (5.44), (7.2)
GAPAV	Annual average of output gap	D	(4.1), (**5.44**), (7.1)
GDP	GDP	I	(4.2), (4.25), (5.10) (5.14), (**5.39**), (5.43) (6.5), (6.11), (7.10)
GDPN	Nominal GDP	I	(4.16), (**5.40**), (7.10) (8.5), (8.7), (8.8) (8.9), (8.15), (8.16)
GDPT	Potential output	E	(4.2), (**5.42**), (5.43) (6.12)
GFW	Gross financial wealth	T	(4.19), (**4.20**), (8.4) (9.4)
GN	Nominal government consumption	D	(**5.4**), (5.24), (8.18)
HW	Housing wealth	D	(4.17), (**4.18**)
I	Fixed investment	I	(**5.5**), (5.6), (5.18) (5.23)
IBOTH	Aluminium sector investment	X	(5.11)
IBREG	Business investment excluding the aluminium sector	E	(**5.10**), (5.11)
IBUS	Business investment	I	(5.5), (**5.11**), (5.19)
IBUSN	Nominal business investment	I	(**5.12**)
IG	Government investment	X	(5.5), (5.16)
IGN	Nominal government investment	D	(5.12), (**5.16**), (5.17)
IGNNET	Nominal net government investment	T	(**5.17**), (8.18)

Table 12.1. List of variables (continued)

Name	Description	Type	Equations
IH	Private sector housing investment	E	(4.20), (4.21), (5.5) (**5.14**), (5.15), (5.20)
IHN	Nominal housing investment	D	(5.12)
II	Net stockbuilding	E	(**5.21**), (5.23)
IIN	Nominal net stockbuilding	D	(**5.22**), (5.24)
IMP	Imports of goods and services	E	(**5.30**), (5.31), (5.39)
IMPN	Nominal imports of goods and services	D	(**5.31**), (5.33), (5.40) (8.13)
IN	Nominal fixed investment	D	(**5.6**), (5.12), (5.24)
INF	Four-quarter CPI inflation rate	D	(4.1), (4.2), (**7.15**) (7.17)
INFE	Inflation expectations	E	(4.4), (7.1), (**7.16**) (**7.17**)
INFQ	Quarterly CPI inflation rate	D	(**7.15**), (8.4), (9.4)
ISA	Icelandic holdings of foreign assets	T	(5.36), (**5.37**), (5.38)
IT	Central Bank of Iceland inflation target	X	(4.1), (4.2), (7.17)
K	Total capital stock	I	(5.17), (**5.18**), (5.42)
KBUS	Business capital stock	I	(5.17), (**5.19**)
KH	Private sector housing stock	I	(4.18), (4.20), (4.21) (5.17), (**5.20**), (7.12)
LY	Real post-tax labour income	D	(**9.6**), (7.12)
M3	Broad money	E	(**4.25**)
NAIRU	Natural rate of unemployment	X	(6.2), (6.5), (6.10)
NFA	Net foreign assets	I	(5.34), (**5.36**)
NFW	Net financial wealth	I	(4.17), (**4.19**)
PA	Participation rate	E	(6.6), (**6.7**), (6.8) (6.9)
PAT	Trend participation rate	D	(**6.8**), (6.10)
PC	Private consumption deflator	E	(4.20), (4.21), (5.2) (5.3), (**7.5**), (9.5) (9.6)
PCOM	Non-oil commodity prices in USD	X	(7.2)
PG	Government consumption deflator	E	(5.4), (**7.6**)
PGDP	GDP price deflator	D	(4.14), (4.25), (5.40) (6.2), (**7.10**)

Table 12.1. List of variables (continued)

Name	Description	Type	Equations
PH	House prices	E	(4.18), (4.20), (4.21) (5.14), (**7.12**)
PI	Investment goods price deflator	E	(5.6), (**7.7**), (7.9)
PIG	Government investment deflator	E	(5.16), (5.17), (**7.9**)
PIH	Housing investment deflator	E	(5.14), (5.15), (**7.8**)
PM	Import price deflator	E	(4.14), (5.31), (7.1) (**7.2**), (7.7)
POIL	Oil prices in USD	X	(7.2)
POWA	Population at working age (16-64)	X	(6.6), (6.9), (6.10) (8.3)
PRBUS	Business premium on risk-free interest rate	X	(4.5)
PRISK	Inflation risk premium	X	(4.4), (7.16)
PROD	Labour productivity	D	(6.3), (**6.11**)
PRODT	Trend labour productivity	D	(6.2), (6.4), (**6.12**)
PSNB	Public sector net borrowing	I	(8.17), (**8.18**)
PX	Export price deflator	I	(4.13), (**7.4**)
PXALU	Price of aluminium products in US dollars	X	(5.22), (5.28)
PXMAR	Price of marine products in foreign currency	X	(5.22), (5.28)
PXREG	Export prices excluding aluminium and marine products	E	(5.28), (**7.3**)
RCC	Real cost of capital	D	(**4.5**), (5.10)
RCI	Corporate income tax rate	X	(8.7)
RCP	Corporate property tax rate	X	(8.8)
RD	Short-term interest rate differential	D	(4.8), (**4.11**)
REM	Employers' wage-related cost	X	(6.2), (6.3), (6.4)
REVA	Household assets revaluation term	T	(4.20), (**4.22**)
REVD	Household debt revaluation term	T	(4.21), (**4.23**)
REX	Real exchange rate	D	(4.8), (**4.15**), (5.26)
REXM	Importers' real exchange rate	D	(**4.14**), (5.30)
REXX	Exporters' real exchange rate	D	(**4.13**)
RFIC	Corporate finance income tax rate	X	(8.9)
RHPI	Real household post-tax income	D	(4.20), (4.21), (5.2) (**9.5**)
RI	Interest rate income tax rate	X	(8.4)

Table 12.1. List of variables (continued)

Name	Description	Type	Equations
RIC	Ratio of other households' income to YE	X	(9.3)
RIMP	Tax rate on imports	X	(8.13)
RISK	Exchange rate risk premium	X	(4.11)
RJO	Household other tax rate	X	(8.5)
RJY	Household income tax rate	X	(8.3)
RL	Long-term interest rate	E	(**4.3**), (4.4), (7.16) (8.17)
RLV	Long-term indexed interest rate	T	(**4.4**), (4.5), (5.2) (7.12), (7.16), (8.4) (8.17), (9.4)
RRN	Real neutral interest rate	X	(4.1), (4.2)
RS	Short-term interest rate	E	(**4.1**), (**4.2**), (4.3) (4.11), (4.25), (8.4) (9.4)
RSD	Other expenditure tax rate	X	(8.14)
RTS	Effective subsidies rate	X	(8.15)
RVAT	Value-added tax rate	X	(8.12)
RWC	Corporate wage cost tax rate	X	(8.10)
SPEC	Trade specialisation	D	(5.30), (**5.32**)
SUBS	Government subsidies	T	(**8.15**), (8.18)
TAX	Total tax receipts	I	(**8.1**), (8.18)
TC	Corporate tax payments	I	(8.1), (**8.6**)
TCI	Corporate income tax payments	T	(8.6), (**8.7**)
TCP	Corporate property tax payments	T	(8.6), (**8.8**)
TE	Total taxes on production and imports	I	(8.1), (**8.11**)
TI	Household interest rate income tax	T	(8.2), (**8.4**), (9.6)
TIC	Corporate finance income tax payments	T	(8.6), (**8.9**)
TIMP	Tarrifs and other taxes on imports	T	(8.11), (**8.13**)
TJ	Household tax payments	I	(8.1), (**8.2**), (9.5) (9.6)
TJO	Other household tax payments	T	(8.2), (**8.5**)
TJY	Household income tax	T	(8.2), (**8.3**)
TRADE	World trade	X	(5.26), (5.32)
TSD	Other expenditure taxation receipts	T	(8.11), (**8.14**)

Table 12.1. List of variables (continued)

Name	Description	Type	Equations
TVAT	Value-added taxation receipts	T	(8.11), (**8.12**)
TWC	Corporate wage cost tax payments	T	(8.6), (**8.10**)
ULC	Unit labour costs	D	(**6.3**)
ULCT	Trend unit labour costs	D	(**6.4**), (7.1), (7.2) (7.6), (7.13)
UN	Level of unemployment	D	(**6.6**)
UR	Unemployment rate	E	(5.2), (6.2), (**6.5**) (6.9)
USRL	US long-term interest rate	X	(8.17)
W	Wages	E	(**6.2**), (6.3), (6.4) (9.2)
WCPI	World consumer prices	X	(4.15), (7.3)
WEL	Household sector wealth	I	(**4.17**), (4.25), (5.2)
WEQP	World equity prices	X	(4.22), (5.37), (5.38)
WGDP	World GDP	X	(5.32)
WPX	World export prices	X	(4.13), (7.2)
WRS	Foreign short-term interest rate	X	(4.11), (5.34)
YDIJ	Other household non-labour income	T	(9.1), (**9.4**), (9.6)
YE	Wages, salaries and self-employed income	I	(8.3), (8.10), (9.1) (**9.2**), (9.3)
YIC	Households' other income	T	(9.1), (**9.3**)
YJ	Total household pre-tax income	I	(**9.1**), (9.5), (9.6)
Summary			
	Total number of variables		148
	Number of endogenous variables	(E)	28
	Number of technical variables	(T)	24
	Number of definitions	(D)	28
	Number of identies	(I)	26
	Number of exogenous variables	(X)	42

Equations where variables are defined are in bold. D denotes definitions, E denotes endogenous variables, I denotes identities, T denotes technical definitions and X denotes exogenous variables.

Table 12.2. List of empirically estimated equations

Number of estimated equations		20	

Variable	Mnemonic	Equation number	Page number
Financial markets			
Long-term interest rates	RL	4.3	19
Broad money	M3	4.25	26
Domestic demand and output			
Private consumption	C	5.2	28
Business investment excluding the aluminium sector	IBREG	5.10	31
Private sector housing investment	IH	5.14	33
Exports of goods and services (excluding marine and aluminium)	EXREG	5.26	37
Imports of goods and services	IMP	5.30	39
Potential output	GDPT	5.42	43
Labour market			
Wages	W	6.2	45
Unemployment rate	UR	6.5	47
Participation rate	PA	6.7	49
Price setting and inflation			
Consumer price index	CPI	7.1	51
Import price deflator	PM	7.2	53
Export prices excluding aluminium and marine products	PXREG	7.3	54
Private consumption deflator	PC	7.5	56
Government consumption deflator	PG	7.6	57
Investment goods price deflator	PI	7.7	58
Government investment deflator	PIG	7.9	60
House prices	PH	7.12	61
Building costs	BC	7.13	62

Table 12.3. Dummy variables in QMM

Dummy variable	Period equal to one	Equation that dummy variable enters
D03	2003:Q1-2003:Q4	M3 (4.25)
D031	2003:Q1	C (5.2)
D9395	1993:Q1-1995:Q4	IBREG (5.10)
D981	1998:Q1	IBREG (5.10)
D9801	1998:Q1-2001:Q4	IBREG (5.10)
D021	2002:Q1	IBREG (5.10)
D971	1997:Q1	IH (5.14),W (6.2),PXREG (7.3)
D891	1998:Q1	EXREG (5.26),PXREG (7.3)
D012	2001:Q2	PG (7.6)
D894	1994:Q4	PH (7.12)
D04	2004:Q1-2004:Q4	PH (7.12)
D021	2002:Q1	BC (7.13)

13. Data description

In this section is a detailed description of the data used in QMM. The information includes the beginning of the series, the data source and unit, the FAME code of the variable in the Central Bank of Iceland centralised database, and any explanation of the data necessary. This might include how higher frequency observations are averaged to quarterly observations, how quarterly data was calculated in cases where only annual observations are available and how data from different sources was linked together.

The main data sources are the following:

Mnemonic	Institution	Icelandic
CBI	Central Bank of Iceland	Seðlabanki Íslands
DOL	Directorate of Labour	Vinnumálastofnun
EcoWin	EcoWin	-
FIN	Ministry of Finance	Fjármálaráðuneytið
ICEX	Iceland Stock Exchange	Kauphöll Íslands
ILMS	Institute of Labour Market Research	Kjararannsóknarnefnd
IMF	International Monetary Fund	Alþjóðagjaldeyrissjóðurinn
ISD	Icelandic Securities Depository	Verðbréfaskráning Íslands
LRI	Land Registry of Iceland	Fasteignamat ríkisins
NEI	National Economic Institute	Þjóðhagsstofnun
STATICE	Statistics Iceland	Hagstofa Íslands
DIR	Director of Internal Revenue	Ríkisskattstjóri

Name: $ALLOW$. **Short description:** Personal allowances. **Beginning of series:** 1988Q1. **Source:** STATICE/CBI. **Unit:** Millions of kronas at current prices. **FAME code:** QMM.EXO.ALLOWZ.Q. **Comment:** Defined as $(RJY \times (YE + CJ) - TJY)/POWA$.

Name: BAL. **Short description:** Current account balance. **Beginning of series:** 1978Q1. **Source:** CBI. **Unit:** Millions of kronas at current prices. **FAME code:** QMM.DEM.BALZZZ.Q. **Comment:** An accounting identity defined $BAL = BALT + BIPD + BTRF$.

Name: $BALT$. **Short description:** Balance of trade. **Beginning of series:** 1970Q1. **Source:** CBI. **Unit:** Millions of kronas at current prices. **FAME code:** QMM.DEM.BALTZZ.Q. **Comment:** Defined as $EXN - IMPN$.

Name: BC. **Short description:** Building costs. **Beginning of series:** 1970Q1. **Source:** STATICE/CBI. **Unit:** Index, $2000 = 1$. **FAME code:** QMM.PRI.-BCZZZZ.Q. **Comment:** Measures changes in building costs of a specified block of flats. The index is normalised so that the average index of the quarters of year 2000 equals 1. **Detailed description:** Simple average of official monthly observations from 1976. Estimated series from CBI prior to 1976.

Name: $BIPD$. **Short description:** Balance of interest, salaries, dividends and profits. **Beginning of series:** 1978Q1. **Source:** CBI. **Unit:** Millions of kronas at current prices. **FAME code:** QMM.DEM.BIPDZZ.Q. **Comment:** Quarterly data available since 1978.

Name: $BTRF$. **Short description:** Balance of transfers. **Beginning of series:** 1978Q1. **Source:** CBI. **Unit:** Millions of kronas at current prices. **FAME code:** QMM.EXO.BTRFZZ.Q. **Comment:** Quarterly data available from 1978.

Name: C. **Short description:** Private consumption. **Beginning of series:** 1970Q1. **Source:** STATICE/CBI. **Unit:** Millions of kronas at constant 2000 prices. **FAME code:** QMM.DEM.CZZZZZ.Q. **ECOTRIM:** Flow AR(1) Max Log Par : -.99 to .99. **Comment:** Quarterly data available since 1997Q1 from STATICE. **Detailed description:** *Period from 1970 to 1979:* The annual value is divided between the quarters such that the growth rate in each quarter is the same and the growth over the year fits with the annual values. Seasonal variation derived from the period 1997 to 2003 is added. The difference between the annual value and the sum of the quarters is then distributed evenly between the quarters. *Period from 1979 to 1990:* 40% of annual values is split between the quarters using a simple disaggregation algorithm (minimizing the sum of squared residuals). The rest of the annual values is disaggregated using an auxilliary series for the quarterly variation. This series shows quarterly sales for consumption goods and private cars. *Period from 1990 to 1996:* This is disaggregated in the same way as the previous period, except the additional (quarterly) series for the 60% of consumption uses VAT reports as an indication of sales volume. These reports are bi-monthly. Quarterly values were constructed simply by dividing every other period in half, thus splitting it evenly between the previous and the following period.

Name: CJ. **Short description:** Current grants to the household sector. **Beginning of series:** 1980Q1. **Source:** CBI/STATICE. **Unit:** Millions of kronas at current prices. **FAME code:** QMM.GOV.CJZZZZ.Q. **ECOTRIM:** Flow AR(1) Max Log Par : -.99 to .99. **Comment:** The main items are social security payments, child benefits and interest rate subsidies (the two last items are linked to income so they are in a way a negative part of the income tax). **Detailed description:** Quarterly data obtained with ECOTRIM using estimated quarterly income from wages and salaries as a reference series.

Name: CN. **Short description:** Nominal private consumption. **Beginning of series:** 1970Q1. **Source:** STATICE/CBI. **Unit:** Millions of kronas at current prices. **FAME code:** QMM.DEM.CNZZZZ.Q. **ECOTRIM:** Flow AR(1) Max Log Par : -.99 to .99. **Comment:** Quarterly data available since 1997Q1 from STATICE.

Detailed description: *Period from 1970 to 1996:* Annual data on nominal private consumption from STATICE was disaggregated using ECOTRIM, using quarterly data on $CPI \times C$ as a related series.

Name: CPI. **Short description:** Consumer price index. **Beginning of series:** 1970Q1. **Source:** STATICE/CBI. **Unit:** Index, 2000 = 1. **FAME code:** QMM.PRI.CPIZZZ.Q. **Comment:** Centralised quarterly averaged using monthly observations of the headline CPI. For example, the fourth-quarter figure is calculated as $[0.5CPI_{OCT} + CPI_{NOV} + CPI_{DEC} + 0.5CPI_{JAN}]/3$. The index is normalised so that the average index of the quarters of year 2000 equals 1.

Name: DD. **Short description:** Domestic demand. **Beginning of series:** 1971Q1. **Source:** STATICE/CBI. **Unit:** Millions of kronas at constant 2000 prices. **FAME code:** QMM.DEM.DDZZZZ.Q. **ECOTRIM:** Flow AR(1) Max Log Par : -.99 to .99. **Comment:** Quarterly data available since 1997Q1 from STATICE. **Detailed description:** *Period from 1970 to 1996:* Annual data on domestic demand from STATICE was disaggregated using ECOTRIM, using quarterly data on domestic demand from the income identity $DD = C + G + I + II$ at constant 1990 prices as a related series.

Name: DDN. **Short description:** Nominal domestic demand. **Beginning of series:** 1971Q1. **Source:** STATICE/CBI. **Unit:** Millions of kronas at current prices. **FAME code:** QMM.DEM.DDNZZZ.Q. **Comment:** Defined from the income identity $DDN = CN + GN + IN + IIN$.

Name: $DELTA$. **Short description:** Depreciation rate for total capital stock. **Beginning of series:** 1970Q1. **Source:** STATICE/CBI. **Unit:** Fraction. **FAME code:** QMM.EXO.DELTAZ.Q. **ECOTRIM:** Flow, Boot, Feibes and Lisman - FD. **Comment:** Annual depreciation rates calculated from annual data as the difference between the investment and the change in the capital stock at fixed prices. Quarterly data obtained using ECOTRIM.

Name: $DELTAB$. **Short description:** Depreciation rate for business capital stock. **Beginning of series:** 1970Q1. **Source:** STATICE/CBI. **Unit:** Fraction. **FAME code:** QMM.EXO.DELTAB.Q. **ECOTRIM:** Flow, Boot, Feibes and Lisman - FD. **Comment:** Annual depreciation rates calculated from annual data as the difference between the investment and the change in the capital stock at fixed prices. Quarterly data obtained using ECOTRIM.

Name: $DELTAG$. **Short description:** Depreciation rate of government capital stock. **Beginning of series:** 1970Q1. **Source:** STATICE/CBI. **Unit:** Fraction. **FAME code:** QMM.EXO.DELTAG.Q. **ECOTRIM:** Flow Boot, Feibes and Lisman - FD. **Comment:** Annual depreciation rates calculated from annual data as the difference between the investment and the change in the capital stock at fixed prices. Quarterly data obtained using ECOTRIM.

Name: $DELTAH$. **Short description:** Depreciation rate of housing stock. **Beginning of series:** 1970Q1. **Source:** STATICE/CBI. **Unit:** Fraction. **FAME code:** QMM.EXO.DELTAH.Q. **ECOTRIM:** Flow AR(1) Max Log Par : -.99 to .99. **Comment:** The historical values of the depreciation rate are calculated using the STATICE annual data on depreciations which are disaggregated using ECOTRIM using quarterly data on KH, constructed using the dynamic equation for the capital stock and lagged one period, as a reference series.

Name: DH. **Short description:** Financial debt of households. **Beginning of series:** 1986Q1. **Source:** CBI. **Unit:** Millions of kronas at current prices (average prices during the period). **FAME code:** QMM.FIN.DHZZZZ.Q. **ECOTRIM:** StockL Boot, Feibes and Lisman - FD. **Detailed description:** Financial debt of households is obtained from quarterly data produced by the CBI (FAME series LAK.SAM.EUM$$$.EIN.SX.XXX.ISK.IS.N.F (credit system, assets, loans and domestic securities holdings, individuals)) from 1991Q4. Quarterly data for earlier periods have been estimated with ECOTRIM. The CPI is used to transform end-of-year data at end-of-year prices to average price during the period.

Name: DI. **Short description:** General government debt interest payments. **Beginning of series:** 1980Q1. **Source:** STATICE/CBI. **Unit:** Millions of kronas at current prices. **FAME code:** QMM.GOV.DIZZZZ.Q. **ECOTRIM:** Flow Boot, Feibes and Lisman - FD. **Detailed description:** Quarterly data on net general government debt interest rate payments obtained with ECOTRIM.

Name: EER. **Short description:** Exchange rate index of foreign currency. **Beginning of series:** 1972Q1. **Source:** CBI. **Unit:** Index, 2000 = 1. **FAME code:** QMM.FIN.EERZZZ.Q. **Comment:** Quarterly average of monthly average observations (FAME series VIS.ISK.OVVG.S.D). The index is normalised so that the average index of the quarters of year 2000 equals 1. **Detailed description:** *Period from January 1993*: Official trade-weighted exchange rate index, using trade and services weights from previous year bilateral trade (adjusted for third-country effects). The index includes the United States, Great Britain, Canada, Denmark, Norway, Sweden, Switzerland, Euroland and Japan, with the weights updated each year. *Period from 1980 to 1992:* From 1980 to 1992 the previous year bilateral trade and services weights are used. *Period from 1972 to 1979:* Up to 1980 the trade weights for 1980 are used.

Name: EMP. **Short description:** Level of employment in man-years. **Beginning of series:** 1980Q1. **Source:** CBI. **Unit:** Heads measured in man-years. **FAME code:** QMM.LAB.EMPZZZ.Q. **Comment:** Calculated using official data on UR and UN as $EMP = ((1 - UR)/UR)UN$.

Name: $EMPT$. **Short description:** Trend employment. **Beginning of series:** 1980Q4. **Source:** CBI. **Unit:** Heads measured in man-years. **FAME code:**

QMM.LAB.EMPTZZ.Q. **Comment:** Defined as $EMPT = PAT \times POWA \times (1 - NAIRU)$.

Name: EQP. **Short description:** Equity prices. **Beginning of series:** 1987Q1. **Source:** ICEX/CBI. **Unit:** Index, 2000 = 1. **FAME code:** QMM.FIN.-EQPZZZ.Q. **Comment:** Quarterly averages of end-of-month data from 1987 to 1993 and quarterly averages of daily data from 1993 onwards. **Detailed description:** The index is normalised so that the average index of the quarters of year 2000 equals 1. From 1/1 1993 ICEX-MAIN stock index is used. Prior to that the HMARK index published by VÍB was used as no official stock index data existed.

Name: EUS. **Short description:** US dollar exchange rate. **Beginning of series:** 1972Q3. **Source:** CBI. **Unit:** Index, 2000 = 1. **FAME code:** QMM.FIN.-EUSZZZ.Q. **Comment:** Icelandic kronas per 1 US dollar (adjusted for krona re-denomination in 1980). Quarterly average of monthly average observations.

Name: EX. **Short description:** Exports of goods and services. **Beginning of series:** 1970Q1. **Source:** STATICE/CBI. **Unit:** Millions of kronas at constant 2000 prices. **FAME code:** QMM.DEM.EXZZZZ.Q. **ECOTRIM:** Flow AR(1) Max Log Par : -.99 to .99. **Comment:** Quarterly data available since 1997Q1 from STATICE. **Detailed description:** *Period from 1970 to 1996:* Quarterly data obtained with ECOTRIM by disaggregating annual figures using EXN/PX at constant 1990 prices as a related series. Annual data for the period 1970 to 1979 are calculated from the volume index.

Name: $EXALU$. **Short description:** Exports of aluminium products. **Beginning of series:** 1988Q1. **Source:** STATICE/CBI. **Unit:** Millions of kronas at constant 2000 prices. **FAME code:** QMM.EXO.EXALUZ.Q. **Detailed description:** The annual exports of power intensive industry products is estimated from the annual price index and FOB value of exports. Quarterly data are obtained with ECOTRIM using the quarterly values of exports with average prices of year 2000 as a related series. The quarterly data on average prices of year 2000 is calculated from exports of each quarter on the average price of that quarter divided by $PXALU$.

Name: $EXMAR$. **Short description:** Exports of marine products. **Beginning of series:** 1988Q1. **Source:** STATICE/CBI. **Unit:** Millions of kronas at constant 2000 prices. **FAME code:** QMM.EXO.EXMARZ.Q. **Detailed description:** The annual exports of marine products is estimated from the annual price index and FOB value of exports. Quarterly data are obtained with ECOTRIM using the quarterly values of exports with average prices of year 2000 as a related series. The quarterly data on average prices of year 2000 is calculated from exports of each quarter on the average price of that quarter divided by $PXMAR$.

Name: EXN. **Short description:** Nominal exports of goods and services. **Beginning of series:** 1970Q1. **Source:** STATICE/CBI. **Unit:** Millions of kronas at current prices. **FAME code:** QMM.DEM.EXNZZZ.Q. **ECOTRIM:** Flow AR(1) Max Log Par : -.99 to .99. **Comment:** Quarterly data available since 1997Q1 from STATICE. **Detailed description:** *Period from 1970 to 1977:* Exported goods are obtained from STATICE. Exported services were disaggregated using exported services as recorded by an older definition by STATICE as an indicator series. *Period from 1978 to 1996:* Exported goods and services are obtained from the CBI.

Name: $EXREG$. **Short description:** Exports, excluding aluminium and marine products. **Beginning of series:** 1988Q1. **Source:** STATICE/CBI. **Unit:** Millions of kronas at constant 2000 prices. **FAME code:** QMM.DEM.EXREGZ.Q. **Comment:** Defined as $EXREG = EX - EXALU - EXMAR$.

Name: $FEER$. **Short description:** Expected exchange rate index. **Source:** CBI. **Unit:** Index, 2000 = 1. **FAME code:** QMM.FIN.FEERZZ.Q. **Detailed description:** Currently calculated as $feer_t = eer_{t-1}$. An alternative option would be to use model consistent expectations where $feer_t = eer_{t+1}$.

Name: FOH. **Short description:** Foreign holdings of Icelandic assets. **Beginning of series:** 1989Q4. **Source:** CBI. **Unit:** Millions of kronas at current prices. **FAME code:** QMM.DEM.FOHZZZ.Q. **Comment:** Foreign holdings of Icelandic assets are from the balance of payments and external positions statistics (in the International investment positions table). **Detailed description:** FOH equals Direct investment in Iceland + Portfolio investment liabilities + Financial derivatives liabilities + Other capital liabilities.

Name: G. **Short description:** Government consumption. **Beginning of series:** 1970Q1. **Source:** STATICE/CBI. **Unit:** Millions of kronas at constant 2000 prices. **FAME code:** QMM.EXO.GZZZZZ.Q. **Comment:** Quarterly data available since 1997Q1 from STATICE. **Detailed description:** *Period from 1970 to 1996:* Quarterly data obtained with ECOTRIM by disaggregating annual figures using GN/PG at constant 1990 prices as a related series. Annual data for the period 1970 to 1979 are calculated from the volume index.

Name: GAP. **Short description:** Output gap. **Beginning of series:** 1980Q4. **Source:** CBI. **Unit:** Fraction. **FAME code:** QMM.DEM.GAPZZZ.Q. **Comment:** Obtained as the Solow residual from the Cobb-Douglas production function (5.42) using trend employment and capital.

Name: $GAPAV$. **Short description:** Annual average of output gap. **Beginning of series:** 1981Q3. **Source:** CBI. **Unit:** Fraction. **FAME code:** QMM.DEM.-GAPAVZ.Q. **Comment:** Annual average of GAP defined in equation (5.44).

Name: GDP. **Short description:** GDP. **Beginning of series:** 1971Q1. **Source:** STATICE/CBI. **Unit:** Millions of kronas at constant 2000 prices. **FAME code:** QMM.DEM.GDPZZZ.Q. **ECOTRIM:** Flow AR(1) Max Log Par : -.99 to .99.

Comment: Quarterly data available since 1997Q1 from STATICE. **Detailed description:** *Period from 1970 to 1996:* Quarterly data obtained with ECOTRIM by disaggregating annual figures using $DD + EX - IMP$ at constant 1990 prices as a related series. Annual data for the period 1970 to 1979 are calculated from the volume index.

Name: $GDPN$. **Short description:** Nominal GDP. **Beginning of series:** 1971Q1. **Source:** STATICE/CBI. **Unit:** Millions of kronas at current prices. **FAME code:** QMM.DEM.GDPNZZ.Q. **Comment:** Quarterly data available since 1997Q1 from STATICE. **Detailed description:** Defined from the income identity $GDPN = DDN + EXN - IMPN$.

Name: $GDPT$. **Short description:** Potential output. **Beginning of series:** 1980Q4. **Source:** CBI. **Unit:** Millions of kronas at constant 2000 prices. **FAME code:** QMM.DEM.GDPTZZ.Q. **Comment:** Potential (trend) output calculated from a Cobb-Douglas production function in equation (5.42).

Name: GFW. **Short description:** Gross financial wealth. **Beginning of series:** 1987Q1. **Source:** DIR/CBI/ISD. **Unit:** Millions of kronas at current prices (average prices during the period). **FAME code:** QMM.FIN.GFWZZZ.Q. **ECOTRIM:** Flow Fernandez Par : -.99 to .99 and StockL Boot,Feibes,Lisman SD. **Comment:** Total household holding of bonds, bank deposits and equities. **Detailed description:** GFW consists of deposits with banks, bonds and equities. The CBI provides direct observations on deposits owned by households since end-of-year 2003 (FAME code: INN.SAM.SIN$$$.EIN.SX.XXX.ISK.IS.N.M). These data exist at quarterly frequency. Quarterly data exist on equities-ownership by households from the same time. Data on the households ownership of bonds are annual data on bonds declared to the DIR. ECOTRIM is used to estimate quarterly data (Flow Fernandez Par : -.99 to .99) using data from CBI on changes in aggregate deposits as a related series. Before end-of-year 2003 quarterly data for the sum of deposits, bonds and equities were estimated from the sum of deposits and bonds as declared by the households to the DIR using ECOTRIM (StockL Boot,Feibes,Lisman SD). Since 1999 ISD has provided estimates of the end-of-month value of registered shares owned by households. Data for earlier quarters is estimated from share prices and nominal share holdings of households as declared to the DIR. ECOTRIM is used to estimate quarterly data on nominal share holdings of households. The CPI is used to transform end-of-year data at end-of-year prices to average price during the period. The two series (before 2003Q4 and after 2003Q4) for the sum of deposits, bonds and equities is linked so that the values before 2003Q4 are increased by the factor between the two estimates of the sum for 2003Q4.

Name: GN. **Short description:** Nominal government consumption. **Beginning of series:** 1970Q1. **Source:** STATICE/FIN/CBI. **Unit:** Millions of kronas at current prices. **FAME code:** QMM.DEM.GNZZZZ.Q. **ECOTRIM:** Flow AR(1) Max Log Par: -.99 to .99. **Comment:** Quarterly data available since 1997Q1 from

STATICE. **Detailed description:** *Period from 1970 to 1996:* Monthly information on a part of government consumption for 1970 to 1996 is from FIN. To generate quarterly data for 1970-1996, information on wages were distributed evenly over the year, and changes within the year assumed to follow changes in the STATICE wage index. Wages were estimated at 2/3 of total government consumption. Government consumption, other than wages from above, was assumed to fluctuate within the year according to the monthly data. This constituted on average about 53% of total government consumption (varying between 47% and 60% in individual years). Other government consumption was disaggregated without the use of additional data.

Name: HW. **Short description:** Housing wealth. **Beginning of series:** 1970Q1. **Source:** STATICE/LRI/CBI. **Unit:** Millions of kronas at current prices. **FAME code:** QMM.FIN.HWZZZZ.Q. **Comment:** Before 1998 the annual estimates of HW do not agree with STATICE data as they used BC to estimate price changes prior to 1998 instead of PH. **Detailed description:** Defined as $HW = PH \times KH$.

Name: I. **Short description:** Fixed investment. **Beginning of series:** 1970Q1. **Source:** STATICE/CBI. **Unit:** Millions of kronas at constant 2000 prices. **FAME code:** QMM.DEM.IZZZZZ.Q. **ECOTRIM:** Flow Boot, Feibes and Lisman - FD and Flow AR(1) Max Log Par : -.99 to .99. **Comment:** Quarterly data available since 1997Q1 from STATICE. **Detailed descriptionn:** Quarterly data for the period before 1997Q1 is obtained by: (1) Estimating quarterly data from annual data with ECOTRIM (Flow Boot, Feibes and Lisman - FD) using no reference series; (2) Estimate the seasonality factors in the quarterly series from 1997Q1 using STAMP and then adding these seasonality factors to the series constructed in (1); and (3) Using ECOTRIM (Flow AR(1) Max Log Par : -.99 to .99) to estimate quarterly data from annual data before 1997Q1 using the reference series constructed in (2).

Name: $IBOTH$. **Short description:** Aluminium sector investment. **Beginning of series:** 1970Q1. **Source:** STATICE/CBI. **Unit:** Millions of kronas at constant 2000 prices. **FAME code:** QMM.EXO.IBOTHZ.Q. **ECOTRIM:** Flow Boot, Feibes and Lisman - FD. **Comment:** Fixed investment in energy-intensive industries; i.e. investment in the production of metals (mostly aluminium) and in the production and distribution of electricity and (hot and cold) water. Only annual data available from STATICE. **Detailed description:** Quarterly data obtained with ECOTRIM using no reference series.

Name: $IBREG$. **Short description:** Business investment excluding the aluminium sector. **Beginning of series:** 1970Q1. **Source:** STATICE/CBI. **Unit:** Millions of kronas at constant 2000 prices. **FAME code:** QMM.DEM.IBREGZ.Q. **Detailed description:** Obtained as a residual series according to $IBREG = IBUS - IBOTH$.

Name: $IBUS$. **Short description:** Business investment. **Beginning of series:** 1970Q1. **Source:** STATICE/CBI. **Unit:** Millions of kronas at constant 2000 prices. **FAME code:** QMM.DEM.IBUSZZ.Q. **ECOTRIM:** Flow Boot, Feibes and Lisman - FD and Flow AR(1) Max Log Par : -.99 to .99. **Comment:** Quarterly data available since 1997Q1 from STATICE. **Detailed description:** Quarterly data for the period before 1997Q1 is obtained by: (1) Estimating quarterly data from annual data with ECOTRIM (Flow Boot, Feibes and Lisman - FD) using no reference series.; (2) Estimate the seasonality factors in the quarterly series from 1997Q1 using STAMP and then adding these seasonality factors to the series constructed in (1); and (3) Using ECOTRIM (Flow AR(1) Max Log Par : -.99 to .99) to estimate quarterly data from annual data before 1997Q1 using the reference series constructed in (2).

Name: $IBUSN$. **Short description:** Nominal business investment. **Beginning of series:** 1970Q1. **Source:** STATICE/CBI. **Unit:** Millions of kronas at constant 2000 prices. **FAME code:** QMM.DEM.IBUSNZ.Q. **Detailed description:** Obtained as a residual series according to $IBUSN = IN - IGN - IHN$.

Name: IG. **Short description:** Government investment. **Beginning of series:** 1970Q1. **Source:** STATICE/CBI. **Unit:** Millions of kronas at constant 2000 prices. **FAME code:** QMM.EXO.IGZZZZ.Q. **ECOTRIM:** Flow Boot, Feibes and Lisman - FD and Flow AR(1) MaxLog Par : -.99 to .99. **Comment:** Quarterly data available since 1997Q1 from STATICE. **Detailed description:** Quarterly data for the period before 1997Q1 is obtained by: (1) Estimating quarterly data from annual data with ECOTRIM (Flow Boot, Feibes and Lisman - FD) using no reference series, (2) Estimate the seasonality factors in the quarterly series from 1997Q1 using STAMP and then adding these seasonality factors to the series constructed in (1); and (3) Using ECOTRIM (Flow AR(1) MaxLog Par : -.99 to .99) to estimate quarterly data from annual data before 1997Q1 using the reference series constructed in (2).

Name: IGN. **Short description:** Nominal government investment. **Beginning of series:** 1970Q1. **Source:** STATICE/CBI. **Unit:** Millions of kronas at current prices. **FAME code:** QMM.DEM.IGNZZZ.Q. **ECOTRIM:** Flow Fernandez Par : -.99 to .99. **Comment:** Quarterly data available since 1997Q1 from STATICE. **Detalied description:** Before 1997 the annual values from STATICE are disaggregated in ECOTRIM (Flow Fernandez Par : -.99 to .99) with quarterly data $BC \times IG$ as a reference series.

Name: $IGNNET$. **Short description:** Nominal net government investment. **Beginning of series:** 1990Q1. **Source:** STATICE/CBI. **Unit:** Millions of kronas at current prices. **FAME code:** QMM.DEM.IGNNET.Q. **ECOTRIM:** Flow AR(1) Max Log Par : -.99 to .99. **Comment:** Obtained as IGN minus depreciation of public capital at current prices, which was obtained from annual data using ECOTRIM, with $PIG \times DELTAG \times (K - KH - KBUS)$) as a reference series.

Name: IH. **Short description:** Private sector housing investment. **Beginning of series:** 1970Q1. **Source:** STATICE/CBI. **Unit:** Millions of kronas at constant 2000 prices. **FAME code:** QMM.DEM.IHZZZZ.Q. **ECOTRIM:** Flow Boot, Feibes and Lisman - FD and Flow AR(1) Max Log Par : -.99 to .99. **Comment:** Quarterly data available since 1997Q1 from STATICE. **Detailed description:** Quarterly data for the period before 1997Q1 is obtained by: (1) Estimating quarterly data from annual data with ECOTRIM (Flow Boot, Feibes and Lisman - FD) using no reference series; (2) Estimate the seasonality factors in the quarterly series from 1997Q1 using STAMP and then adding these seasonality factors to the series constructed in (1); and (3) Using ECOTRIM (Flow AR(1) Max Log Par : -.99 to .99) to estimate quarterly data from annual data before 1997Q1 using the reference series constructed in (2).

Name: IHN. **Short description:** Nominal housing investment. **Beginning of series:** 1970Q1. **Source:** STATICE/CBI. **Unit:** Millions of kronas at current prices. **FAME code:** QMM.DEM.IHNZZZ.Q. **ECOTRIM:** Flow AR(1) Max Log Par : -.99 to .99. **Comment:** Quarterly data available since 1997Q1 from STATICE. **Detailed description:** Before 1997 the annual values from STATICE are disaggregated in ECOTRIM (Flow AR(1) Max Log Par : -.99 to .99) with quarterly data $BC \times IH$ as a reference series.

Name: II. **Short description:** Net stockbuilding. **Beginning of series:** 1980Q1. **Source:** STATICE/CBI. **Unit:** Millions of kronas at constant 2000 prices. **FAME code:** QMM.DEM.IIZZZZ.Q. **ECOTRIM:** Flow AR(1) Max Log Par : -.99 to .99. **Comment:** Quarterly data available since 1997Q1 from STATICE. **Detailed description:** Prior to 1997 annual net stockbuilding data was disaggregated in ECOTRIM with changes in EX as a related series.

Name: IIN. **Short description:** Nominal net stockbuilding. **Beginning of series:** 1971Q1. **Source:** STATICE/CBI. **Unit:** Millions of kronas at current prices. **FAME code:** QMM.DEM.IINZZZ.Q. **ECOTRIM:** Flow AR(1) (minimum sum of squared residuals). **Comment:** Quarterly data available since 1997. **Detailed description:** Prior to 1997 annual net stockbuilding data was disaggregated in ECOTRIM with changes in EXN as a related series.

Name: IMP. **Short description:** Import volume of goods and services. **Beginning of series:** 1970Q1. **Source:** STATICE/CBI. **Unit:** Millions of kronas at constant 2000 prices. **FAME code:** QMM.DEM.IMPZZZ.Q. **ECOTRIM:** Flow AR(1) Max Log Par : -.99 to .99. **Comment:** Quarterly data available since 1997Q1 from STATICE. **Detailed description:** *Period from 1970 to 1996:* Quarterly data obtained with ECOTRIM by disaggregating annual figures using $IMPN/PM$ at constant 1990 prices as a related series. Annual data for the period 1970 to 1979 are calculated from the volume index.

Name: $IMPN$. **Short description:** Nominal imports of goods and services. **Beginning of series:** 1970Q1. **Source:** STATICE/CBI. **Unit:** Millions of kronas at current prices. **FAME code:** QMM.DEM.IMPNZZ.Q. **ECOTRIM:** Flow AR(1) Max Log Par : -.99 to .99. **Comment:** Quarterly data available since 1997Q1 from STATICE. **Detailed description:** Imported goods and services from 1978 to 1996 are taken from the CBI, statistics department. Imported goods from 1970 to 1977 from STATICE. Imported services from 1970 to 1977 were disaggregated using imported services as recorded by an older definition by STATICE as an indicator series.

Name: IN. **Short description:** Nominal fixed investment. **Beginning of series:** 1970Q1. **Source:** STATICE/CBI. **Unit:** Millions of kronas at current prices. **FAME code:** QMM.DEM.INZZZZ.Q. **ECOTRIM:** Flow Fernandez Par : -.99 to .99. **Comment:** Quarterly data available since 1997Q1 from STATICE. **Detailed description:** Before 1997 the annual values from STATICE are disaggregated in ECOTRIM with quarterly data on $BC \times I$ as a reference series.

Name: INF. **Short description:** Four-quarter CPI inflation rate. **Beginning of series:** 1971Q1. **Source:** CBI. **Unit:** Fraction. **FAME code:** QMM.PRI.INFZZZ.Q. **Comment:** Variable defined in equation (7.15).

Name: $INFE$. **Short description:** Inflation expectations. **Beginning of series:** 1994Q1. **Source:** CBI. **Unit:** Fraction. **FAME code:** QMM.PRI.INFEZZ.Q. **Detailed description:** Historical data obtained as $RL - RLV - PRISK$. Forecasted data obtained either using a backward-looking approach, as in (7.17), or model consistent expectations.

Name: $INFQ$. **Short description:** Quarterly CPI inflation rate. **Beginning of series:** 1970Q2. **Source:** CBI. **Unit:** Fraction. **FAME code:** QMM.PRI.INFQZZ.Q. **Comment:** Variable defined in equation (7.14).

Name: ISA. **Short description:** Icelandic holdings of foreign assets. **Beginning of series:** 1989Q4. **Source:** CBI. **Unit:** Millions of kronas at current prices. **FAME code:** QMM.DEM.ISAZZZ.Q. **Comment:** Icelandic holdings of foreign assets are from the balance of payments and external positions statistics (in the International investment positions table). **Detailed description:** ISA equals Direct investment abroad + Portfolio investment assets + Financial derivatives assets + Other capital assets + Central Bank's reserve of foreign currencies.

Name: IT. **Short description:** Central Bank of Iceland inflation target. **Source:** CBI. **Unit:** Fraction. **FAME code:** QMM.EXO.ITZZZZ.Q. **Comment:** Inflation target currently defined in terms of annual CPI inflation and is equal to 2.5%.

Name: K. **Short description:** Total capital stock. **Beginning of series:** 1970Q1. **Source:** STATICE/CBI. **Unit:** Millions of kronas at constant 2000 prices. **FAME code:** QMM.DEM.KZZZZZ.Q. **ECOTRIM:** StockL Fernandez Par : -.99 to .99. **Comment:** Only annual data available from STATICE. **Detailed description:** Quarterly data obtained using ECOTRIM with a quarterly series constructed using the stock-flow identity as a reference series.

Name: $KBUS$. **Short description:** Business capital stock. **Beginning of series:** 1970Q1. **Source:** STATICE/CBI. **Unit:** Millions of kronas at constant 2000 prices. **FAME code:** QMM.DEM.KBUSZZ.Q. **ECOTRIM:** StockL Fernandez Par : -.99 to .99. **Comment:** Only annual data available from STATICE. **Detailed description:** Quarterly data obtained from ECOTRIM with a quarterly series construced using the stock-flow identity as a reference series.

Name: KH. **Short description:** Private sector housing stock. **Beginning of series:** 1970Q1. **Source:** STATICE/CBI. **Unit:** Millions of kronas at constant 2000 prices. **FAME code:** QMM.DEM.KHZZZZ.Q. **ECOTRIM:** StockL Fernandez Par : -.99 to .99. **Comment:** Only annual data available from STATICE. **Detailed description:** Quarterly data is estimated with ECOTRIM using a series estimated from quarterly data on investment in appartments and the stock-flow identity as a reference series. The upward revision of the estimate of the housing stock at the end of 2001 of 2.4% is set at the last quarter of 2001.

Name: LY. **Short description:** Real post-tax labour income. **Beginning of series:** 1987Q4. **Source:** CBI. **Unit:** Millions of kronas at 2000 prices. **FAME code:** QMM.INC.LYZZZZ.Q. **Comment:** Calculated as $LY = [(YJ - YDIJ) - (TJ - TI)]/PC$.

Name: $M3$. **Short description:** Broad money. **Beginning of series:** 1970Q1. **Source:** CBI. **Unit:** Millions of kronas at current prices. **FAME code:** QMM.FIN.-M3ZZZZ.Q. **Comment:** Quarterly average of monthly values. **Detailed description:** Contains notes and coins in circulation and deposit money banks demand deposits, demand savings deposists and time savings deposists.

Name: $NAIRU$. **Short description:** Natural rate of unemployment. **Source:** CBI. **Unit:** Fraction. **FAME code:** QMM.EXO.-NAIRUZ.Q. **Comment:** Currently fixed and equal to 3%.

Name: NFA. **Short description:** Net foreign assets. **Beginning of series:** 1989Q4. **Source:** CBI. **Unit:** Millions of kronas at current prices. **FAME code:** QMM.DEM.NFAZZZ.Q. **Comment:** The difference between Icelandic holdings of foreign assets and foreign holdings of Icelandic assets, defined as $NFA = ISA - FOH$.

Name: NFW. **Short description:** Net financial wealth. **Beginning of series:** 1987Q1. **Source:** DIR and CBI. **Unit:** Millions of kronas at current prices.

FAME code: QMM.FIN.NFWZZZ.Q. **Comment:** Data derived from GFW and DH as $NFW = GFW - DH$.

Name: PA. **Short description:** Participation rate. **Beginning of series:** 1980Q1. **Source:** CBI. **Unit:** Fraction. **FAME code:** QMM.LAB.PAZZZZ.Q. **Comment:** Calculated as $(UN + EMP)/POWA$.

Name: PAT. **Short description:** Trend participcation rate. **Beginning of series:** 1980Q4. **Source:** CBI. **Unit:** Fraction. **FAME code:** QMM.LAB.PATZZZ.Q. **Comment:** Calculated as a four-quarter moving average of PA, (6.8).

Name: PC. **Short description:** Private consumption deflator. **Beginning of series:** 1970Q1. **Source:** STATICE/CBI. **Unit:** Index, 2000 = 1. **FAME code:** QMM.PRI.PCZZZZ.Q. **Detailed description:** Defined as $PC = CN/C$.

Name: $PCOM$. **Short description:** Non-oil commodity prices in USD. **Beginning of series:** 1980Q2. **Source:** IMF. **Unit:** Index, 2000 = 1. **FAME code:** QMM.EXO.PCOMZZ.Q. **Comments**: Obtained from IMF (code: Q.00176NFDZF...). **Detailed description:** Index of market prices of non-fuel commodities. The index is normalised so that the average index of the quarters of year 2000 equals 1.

Name: PG. **Short description:** Government consumption deflator. **Beginning of series:** 1970Q1. **Source:** STATICE/CBI. **Unit:** Index, 2000 = 1. **FAME code:** QMM.PRI.PGZZZZ.Q. **Detailed description:** Defined as $PG = GN/G$.

Name: $PGDP$. **Short description:** GDP price deflator. **Beginning of series:** 1971Q1. **Source:** STATICE/CBI. **Unit:** Index, 2000 =1. **FAME code:** QMM.PRI.PGDPZZ.Q. **Detailed description:** Defined as $PGDP = GDPN/GDP$.

Name: PH. **Short description:** House prices. **Beginning of series:** 1970Q1. **Source:** LRI/STATICE. **Unit:** Index, 2000 = 1. **FAME code:** QMM.PRI.PHZZZZ.Q. **ECOTRIM:** Index Fernandez Par : -.99 to .99. **Comment:** Annual values obtained implicitly from STATICE series on the housing stock at fixed and current prices. **Detailed description:** Implicit annual prices for appartments are calculated from the STATICE data. Quarterly values are estimated with ECOTRIM. Following the practice at the STATICE a series composed of the building cost index (BC) before 1997 and the LRI series on prices of appartments after that was used as a reference series in the estimation of the quarterly data.

Name: PI. **Short description:** Investment goods price deflator. **Beginning of series:** 1970Q1. **Source:** STATICE/CBI. **Unit:** Index, 2000 = 1. **FAME code:** QMM.PRI.PIZZZZ.Q. **Detailed description:** Defined as $PI = IN/I$.

Name: PIG. **Short description:** Government investment deflator. **Beginning of series:** 1970Q1. **Source:** STATICE/CBI. **Unit:** Index, 2000 = 1. **FAME code:**

QMM.PRI.PIGZZZ.Q. **Detailed description:** Defined as $PIG = IGN/IG$.

Name: PIH. **Short description:** Housing investment deflator. **Beginning of series:** 1970Q1. **Source:** STATICE/CBI. **Unit:** Index, 2000 = 1. **FAME code:** QMM.PRI.PIHZZZ.Q. **Detailed description:** Defined as $PIH = IHN/IH$.

Name: PM. **Short description:** Import price deflator. **Beginning of series:** 1970Q1. **Source:** STATICE/CBI. **Unit:** Index, 2000 =1. **FAME code:** QMM.PRI.PMZZZZ.Q. **Detailed description:** Defined as $PM = IMPN/IMP$.

Name: $POIL$. **Short description:** Oil prices in USD. **Beginning of series:** 1970Q4. **Source:** IMF. **Unit:** Index, 2000 = 1. **FAME code:** QMM.EXO.POILZZ.Q. **Comment:** Petroleum (spot prices), US$ per barrel, obtained from IMF (code: Q.00176AAZZF...). The index is normalised so that the average index of the quarters of year 2000 equals 1.

Name: $POWA$. **Short description:** Population of working age. **Beginning of series:** 1970Q1. **Source:** STATICE/CBI. **Unit:** Heads. **FAME code:** QMM.EXO.POWAZZ.Q. **ECOTRIM:** StockL Boot, Feibes and Lisman - None FD 1. **Comment:** Working age defined as 16-64 years old. **Detailed description:** Annual data are disaggregated to quarters with ECOTRIM.

Name: $PRBUS$. **Short description:** Business premium on risk-free interest rate. **Source:** CBI. **Unit:** Fraction. **FAME code:** QMM.EXO.PRBUSZ.Q. **Comment:** Currently assumed fixed at 2%.

Name: $PRISK$. **Short description:** Inflation risk premium. **Source:** CBI. **Unit:** Fraction. **FAME code:** QMM.EXO.PRISKZ.Q. **Comment:** Currently fixed and set equal to 0.5%.

Name: $PROD$. **Short description:** Labour productivity. **Beginning of series:** 1980Q1. **Source:** CBI. **Unit:** Fraction. **FAME code:** QMM.LAB.PRODZZ.Q. **Comment:** Average labour productivity defined as $PROD = GDP/EMP$.

Name: $PRODT$. **Short description:** Trend labour productivity. **Beginning of series:** 1981Q1. **Source:** CBI. **Unit:** Fraction. **FAME code:** QMM.LAB.-PRODTZ.Q. **Comment:** Average trend labour productivity from the production function (5.42) defined as $PRODT = GDPT/EMPT$.

Name: $PSNB$. **Short description:** Public sector net borrowing. **Beginning of series:** 1990Q1. **Source:** CBI. **Unit:** Millions of kronas at current prices. **FAME code:** QMM.GOV.PSNBZZ.Q. **Comment:** Accounting identity defined as $PSNB = (GN + IGN + CJ + DI + SUBS) - TAX$.

Name: PX. **Short description:** Export price deflator. **Beginning of series:** 1970Q1. **Source:** STATICE/CBI. **Unit:** Index, 2000 =1. **FAME code:** QMM.PRI.PXZZZZ.Q. **Detailed description:** Defined as $PX = EXN/EX$.

Name: $PXALU$. **Short description:** Price of aluminium products in US dollars. **Beginning of series:** 1988Q1. **Source:** STATICE/CBI. **Unit:** Index, 2000 =1. **FAME code:** QMM.EXO.PXALUZ.Q. **ECOTRIM:** Index Litterman Min SSR : -.99 to .99. **Comment:** The price index used is for the power intensive industry in whole. **Detailed description:** *Period from 1988 to 1996:* The annual price index is estimated from changes in Laspayers index for power intensive industry until 1993 and the Fisher index from 1994 to 1996. The annual figures are disaggregated using quarterly average of monthly FOB values of exported power intensive industry products divided by the volume of the export as a related series. *Period from 1997 onwards:* The index is found by using the change in quarterly Fisher index which is available from STATICE since 1997Q1. The index is normalised so that the average index of the quarters of year 2000 equals 1.

Name: $PXMAR$. **Short description:** Price of marine products in foreign currency. **Beginning of series:** 1986Q1. **Source:** STATICE/CBI. **Unit:** Index, 2000 =1. **FAME code:** QMM.EXO.PXMARZ.Q. **ECOTRIM:** Index Fernandez : -.99 to .99. **Detailed description:** *Period from 1988 to 1996:* The annual price index is estimated from changes in Laspayers index for marine exports until 1993 and the Fisher index from 1994 to 1996. The annual figures are disaggregated using quarterly average of monthly FOB values of exported marine products divided by the volume of the export as a related series. *Period from 1997 onwards:* The index is found by using the change in quarterly Fisher index which is available from STATICE since 1997Q1 . The index is normalised so that the average index of the quarters of year 2000 equals 1.

Name: $PXREG$. **Short description:** Export prices excluding aluminium and marine products. **Beginning of series:** 1988Q1. **Source:** STATICE/CBI. **Unit:** Index, 2000 =1. **FAME code:** QMM.PRI.PXREGZ.Q. **Detailed description:** Defined as $PXREG = (PX \times EX - EUS \times 1.011 \times PXALU - EER \times PXMAR \times EXMAR)/EXREG$.

Name: RCC. **Short description:** Real cost of capital. **Beginning of series:** 1980Q1. **Source:** CBI. **Unit:** Fraction. **FAME code:** QMM.FIN.RCCZZZ.Q. **Comment:** Real user cost of capital is calculated with a Hall-Jorgenson type formula on a quarterly basis using equation (4.5).

Name: RCI. **Short description:** Corporate income tax rate. **Beginning of series:** 1990Q1. **Source:** CBI. **Unit:** Fraction. **FAME code:** QMM.EXO.RCIZZZ.Q. **Detailed description:** Obtained as $TCI/GDPN_{-4}$ in historical data but treated exogenous from last observed value in forecasts and simulations.

Name: RCP. **Short description:** Corporate property tax rate. **Beginning of series:** 1990Q1. **Source:** CBI. **Unit:** Fraction. **FAME code:** QMM.EXO.RCPZZZ.Q. **Detailed description:** Obtained as $TCP/GDPN$ in historical data but treated exogenous from last observed value in forecasts and simulations.

Name: RD. **Short description:** Short-term interest rate differential. **Beginning of series:** 1987Q4. **Source:** CBI. **Unit:** Fraction. **FAME code:** QMM.FIN.-RDZZZZ.Q. **Comment:** Defined in equation (4.11).

Name: REM. **Short description:** Employers' wage-related cost. **Beginning of series:** 1980Q1. **Source:** ILMS/CBI. **Unit:** Fraction. **FAME code:** QMM.EXO.REMZZZ.Q. **ECOTRIM:** Boot, Feibes and Lisman - FD. **Comment:** ILMS estimates various taxes that are linked to wages once a year, usually for the month of July. For convenience the employees' contribution to the pension funds is included. This contribution is compulsory. The entitlements that household have in the pension funds are treated as a part of the household's decision problem. **Detailed description:** The tax rate is a simple average calculated for different types of manual labourers covered in the ILMS surveys. Quarterly data obtained with ECOTRIM by disaggregating annual figures.

Name: $REVA$. **Short description:** Household assets revaluation term. **Beginning of series:** 1987Q2. **Source:** CBI. **Unit:** Fraction. **FAME code:** QMM.FIN.-REVAZZ.Q. **Comment:** Defined in equation (4.22).

Name: $REVD$. **Short description:** Household debt revaluation term. **Beginning of series:** 1980Q2. **Source:** CBI. **Unit:** Fraction. **FAME code:** QMM.FIN.-REVDZZ.Q. **Comment:** Defined in equation (4.23).

Name: REX. **Short description:** Real exchange rate. **Beginning of series:** 1972Q1. **Source:** CBI. **Unit:** Fraction. **FAME code:** QMM.FIN.REXZZZ.Q. **Comment:** Defined as $REX = CPI/(EER \times WCPI)$.

Name: $REXM$. **Short description:** Importers' real exchange rate. **Beginning of series:** 1971Q1. **Source:** CBI. **Unit:** Fraction. **FAME code:** QMM.FIN.-REXMZZ.Q. **Comment:** Defined as $REXM = PM/PGDP$.

Name: $REXX$. **Short description:** Exporters' real exchange rate. **Beginning of series:** 1972Q1. **Source:** CBI. **Unit:** Fraction. **FAME code:** QMM.FIN.-REXXZZ.Q. **Comment:** Defined as $REXX = PX/(EER \times WPX)$.

Name: $RFIC$. **Short description:** Corporate finance income tax rate. **Beginning of series:** 1971Q1. **Source:** CBI. **Unit:** Fraction. **FAME code:** QMM.EXO.-RFICZZ.Q. **Detailed description:** Obtained as $TIC/GDPN$ in historical data but treated as exogenous from last observed value in forecasts and simulations.

Name: $RHPI$. **Short description:** Real household post-tax income. **Beginning of series:** 1987Q4. **Source:** CBI. **Unit:** Millions of kronas at constant 2000 prices. **FAME code:** QMM.INC.RHPIZZ.Q. **Comment:** Calculated as $RHPI = 1.25 \times (YJ - TJ)/PC$. **Detailed description:** Available data on household income, assets and debt indicate that the income data has underestimated household income by roughly 25% on average for the period 1990-2004. Historical data on $RHPI$ is therefore scaled by 1.25 so that the income data corresponds to the development of savings and net wealth accumulation.

Name: RI. **Short description:** Interest rate income tax rate. **Beginning of series:** 1970Q1. **Source:** CBI. **Unit:** Fraction. **FAME code:** QMM.EXO.RIZZZZ.Q. **Comment:** Given as the current 10% flat rate from 1997Q1 and zero prior to that.

Name: RIC. **Short description:** Ratio of households' other income to YE. **Beginning of series:** 1980Q1. **Source:** CBI. **Unit:** Fraction. **FAME code:** QMM.EXO.RICZZZ.Q. **Comment:** Obtained as YIC/YE in historical data but treated as exogenous from last observed value in forecasts and simulations.

Name: $RIMP$. **Short description:** Tax rate on imports. **Beginning of series:** 1990Q1. **Source:** CBI. **Unit:** Fraction. **FAME code:** QMM.EXO.RIMPZZ.Q. **Detailed description:** Obtained as $TIMP/IMPN$ in historical data but treated as exogenous from last observed value in forecasts and simulations.

Name: $RISK$. **Short description:** Exchange rate risk premium. **Source:** CBI. **Unit:** Fraction. **FAME code:** QMM.EXO.RISKZZ.Q. **Comment:** Currently fixed and set equal to 2%.

Name: RJO. **Short description:** Household other tax rate. **Beginning of series:** 1986Q1. **Source:** CBI. **Unit:** Fraction. **FAME code:** QMM.EXO.RJOZZZ.Q. **Detailed description:** Obtained as $TJO/GDPN$ in historical data but treated as exogenous from last observed value in forecasts and simulations.

Name: RJY. **Short description:** Household income tax rate. **Beginning of series:** 1988Q1. **Source:** CBI. **Unit:** Fraction. **FAME code:** QMM.EXO.RJYZZZ.Q. **Detailed description:** Obtained as $(TJY + ALLOW \times POWA)/(YE + CJ)$ in historical data but treated as exogenous from last observed value in forecasts and simulations.

Name: RL. **Short description:** Long-term interest rate. **Beginning of series:** 1994Q1. **Source:** CBI/ICEX. **Unit:** Fraction. **FAME code:** QMM.FIN.RLZZZZ.Q. **Comment:** Monthly averages of FAME series RIBR.05A.A.VBM.VTI.ISK.IS.O.D until 2004Q2 and RIKB 10 0317 from 2004Q3 onwards. **Detailed description:** Average of end-of-month Treasury notes yields. Before 1996Q2 Treasury notes where quoted by the Central Bank, but from 1996Q1 and onwards the yields are quotes from ICEX.

Name: RLV. **Short description:** Long-term indexed interest rate. **Beginning of series:** 1980Q1. **Source:** CBI. **Unit:** Fraction. **FAME code:** QMM.FIN.RLVZZZ.Q. **Comment:** Quarterly averages of end-of-month figures. **Detailed description:** Long-term yield on indexed bonds. Data for 1980-1987 are chain linked with data from Economic Statistics published by the CBI. A data break in 1984Q4 is interpolated. Data until 2002Q2 are five year government indexed bond. From 2002Q2 to 2004Q3 the RIKS15 government index bond was used as the five year bond was no longer active in 2003. From 2004Q4 onwards the HFF14 indexed housing loand fund bond (which has a government guarantee) is used as the government intends to buy back the RIKS15 bond.

Name: RRN. **Short description:** Real neutral interest rate. **Source:** CBI. **Unit:** Fraction. **FAME code:** QMM.FIN.RRNZZZ.Q. **Comment:** Currently fixed and equal to 3%.

Name: RS. **Short description:** Short-term interest rate. **Beginning of series:** 1987Q4. **Source:** CBI. **Unit:** Fraction. **FAME code:** QMM.FIN.RSZZZZ.Q. **Comment:** Quarterly averages of end-of-month figures. **Detailed description:** Central Bank of Iceland monetary policy rate. From March 1998 this is the interest rate on 14-day repurchase agreements (7-day from June 2004) between the Central Bank and domestic financial institutions. Before March 1998 this is the interest rate on tap sales.

Name: RSD. **Short description:** Other expenditure tax rate. **Beginning of series:** 1990Q1. **Source:** CBI. **Unit:** Fraction. **FAME code:** QMM.EXO.RSDZZZ.Q. **Detailed description:** Obtained as TSD/CN in historical data but treated as exogenous from last observed value in forecasts and simulations.

Name: RTS. **Short description:** Effective subsidies rate. **Beginning of series:** 1980Q1. **Source:** CBI. **Unit:** Fraction. **FAME code:** QMM.EXO.RTSZZZ.Q. **Detailed description:** Obtained as $SUBS/GDPN$ in historical data but treated as exogenous from last observed value in forecasts and simulations.

Name: $RVAT$. **Short description:** Value-added tax rate. **Beginning of series:** 1990Q1. **Source:** CBI. **Unit:** Fraction. **FAME code:** QMM.EXO.RVATZZ.Q. **Detailed description:** Obtained as $TVAT/CN$ in historical data but treated as exogenous from last observed value in forecasts and simulations.

Name: RWC. **Short description:** Corporate wage cost tax rate. **Beginning of series:** 1990Q1. **Source:** CBI. **Unit:** Fraction. **FAME code:** QMM.EXO.-RWCZZZ.Q. **Detailed description:** Obtained as TWC/YE in historical data but treated as exogenous from last observed value in forecasts and simulations.

Name: $SPEC$. **Short description:** Trade specialisation. **Beginning of series:** 1970Q1. **Source:** CBI. **Unit:** Fraction. **FAME code:** QMM.DEM.SPECZZ.Q. **Comment:** Defined as $SPEC = TRADE/WGDP$.

Name: $SUBS$. **Short description:** Government subsidies. **Beginning of series:** 1980Q1. **Source:** STATICE/CBI. **Unit:** Millions of kronas at current prices. **FAME code:** QMM.GOV.SUBSZZ.Q. **ECOTRIM:** Flow Boot, Feibes and Lisman - FD. **Comment:** Net production subsidies, i.e. production subsidies and financial transfers net of government income from assets, dividends and rent. **Detailed description:** Quarterly data obtained from ECOTRIM.

Name: TAX. **Short description:** Total tax receipts. **Beginning of series:** 1990Q1. **Source:** CBI. **Unit:** Millions of kronas at current prices. **FAME code:** QMM.GOV.TAXZZZ.Q. **Comment:** Accounting identity given as $TAX = TJ+TC+TE$.

Name: TC. **Short description:** Corporate tax payments. **Beginning of series:** 1990Q1. **Source:** CBI. **Unit:** Millions of kronas at current prices. **FAME code:** QMM.GOV.TCZZZZ.Q. **Comment:** Accounting identity given as $TC = TCI + TCP + TIC + TWC$.

Name: TCI. **Short description:** Corporate income tax payments. **Beginning of series:** 1990Q1. **Source:** STATICE/CBI. **Unit:** Millions of kronas at current prices. **FAME code:** QMM.GOV.TCIZZZ.Q. **ECOTRIM:** Flow Boot, Feibes and Lisman - FD. **Detailed description:** Quarterly data obtained with ECOTRIM.

Name: TCP. **Short description:** Corporate property tax payments. **Beginning of series:** 1990Q1. **Source:** STATICE/CBI. **Unit:** Millions of kronas at current prices. **FAME code:** QMM.GOV.TCPZZZ.Q. **ECOTRIM:** Flow Boot, Feibes and Lisman - FD. **Detailed description:** Quarterly data obtained with ECOTRIM.

Name: TE. **Short description:** Total taxes on production and imports. **Beginning of series:** 1990Q1. **Source:** CBI. **Unit:** Millions of kronas at current prices. **FAME code:** QMM.GOV.TEZZZZ.Q. **Comment:** Accounting identity given as $TE = TVAT + TIMP + TSD$.

Name: TI. **Short description:** Household interest rate income tax. **Beginning of series:** 1987Q4. **Source:** CBI. **Unit:** Millions of kronas at current prices. **FAME code:** QMM.GOV.TIZZZZ.Q. **Comment:** Defined in equation (8.4).

Name: TIC. **Short description:** Corporate finance income tax payments. **Beginning of series:** 1970Q1. **Source:** STATICE/CBI. **Unit:** Millions of kronas at current prices. **FAME code:** QMM.GOV.TICZZZ.Q. **ECOTRIM:** Flow AR(1)Max Log Par : -.99 to .99. **Detailed description:** Quarterly data obtained with ECOTRIM using TI as auxiliary information. This tax income series is zero prior to 1997.

Name: $TIMP$. **Short description:** Tariffs and other taxes on imports. **Beginning of series:** 1990Q1. **Source:** STATICE/CBI. **Unit:** Millions of kronas at current prices. **FAME code:** QMM.GOV.TIMPZZ.Q. **ECOTRIM:** Flow AR(1)Max Log Par : -.99 to .99. **Detailed description:** Quarterly data obtained with ECOTRIM using $IMPN$ as auxiliary information.

Name: TJ. **Short description:** Household tax payments. **Beginning of series:** 1987Q4. **Source:** CBI. **Unit:** Millions of kronas at current prices. **FAME code:** QMM.GOV.TJZZZZ.Q. **Comment:** Accounting identity given as $TJ = TJY + TI + TJO$.

Name: TJO. **Short description:** Other household tax payments. **Beginning of series:** 1987Q4. **Source:** STATICE/CBI. **Unit:** Millions of kronas at current prices. **FAME code:** QMM.GOV.TJOZZZ.Q. **ECOTRIM:** Flow Boot, Feibes and Lisman - FD. **Detailed description:** Quarterly data obtained with ECOTRIM.

Name: TJY. **Short description:** Household income tax. **Beginning of series:** 1980Q1. **Source:** STATICE/CBI. **Unit:** Millions of kronas at current prices. **FAME code:** QMM.GOV.TJYZZZ.Q. **ECOTRIM:** Flow AR(1)Max Log Par : -.99 to .99. **Detailed description:** Quarterly data obtained with ECOTRIM using YE as auxiliary information.

Name: $TRADE$. **Short description:** World trade. **Beginning of series:** 1970Q1. **Source:** IMF/CBI. **Unit:** Index, 2000 = 1. **FAME code:** QMM.EXO.-TRADEZ.Q. **Comment:** The index is normalised so that the average of the quarters of year 2000 equals 1. **Detailed description:** Trade weighted import volumes in Iceland's main trading partners (Canada, Denmark, Euroland, Japan, Norway, Sweden, Switzerland, UK and US). The weights are revised annually on the basis of the previous year trade in goods and services, using the same weights as in the official exchange rate index (EER).

Name: TSD. **Short description:** Other expenditure taxation receipts. **Beginning of series:** 1990Q1. **Source:** FIN/ STATICE/CBI. **Unit:** Millions of kronas at current prices. **FAME code:** QMM.GOV.TSDZZZ.Q. **ECOTRIM:** Flow AR(1) Max Log Par :-.99 to .99. **Detailed description:** Quarterly data obtained with ECOTRIM using CN as auxiliary information.

Name: $TVAT$. **Short description:** Value added taxation receipts. **Beginning of series:** 1990Q1. **Source:** STATICE/CBI. **Unit:** Millions of kronas at current prices. **FAME code:** QMM.GOV.TVATZZ.Q. **ECOTRIM:** Flow AR(1) Max Log : -.99 to .99. **Detailed description:** Quarterly data obtained with ECOTRIM using $W \times EMP$ as auxiliary information.

Name: TWC. **Short description:** Corporate wage cost tax payments. **Beginning of series:** 1990Q1. **Source:** STATICE/CBI. **Unit:** Millions of kronas at current prices. **FAME code:** QMM.GOV.TWCZZZ.Q. **ECOTRIM:** Flow AR(1) Max Log : -.99 to .99. **Detailed description:** Quarterly data obtained with ECOTRIM using $W \times EMP$ as auxiliary information.

Name: ULC. **Short description:** Unit labour costs. **Beginning of series:** 1980Q1. **Source:** CBI. **Unit:** Fraction. **FAME code:** QMM.LAB.ULCZZZ.Q. **Comment:** Defined as $ULC = W \times REM/PROD$.

Name: $ULCT$. **Short description:** Trend unit labour costs. **Beginning of series:** 1981Q1. **Source:** CBI. **Unit:** Fraction. **FAME code:** QMM.LAB.ULCTZZ.Q. **Comment:** Defined as $ULCT = W \times REM/PRODT$.

Name: UN. **Short description:** Level of unemployment. **Beginning of series:** 1980Q1. **Source:** DOL. **Unit:** Number of heads. **FAME code:** QMM.LAB.-UNZZZZ.Q. **Comment:** Quarterly averages of monthly unemployment data from DOL.

Name: UR. **Short description:** Unemployment rate. **Beginning of series:** 1970Q1. **Source:** DOL. **Unit:** Fraction. **FAME code:** QMM.LAB.URZZZZ.Q. **Comment:** Quarterly averages of monthly unemployment rate data from DOL.

Name: $USRL$. **Short description:** US long-term interest rate. **Beginning of series:** 1970Q1. **Source:** IMF. **Unit:** Fraction. **FAME code:** QMM.EXO.USRLZZ.Q. **Comment:** 10 year US government bond yield (IFS-code Q.11161...ZF...).

Name: W. **Short description:** Wages. **Beginning of series:** 1980Q1. **Source:** STATICE. **Unit:** Index, 2000 = 1. **FAME code:** QMM.LAB.WZZZZZ.Q. **ECOTRIM:** AR(1) Max Log Par : -.99 to .99. **Comment:** The index is normalised so that the average index of the quarters of year 2000 equals 1. **Detailed description:** Annual data on wage cost is given in the national accounts. REM is used to estimate the indirect wage cost and EMP and the share of self-employed in the data on man-years (collected until 1997 by NEI) to calculate the wage cost per unit of labour (excluding self-employed). The wage index produced by STATICE is used as a reference series when annual data is disaggregated using ECOTRIM.

Name: $WCPI$. **Short description:** World consumer prices. **Beginning of series:** 1970Q1. **Source:** IMF/CBI. **Unit:** Index, 2000 = 1. **FAME code:** QMM.EXO.WCPIZZ.Q. **Comment:** The index is normalised so that the average index of the quarters of year 2000 equals 1. **Detailed description:** Trade weighted average of consumer prices in Canada, Denmark, Euroland, Japan, Norway, Sweden, Switzerland, UK and US. The weights are revised annually on the basis of the previous year trade in goods and services, using the same weights as in the official exchange rate index (EER).

Name: WEL. **Short description:** Household sector wealth. **Beginning of series:** 1987Q1. **Source:** CBI. **Unit:** Millions of kronas at current prices. **FAME code:** QMM.FIN.WELZZZ.Q. **Comment:** Defined as $WEL = HW + NFW$.

Name: $WEQP$. **Short description:** World equity prices. **Beginning of series:** 1970Q1. **Source:** EcoWin. **Unit:** Index, 2000 = 1. **FAME code:** QMM.EXO.-WEQPZZ.Q. **Comment:** Morgan Stanley Capital International (MSCI) Index from EcoWin (code: ew:wld15420). The index is normalised so that the average of the quarters of year 2000 equals 1.

Name: $WGDP$. **Short description:** World GDP. **Beginning of series:** 1970Q1. **Source:** IMF/CBI. **Unit:** Index, 2000 = 1. **FAME code:** QMM.EXO.-WGDPZZ.Q. **Comment:** The index is normalised so that the average index of the quarters of year 2000 equals 1. **Detailed description:** Trade weighted real GDP levels in Iceland's main trading partners (Canada, Denmark, Euroland, Japan, Norway, Sweden, Switzerland, UK and US). The weights are revised annually on the basis of the previous year trade in goods and services, using the same weights as in the official exchange rate index (EER).

Name: WPX. **Short description:** World export prices. **Beginning of series:** 1970Q1. **Source:** IMF/CBI. **Unit:** Index, 2000 = 1. **FAME code:** QMM.EXO.-WPXZZZ.Q. **Comment:** The index is normalised so that the average index of the quarters of year 2000 equals 1. **Detailed description:** Trade weighted foreign currency export price deflators (obtained as the ratio of nominal and real exports of goods and services data) of Iceland's main trading partners (Canada, Denmark, Euroland, Japan, Norway, Sweden, Switzerland, UK and US). The weights are revised annually on the basis of the previous year trade in goods and services, using the same weights as in the official exchange rate index (EER).

Name: WRS. **Short description:** Foreign short-term interest rate. **Beginning of series:** 1970Q1. **Source:** IMF/CBI. **Unit:** Fraction. **FAME code:** QMM.EXO.WRSZZZ.Q. **Comment:** Trade weighted foreign 3 month Treasury Bill interest rates of Iceland's main trading partners (Canada, Denmark, Euroland, Japan, Norway, Sweden, Switzerland, UK and US). The weights are revised annually on the basis of the previous year trade in goods and services, using the same weights as in the official exchange rate index (EER).

Name: $YDIJ$. **Short description:** Other household non-labour income. **Beginning of series:** 1987Q4. **Source:** DIR. **Unit:** Millions of kronas at current prices. **FAME code:** QMM.INC.YDIJZZ.Q. **Comment:** This variable is obtained from equation (9.4). **Detailed description:** These figures are estimated from the data on financial wealth and on financial debt of houshold and data on interest rates on different financial assets and liabilities.

Name: YE. **Short description:** Wages, salaries and self-employed income. **Beginning of series:** 1980Q1. **Source:** STATICE/DIR. **Unit:** Millions of kronas at current prices. **FAME code:** QMM.INC.YEZZZZ.Q. **Comment:** Annual data from the National Accounts, except for self-employed income which is from DIR. **Detailed description:** Data on income from wages and salaries are from the National Accounts. Data on self-employed income are taken from the DIR. STATICE's estimates of income from home-ownership and the statistical discrepancy between the estimates of the GDP from the production side and from the expenditure side are included. This method is similar to the present method of STATICE where this discrepancy is largely assumed to be self-employed income.

Name: YIC. **Short description:** Households' other income. **Beginning of series:** 1980Q1. **Source:** DIR. **Unit:** Millions of kronas at current prices. **FAME code:** QMM.INC.YICZZZ.Q. **ECOTRIM:** Flow AR(1) Max Log Par : -.99 to .99. **Comment:** Annual data available from DIR. **Detailed description:** Includes income from pension funds, income from abroad, and accident-compensation. Quarterly data obtained with ECOTRIM with estimated quarterly wages and salaries as a reference series.

Name: YJ. **Short description:** Total household pre-tax income. **Beginning of series:** 1987Q4. **Source:** DIR. **Unit:** Millions of kronas at current prices. **FAME code:** QMM.INC.YJZZZZ.Q. **Detailed description:** Calculated as $YJ = YE + CJ + YIC + YDIJ$.

References

[1] Baldursson, F. M. (1993), "On consumption and income", *Fjármálatídindi*, 40, 186-199. (In Icelandic).

[2] Ball, L., and N. G. Mankiw (1994), "A sticky-price manifesto", *Carnegie-Rochester Conference Series on Public Policy*, 41, 127-151.

[3] Bank of England (1999), *Economic Models at the Bank of England*. London: Bank of England.

[4] Bank of England (2000), *Economic Models at the Bank of England: September 2000 Update*. London: Bank of England.

[5] Central Bank of Iceland (2004), *Economic Effects of Changes in the Mortgage Loan Market*, Report to the Ministry of Social Affairs, June 2004. (In Icelandic).

[6] Christiano, L. J., M. Eichenbaum and C. L. Evans (1999), "Monetary policy shocks: What have we learned and to what end?". In J. B. Taylor and M. Woodford (eds.), *Handbook of Macroeconomics*, Vol. 1A. Amsterdam: North-Holland.

[7] Cooley, T. F. (1995) (ed.), *Frontiers of Business Cycle Research*, Princeton: Princeton University Press.

[8] Eichenbaum, M., and C. L. Evans (1995), "Some empirical evidence on the effects of shocks to monetary policy on exchange rates", *Quarterly Journal of Economics*, 107, 1261-1282.

[9] Elíasson, L. E., and T. G. Pétursson (2006), "The residential housing market in Iceland: Analysing the effects of the recent mortgage market reform", *Central Bank of Iceland Working Papers*, no. 29.

[10] Fagan, G., and J. Morgan (2005) (eds.), *Econometric Models of the Euro-Area Central Banks*. Cheltenham: Edward Elgar Publishing.

[11] Gudmundsson, M., A. Sighvatsson and T. G. Pétursson (2000), "Optimal exchange rate policy: The case of Iceland". In M. Gudmundsson, T. T. Herbertsson and G. Zoega (eds.), *Macroeconomic Policy: Small Open Economies in an Era of Global Integration*. Reykjavík: University of Iceland Press.

[12] Hamilton, J. D. (1994), *Time Series Analysis*, Princeton: Princeton University Press.

[13] Harrison, R., K. Nikolov, M. Quinn, G. Ramsay, A. Scott and R. Thomas (2005), *The Bank of England Quarterly Model*, London: Bank of England.

[14] Hauksson, B. (2005), "Aggregate business fixed investment", *Central Bank of Iceland Working Papers*, no. 27.

[15] Meacci, M., and D. Turner (2001), "Modelling import responsiveness for OECD manufactures trade", *OECD Economics Department Working Paper Series*, no. 311.

[16] Murphy, C. W. (1992), "The steady -state properties of a macroeconometric model", in C. Hargreaves (ed.), *Macroeconomic Modelling of the Long Run*, Aldershot: Edward Elgar Publishing Limited.

[17] Ólafsson, T. T., (2006), "The New Keynesian Phillips curve: In search of improvements and adaption to the open economy", *Central Bank of Iceland Working Papers*, no. 31.

[18] Orphanides, A., R. D. Porter, D. Reifshneider, R. Tetlow and F. Finan (2000), Errors in measurement of the output gap and the design of monetary policy", *Journal of Economics and Business*, 52, 117-141.

[19] Pagan, A., (2003), *Report on Modelling and Forecasting at the Bank of England*, Bank of England, London.

[20] Pétursson, T. G. (2000), "The representative household's demand for money in a cointegrated VAR model", *Econometrics Journal*, 3, 162-76.

[21] Pétursson, T. G. (2001a), "The transmission mechanism of monetary policy: Analysing the financial market pass-through", *Central Bank of Iceland Working Papers*, no. 14.

[22] Pétursson, T. G. (2001b), "The transmission mechanism of monetary policy", Central Bank of Iceland, *Monetary Bulletin*, 2001/4, 62-77.

[23] Pétursson, T. G. (2002), "Wage and price formation in a small open economy: Evidence from Iceland", *Central Bank of Iceland Working Papers*, no. 16.

[24] Powell, A. A., and C. W. Murphy (1997), *Inside a Modern Macroeconometric Model - A Guide to the Murphy Model*, 2nd edition. Berlin: Springer.

[25] Schmidt-Hebbel, K., and M. Tapia (2002), "Monetary policy implementation and results in twenty inflation-targeting countries", Central Bank of Chile *Working Papers*, no. 166.

[26] Stock, J. H., and M. W. Watson (1999), "Business cycle fluctuations in US macroeconomic time series". In J. B. Taylor and M. Woodford (eds.), *Handbook of Macroeconomics*, Vol. 1A. Amsterdam: North-Holland.

[27] Taylor, J. B. (1993), "Discretion versus policy rules in practice", *Carnegie-Rochester Conferences on Public Policy*, 39, 195-214.