Oesterreichische Nationalbank

Working Paper 104

AQM

The Austrian Quarterly Model of the Oesterreichische Nationalbank

Gerhard Fenz and Martin Spitzer

Statement of Purpose

The Working Paper series of the Oesterreichische Nationalbank is designed to disseminate and to provide a platform for discussion of either work of the staff of the OeNB economists or outside contributors on topics which are of special interest to the OeNB. To ensure the high quality of their content, the contributions are subjected to an international refereeing process. The opinions are strictly those of the authors and do in no way commit the OeNB.

Imprint: Responsibility according to Austrian media law: Guenther Thonabauer, Secretariat of the Board of Executive Directors, Oesterreichische Nationalbank

Published and printed by Oesterreichische Nationalbank, Wien.

The Working Papers are also available on our website:

http://www.oenb.at

Editorial

This paper gives a detailed description of the Austrian Quarterly Model (AQM). The modelling strategy of the AQM is in the tradition of the "neoclassical synthesis", a combination of Keynesian short-run analysis and neoclassical long-run analysis. The short run dynamics are based on empirical evidence, the long run relationships are derived from a neoclassical optimization framework. Adjustment processes to the real equilibrium are sluggish. Imperfections on goods and labour markets typically prevent the economy to adjust instantaneously to the long run equilibrium. In the current version of the AQM the formation of expectations is strictly backward looking. The relatively small scale of the model keeps the structure simple enough for projection and simulation purposes while incorporating a sufficiently detailed structure to capture the main characteristics of the Austrian economy. The main behavioural equations are estimated using the two-step Engle-Granger-technique. The AQM constitutes the Austrian block of the ESCB multi-country model (MCM).

September 28, 2005

AQM
The Austrian Quarterly Model of the Oesterreichische Nationalbank

Gerhard Fenz, Martin Spitzer *

June, 2005

Abstract

The modelling strategy of the Austrian Quarterly Model (AQM) is in the tradition of the "neoclassical synthesis", a combination of Keynesian short-run analysis and neoclassical long-run analysis. The short run dynamics are based on empirical evidence, the long run relationships are derived from a neoclassical optimization framework. Adjustment processes to the real equilibrium are sluggish. Imperfections on goods and labour markets typically prevent the economy to adjust instantaneously to the long run equilibrium. In the current version of the AQM the formation of expectations is strictly backward looking. The relatively small scale of the model keeps the structure simple enough for projection and simulation purposes while incorporating a sufficiently detailed structure to capture the main characteristics of the Austrian economy. The main behavioural equations are estimated using the two-step Engle-Granger technique. The AQM constitutes the Austrian block of the ESCB multi-country model (MCM).

*Gerhard Fenz (Gerhard.Fenz@oenb.co.at) and Martin Spitzer (Martin.Spitzer@oenb.co.at) are working in the Econometric Modelling Group of the Austrian National Bank, P.O. Box 61, 1011 Vienna, Austria. We would like to thank Jerome Henry, Peter McAdam, Martin Schneider, Thomas Warmedinger, seminar participants at the ECB and the OeNB and an anonymous referee for helpful advice and the ECB for their hospitality during the work on this paper. The views and findings of this paper are entirely those of the authors and do not necessarily represent those of Oesterreichische Nationalbank.

Contents

List of Tables

List of Figures

1 Introduction

Traditionally, the range of econometric models used by a central bank consists of a set of time series models for short term assessments, calibrated theoretical models, and traditionally estimated structural models. The present paper deals with the last but currently at the OeNB most frequently used element of this range, the Austrian Quarterly Model (AQM). At the same time, the model constitutes one of the building blocks of the Multi-Country-Model (MCM) of the European System of Central Banks (ESCB). The purpose of the AQM is twofold. First, it is used in preparing macroeconomic projections for the Austrian economy, published twice a year in June and December. Second, in scenario analysis the effects of economic shocks on the Austrian economy are simulated.

The model shares the general features of the modelling strategy of the Multi-Country Model (MCM). One element of this strategy involves the decision to build a relatively small-scale model to keep the structure simple enough for projection and simulation purposes while incorporating a sufficiently detailed structure to capture the main characteristics of the Austrian economy. Another element of the modelling strategy is to embody the "neoclassical synthesis", a combination of Keynesian short-run analysis and neoclassical long-run analysis popularized by Samuelson (1967). More precisely, the short run dynamics are estimated to conform to empirical evidence, while the long-run relationships are derived from theoretical optimization. An aggregate neoclassical production function is the central feature of the long-run behavior with a vertical supply curve. The neoclassical relationships ensure that the long-run real equilibrium is determined by available factors of production and technological progress. Therefore real output growth in the long run is independent both of the price level and of inflation. Imperfections in the markets for goods and labour prevent the economy from returning instantaneously to the long-run equilibrium. Thus, the economy converges slowly towards its equilibrium in response to economic shocks. Simulation exercises with the AQM typically show that the adjustment process is rather long, reflecting past experience in the Austrian economy and the fact that expectations formation is strictly backward-looking in the current version of the model. Extensions to include forward-looking elements in the price and wage block are straightforward.

A typical macroeconomic model for an economy with an independent monetary policy incorporates a monetary policy rule. By choosing a target level for a nominal anchor this rule ensures a nominal equilibrium by defining an appropriate feedback rule for nominal interest rates. Typical examples for nominal target variables are price levels or more recently, inflation rates. As long as monetary aggregates are not targeted by interest rate rules there is no specific role for money in this kind of models. Thus monetary aggregates typically influence neither output nor prices. Assuming that the velocity of money is constant, money supply can be thought of moving in line with nominal GDP. Since Austria is part of the euro area and monetary policy decisions are based on an assessment of euro-area-wide conditions, a national interest rate rule is not appropriate. Thus interest rates are typically kept exogenous in projection and simulation exercises. The model incorporates a fiscal policy rule along a public debt criterion of 50 percent of GDP. However, in most cases fiscal policy is assumed to be exogenous and the fiscal closure rule is not activated and only standard automatic fiscal stabilizers are at work.

Further important features of the AQM follow from the main behavioural equations. The long run equilibrium levels of the three main variables - investment, employment, and the GDP-deflator at factor costs - are determined simultaneously in the neoclassical supply block. The coefficients of the production function were estimated treating the supply block as a nonlinear system. The equilibrium level of investment depends on output and relative factor costs. The long-run employment equilibrium is defined by the inverse of the production function. The GDP deflator at factor costs, the key price variable, is set as mark-up over marginal costs. Foreign prices enter the model via import prices. In the long run, real wages are set in line with productivity while the short run dynamics are characterized by a Phillips-curve relationship. Consistent with the permanent-income hypothesis, private consumption is a function of real disposable household income and real wealth in the long run. Nominal short-term interest rates also determine the equilibrium level of consumers' expenditures, capturing substitution effects and credit constraints. Consumption is not further disaggregated into durables and non-durables due to data constraints. Finally, foreign trade is determined by measures of world demand, domestic demand, and competitiveness.

The main behavioural equations are estimated using the two-step Engle-Granger technique. Long-run relationships are estimated in levels and then enter the dynamic equations as error-correction terms.[1] In some cases, to maintain important economic relationships, low significance levels for some of the coefficients have been accepted. Finally, to maintain readability and clarity of exposition, further estimation details have been omitted, but are available from the authors upon request. To summarize the model, the simulation and projection features of the AQM are driven by 38 behavioural equations. An additional 107 equations contain linking relationships, identities and transformations to ensure consistency and a sufficiently detailed analysis. Overall 217 variables enter the model.

The paper is organized as follows. Chapter 2 gives a short overview over the history and the use of the model. In Chapter 3 the theoretical background and the estimation results of the supply block which determine the long run equilibrium of the model are presented. Chapter 4 gives a bird eye view of the AQM-structure. Chapter 5 to 7 deal with the main behavioral equations of the AQM. We start with the demand components of real GDP private consumption, investment, foreign trade and stocks. Then the estimation results for the labour market, i.e. employment and the labour force, are presented. Finally the price block concludes the presentation of the main behavioral equations. In chapter 8 the steady state properties of the AQM are described and illustrated by two long run simulations. In chapter 9 results for three standard short run simulation exercises - a fiscal policy, a monetary policy and a world demand shock - are discussed illustrating the short run properties of the AQM. Finally we draw some conclusions in chapter 10.

All numbers of charts and tables in this paper are based on authors's calculations. All abbreviations used are explained in the Appendix.

2 History and Use of the AQM

Until it joined the European System of Central Banks (ESCB), the Oesterreichische Nationalbank had no strong incentive to undertake the considerable task of building a macroeconomic model for forecasting purposes. From the late 1970s onwards, the Oesterreichische Nationalbank relied mainly on individual models for different sectors and problems. In the late 1990s, an annual macro model was expressly built to contribute a forecast of the Austrian economy within the ESCB projection exercise. As a next step, the development of the Austrian Quarterly Model proceeded in close cooperation with the ECB over a period of two years from 2002 to 2003. Of course, the

[1] For a justification of the two-step procedure see Engle and Granger (1987).

specification of the AQM is not fixed but constantly under review, so that it is extended and reestimated in light of new data and new developments in modelling technology.[2]

The purpose of the AQM is twofold. First, it produces forecasts of the Austrian economy up to three years ahead for the biannual Eurosystem staff macroeconomic projection. The model-based estimates of future economic developments may undergo revisions to incorporate experts' judgmental assessments. This is typically the case when faced with structural breaks or discretionary policy measures which cannot be captured econometrically. The biannual macroeconomic projection exercise of the Eurosystem involves close cooperation between staff from the ECB and the National Central Banks of the euroarea. The national projections rest upon commonly agreed external assumptions and an iterative procedure between national projections ensures that bilateral trade flows are fully consistent with each other. Finally projection figures for the euroarea are calculated by aggregating the national projection figures of the twelve member states. The projection includes, amongst others, figures for prices, growth of real GDP and its demand components, the current account and the fiscal balance. Forecasts are published twice a year in June and December. The macroeconomic projections for the euroarea are published by the ECB while the OeNB publishes the projections for the Austrian economy. [3]

Second, the AQM provides simulations of different scenarios including policy measures or external shocks. These simulation exercises are carried out for international institutions such as the ECB, the OECD or the IMF as well as for internal economic analysis at the Oesterreichische Nationalbank. Furthermore, simulations are usually calculated in the course of the biannual macroeconomic projection exercise in order to stress specific risks surrounding the projection results. Two typical long run simulations - a foreign price shock and labour supply shock - are presented in section 8.3, three typical short run simulation exercises - a fiscal policy, a monetary policy and a world demand shock - in section 9.

3 Theoretical Background and the Supply Block

Consistent with the neoclassical framework, the long-run aggregate supply curve is assumed to be vertical and the long-run equilibrium is solely supply driven. The economy is assumed to produce a single good (YER). The technology is described by a standard constant-returns-to-scale Cobb-Douglas production function with two input factors, capital (KSR) and labour (LNN). Technological progress is exogenously given at a constant rate (γ) and enters in the usual labour-augmenting or Harrod-neutral manner. The long-run properties of the model can be derived by standard static optimization techniques. A representative firm maximizes profits (π) given the technology constraints:

$$\max \pi(YER, LNN, KSR) = YFD \cdot YER - WUN \cdot LNN - CC0 \cdot KSR$$

$$\text{s.t. } YER = \alpha \cdot KSR^{\beta} \cdot LNN^{1-\beta} \cdot e^{(1-\beta)\cdot\gamma\cdot T}$$

[2]For details on the Eurosystem staff macroeconomic projection exercise see ECB (2001). The euroarea projections are published in the ECB Monthly Bulletin (http://www.ecb.int/pub/html/index.en.html). The latest projections of the Austrian economy and detailed background information can be downloaded from www.oenb.at/en/geldp_volksw/prognosen/forecasts.jsp.

[3]An earlier version of the AQM has been published in Fenz and Spitzer (2005). A comprehensive overview of the main structural econometric models used by the ESCB, their structures, main features, purposes and underlying model-building philosophies is provided in Fagan and Morgan (2005).

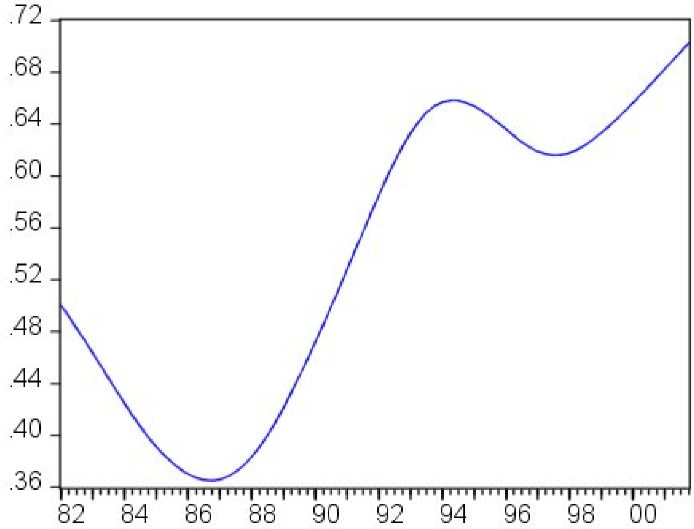

Figure 1: Risk Premium (percent per quarter)

where YFD denotes the price level, WUN the wage rate, $CC0$ the user cost of capital, α a scale parameter, β a technology parameter and T a time index. For estimation purposes we use seasonally-adjusted quarterly ESA95 data for employment, GDP, the GDP deflator and compensation to employees (as a measure of labour income). Quarterly ESA95 data are only available from 1988Q1. In order to extend the data to 1980Q1, we used growth rates from ESA79 data. This procedure causes a break in some time series around 1988 and made it necessary to introduce shift dummies in certain equations. Data for the gross capital stock were provided by Statistics Austria. Employment data include both employees and the self-employed whereas our measure of labour income includes only employees. Therefore we used compensation per employee as a proxy for the "wages" of the self-employed to calculate total labour income. The real user cost of capital is defined as the sum of the real interest rate, the depreciation rate, and a risk premium:

$$CC0/ITD = LTI/400 - infl + \delta_{KSR} + RP$$

where ITD denotes the investment deflator, LTI long term interest rates, $infl$ the inflation rate, δ_{KSR} the depreciation rate and RP the risk premium. The inflation rate is defined as a moving average of changes in the investment deflator over the current and the past four quarters. The risk premium is proxided by the trend component of the difference between the marginal product of capital and the sum of the real interest rate and the average depreciation. The average risk premium is slightly above 0.5 percent per quarter and shows an increasing trend during the nineties (see figure(1)). Solving the profit maximization problem of the firm leads to equations defining the static steady-state levels of prices, employment and capital, which enter the dynamic model specification via ECM-terms. The three equations were estimated as a system.

Initial estimation results indicated residual non-stationarity caused by two different data problems. First, the sample combines two data sets calculated according to different national account systems (ESA79 and ESA95). In order to address this problem, we introduced a shift dummy (D_884) running from 1980 to 1988. Secondly, since quarterly data for full-time equivalents are not available, we initially used unadjusted employment figures. As part-time employment is growing in importance, especially among the self-employed, this may also distort the estimators. Thus we interpolated annual data for full-time equivalents using a cubic spline and constructed an employment series adjusted for full-time equivalents. Both modifications (introduction of dummies and adjustment for full-time equivalents) strongly improved the estimation results. Finally, we introduced a permanent dummy starting in 1996Q1 in the price equation. This period was influenced by the accession to the European Union and characterized by a nationwide agreement to wage moderation. Incorporating the dummies mentioned above, the profit function becomes

$$\begin{aligned}\pi((YER+\delta\cdot D_{884}),LNN_{FE},KSR) = \\ YFD\cdot(YER+\delta\cdot D_{884}) - WUN_{FE}\cdot LNN_{FE} - CC0\cdot KSR\end{aligned} \quad (1)$$

The new profit maximization problem of the representative firm is given by:

$$\begin{aligned}&\max_{LNN_{FE},KSR}\pi((YER+\delta\cdot D_{884}),LNN_{FE},KSR)\\ &\text{s.t. } (Y+\delta\cdot D_{884}) = \alpha\cdot KSR^{\beta}\cdot LNN_{FE}^{(1-\beta)}\cdot e^{(1-\beta)\cdot\gamma\cdot t}\end{aligned} \quad (2)$$

This leads to the following system of equations for prices, employment and capital stock:

$$\begin{aligned}\log(YFD) &= \log(\eta)-\log(1-\beta)-\frac{\log(\alpha)}{(1-\beta)}\\ &\quad +\log(WUN_{FE})+\left[\left(\frac{\beta}{1-\beta}\right)\log\left(\frac{YER+\delta\cdot D_{884}}{KSR}\right)\right]\\ &\quad -\gamma\cdot T-\log(1-TIX)+\epsilon\cdot D^{961P} && (3)\\ \log(LNN_{FE}) &= \log(YER+\delta\cdot D_{884})-\beta\cdot\log\left(\frac{KSR}{LNN_{FE}}\right)\\ &\quad -\log(\alpha)-(1-\beta)\cdot\gamma\cdot T && (4)\\ \log(KSR) &= (1-\beta)\left[-\log(CC0)+\log\left(\frac{\beta}{1-\beta}\right)-\log\left(\frac{\alpha}{1-\beta}\right)\right.\\ &\quad +\log(WUN_{FE})-\gamma\cdot T\\ &\quad \left.+\left(\frac{1}{1-\beta}\right)\cdot\log((YER+\delta\cdot D_{884}))\right] && (5)\end{aligned}$$

YFD denotes the GDP deflator, η the mark-up, WUN_{FE} the nominal wage per full time equivalent , YER real GDP, KSR the real capital stock, TIX the effective indirect tax rate, LNN_{FE} total employment adjusted for full time equivalents, $CC0$ the nominal user costs of capital, α the scale parameter in the production function, β the output elasticity of capital and γ the technological progress.
According to equation (3) the GDP-deflator after indirect taxes is determined by a mark-up (η), wages and the output to capital ratio which should be constant in the long run. Employment depends on the inverse of the production function (equation

Table 1: Estimated Coefficients of the Supply Block

Coefficient	Estimate	Std Error	T-Stat
η	0.91	0.0066	138.5
β	0.37	0.0057	64.6
α	1.70	0.043	39.7
γ	0.0042	0.0002	24.6
δ	1249.7	205.3	6.1
ϵ	0.04	0.0055	7.3
Phillips-Perron test statistic with 8 Lags:			
Equation 3: -5.05323			
Equation 4: -4.65435			
Equation 5: -2.07279			

(4)) and the capital stock on relative factor costs and output (see equation (5)). The equations of the supply block have been estimated simultaneously as a system. The estimation results are reported in table (1). Firms are assumed to have a certain market power and fix their prices above marginal costs. The estimator of the mark up (η) is slightly smaller than one (0.91) indicating that the risk premium captures all capital costs beyond the real interest rate and the depreciation of the capital stock. The output elasticity of capital is estimated to be 0.367, the scale parameter α equals 1.70 and the technological progress parameter γ is 0.0042 which implies an annual exogenous growth of 1.1%.
The residuals of the supply-side equations are shown in figure (2), the optimal or desired equilibrium levels, labeled as "STAR" variables, in figure (3). While the optimal values for employment and prices follow actual data quite closely the desired capital stock is much more volatile. This arises from the fact that the desired capital stock reacts very sensitive to changes in the user costs of capital. Therefore, in simulation exercises changes in interest and/or inflation rates typically have a strong impact on investments. The residuals of the supply-side equations, i.e. the deviations of actual from desired levels, enter the dynamic specifications of the equations for the GDP-deflator at factor costs, for employment and for investment as error correction terms.

4 The AQM-Structure

The theoretical foundations of the AQM were outlined in the previous chapter. The long run equilibrium is determined in a static optimization framework leading to three steady state equations for the GDP deflator at factor costs, the capital stock (investments) and employment.

Within this theoretical framework the overall structure of the AQM becomes already apparent. The model consists of three major building blocks: prices, output and the labor market (see figure (4) for a graphical illustration of the model structure). The static steady state framework links these three building blocks. It determines how in the long run changes in output feed into prices and labor demand, how changes in relative

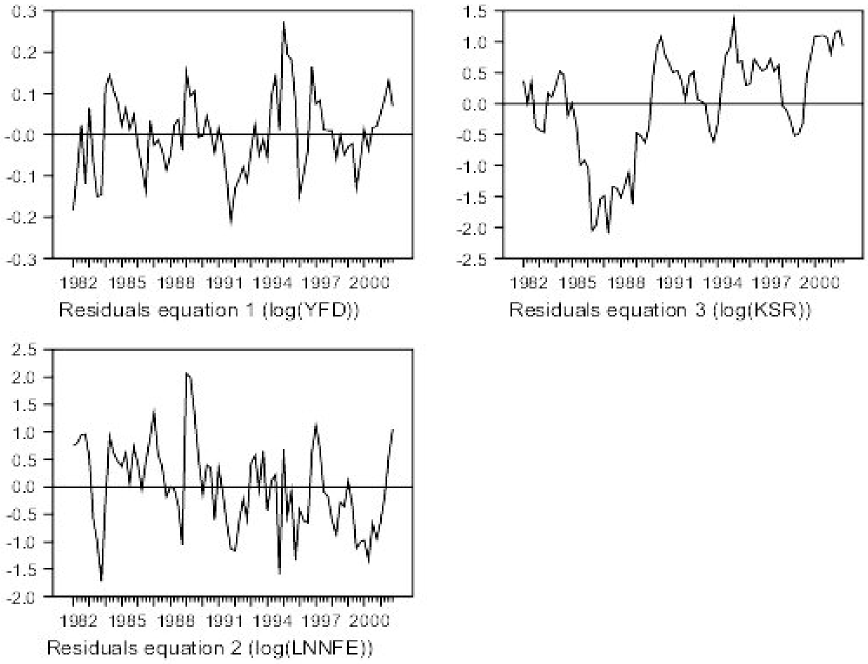

Figure 2: Residuals from the Supply Block

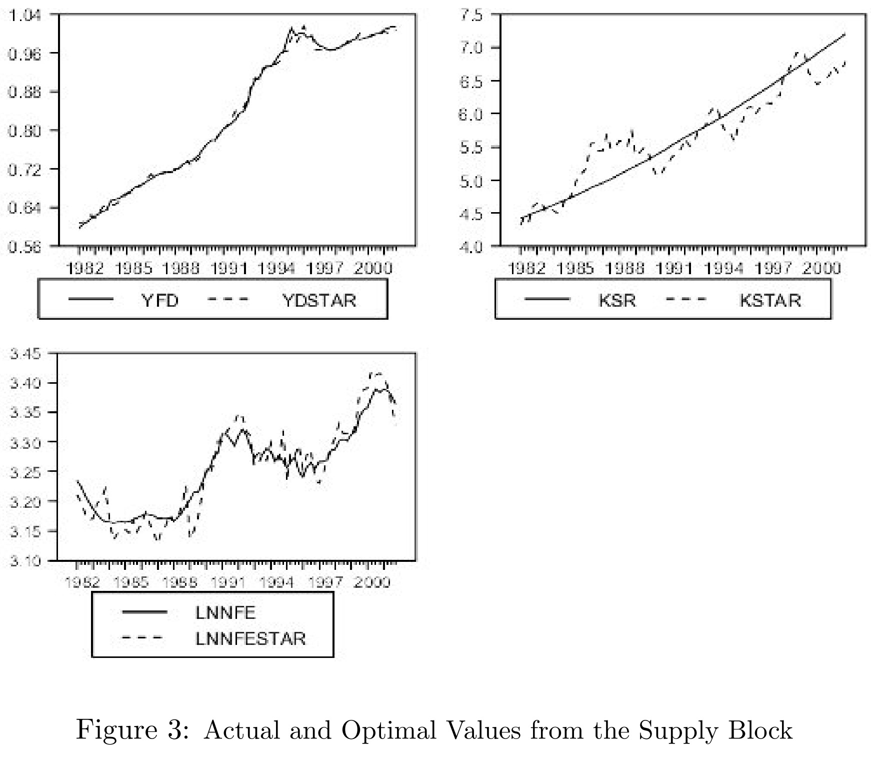

Figure 3: Actual and Optimal Values from the Supply Block

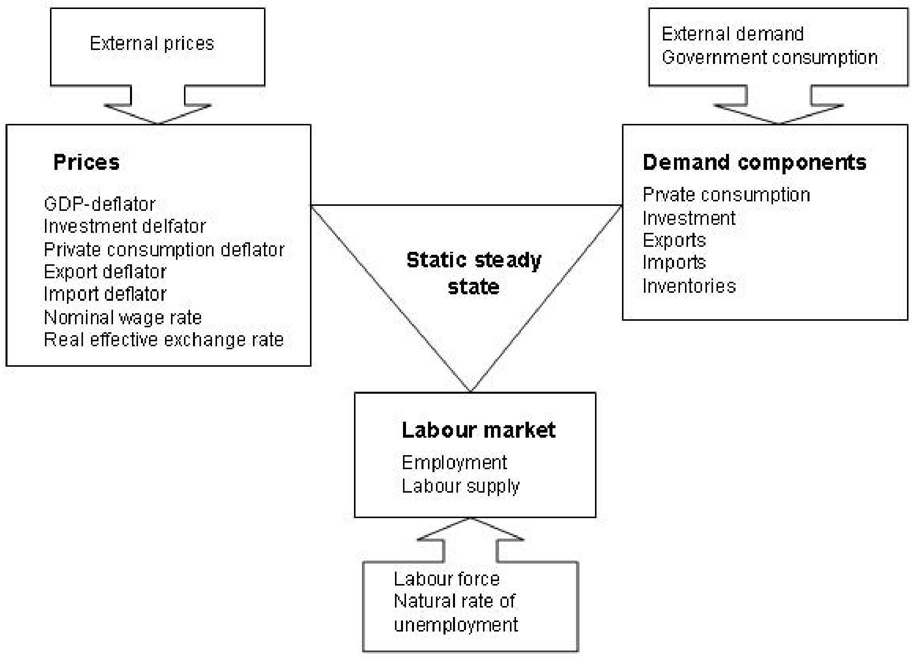

Figure 4: An Overview of the AQM Structure

factor costs influence investment activity, output and employment and how changes in emploment trigger adjustments of prices and the capital stock.

The overall structure of the AQM is of course more complex and involves many other variables. Within the output block the crucial demand components are investment activity, private consumption, exports, imports and inventories. The price block includes the deflators for private consumption, investment, exports and imports, the nominal wage rate and the real effective exchange rate. In the labor market block the level of employment and labour supply are determined. The unemployment rate which is at its natural rate in the long only is decisive for adjustment processes in the short run. Additionally, important variables enter the AQM as exogenous components. Concerning external prices this regards nominal exchange rates, competitors' prices on the import and export side and oil and non-oil commodity prices. Interest rates are exogenous and typically held constant in simulation and forecast exercises in order to derive forecasts and simulation results for policy makers under the assumption of no monetary policy change. Also a great deal of the government sector including several tax rates and government consumption are exogenously given. Finally demand for Austrian exports is independent of domestic developments as is typically the case for small open economies.

Various transmission channels between the three building blocks and the exogenous variables have to be taken into account. Although this list is by far not complete, such mechanisms are: The affection of the disposable income of households by wages and employment. The unemployment rate triggers via the Philips curve changes in the wage rate and determines the amount of transfers paid to households. Changes in prices and interest rates cause substitution and wealth effects. Investments are sensitive to the user costs of capital. The size of exports and imports depends on the international price competitiveness of the exposed sector. Output and employment feed back via productivity on wages and prices. Moreover important transmission mechanisms appear directly between variables within building blocks. Examples are the accelerator mechanism in the case of investments, the pro-cyclical behavior of labor supply or interdependencies between wages, domestic prices and import prices.

In order to get a broad idea of the key equations, single equation responses to shocks are reported in table (2).The shocks typically constitute 10% increases in one of the explanatory variables. The dynamic specifications of the key equations incorporate the long run behaviour as error correction terms. The speed of adjustment in the single equation simulations is strongly determined by the loading factors of the error correction terms in the dynamic specifications which are listed in table (2).

The loading factors of the ECM-terms are typically around 10% implying that in single equation simulations about one third of a disequilibrium are dissolved within the first year. The speed of adjustment is significantly lower in case of investments as the ECM term is formulated with respect to the optimal capital stock which is rather volatile (see figure (3)). In the short run accelerator effects cause an overshooting of investment with respect to output. Higher than average are the loading factors in the export and import equations indicating that changes in demand and competitiveness pass through quickly to trade flows. Effects of changes in the wage rate on employment are only significant in the short run. Since the wage rate does not enter the optimal employment level directly effects are fading out over time in single equation simulations.

5 Estimation of Demand Components

5.1 Private Consumption

Households' consumption behaviour is mainly determined by disposable income and financial wealth. Nominal financial wealth plays a crucial role in determining the stock-flow relations in the AQM. Under the assumption that households own all firms in the economy, it can be shown that a disaggregation of financial wealth into assets of the household sector, the government sector, the corporate sector and the foreign sector is not necessary (see (Willman and Estrada 2002)). Financial wealth of the total economy is identical to financial wealth of the household sector and defined as the sum of the private capital stock (KSN), government debt (GDN) and net foreign assets (NFA):

$$FWN_t = KSN_t + GDN_t + NFA_t \tag{6}$$

Nominal disposable income is given by the sum of compensation to employees (WIN), other personal income (OPN) and transfers received by households (TRN) minus transfers (TPN) and direct taxes (PDN) paid by households:

$$PYN_t = WIN_t + OPN_t + TRN_t - TPN_t - PDN_t \tag{7}$$

Transfers and direct taxes paid by households are assumed to be proportional to nominal GDP during the forecasting horizon. For long run simulations a fiscal rule prevents

Table 2: Single Equation Responses to 10% Shocks of Explanatory Variables

Endogenous variable shocked exogenous variables	Year 1	Year 2	Year 3	Year 5	Year 10	ECM-coefficient
Private consumption						-0.094
Disposable income	2.32	6.00	7.65	8.85	9.22	
Financial wealth	0.05	0.34	0.53	0.67	0.71	
Long term interest rates (+100bp)	-0.05	-0.29	-0.45	-0.57	-0.60	
Investment						-0.051
Output	12.5	15.50	15.00	12.6	10.3	
Wage rate	0.46	1.82	3.10	4.78	6.03	
User cost of capital	-0.45	-1.78	-3.01	-4.56	-5.69	
Exports						-0.226
World demand	8.50	9.39	9.72	9.94	10.00	
Export prices	-3.03	-3.27	-3.45	-3.57	-3.59	
Competitors' prices	3.10	3.36	3.54	3.67	3.70	
Imports						-0.355
Domestic demand	9.70	10.30	10.00	10.00	10.00	
Import prices	-6.03	-8.32	-8.63	-8.69	-8.69	
Oil prices	0.22	0.46	0.50	0.50	0.50	
GDP deflator at factor costs	6.09	8.35	8.67	8.71	8.71	
Employment						-0.112
Output	3.00	5.70	7.90	11.00	14.70	
Wage rate	-1.53	-1.40	-1.10	-0.68	-0.20	
GDP deflator at factor costs						-0.137
Output	0.69	2.64	3.87	5.05	5.64	
Indirect taxes to GDP ratio	0.13	0.57	0.84	1.05	1.19	
Wage rate	4.04	7.12	8.29	9.40	9.96	
Private consumption deflator						-0.117
GDP deflator at factor costs	6.98	7.72	8.17	8.61	8.85	
Import deflator	1.27	1.18	1.12	1.07	1.04	
Investment deflator						-0.412
GDP deflator at factor costs	8.04	8.26	8.29	8.29	8.29	
Import deflator	1.79	1.66	1.59	1.58	1.58	
Import deflator						-0.229
Competitors' prices	3.29	4.91	5.43	5.65	5.67	
GDP deflator at factor costs	1.14	2.85	3.39	3.62	3.63	
Oil prices	0.44	0.44	0.43	0.43	0.43	
Export deflator						-0.127
Competitors' prices	1.67	2.84	3.39	3.86	4.06	
GDP deflator at factor costs	3.35	4.97	5.30	5.58	5.70	
Nominal wage rate						-0.110
Private consumption deflator	0.00	2.57	6.24	9.36	10.00	
Labour productivity	2.95	5.29	7.67	9.61	10.00	
Unemployment rate	-0.02	-0.23	-0.43	-0.58	-0.61	

Table 3: Estimation of Transfers Received in % of GDP

$$TRX_t = C(1) + C(2) \cdot (URX_t) + res_t^{TRX}$$

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	0.224754	0.002003	112.2091	0.0000
C(2)	0.005469	0.000602	9.092174	0.0000
R-squared:	0.502027	Durbin-Watson stat:		0.296245

Table 4: Estimation of Other Personal Income

$$\begin{aligned}\Delta_4 \log(OPN_t) &= C(1) \cdot (1/4) \cdot \sum_{i=1}^{4} (\log(OPN_{t-i}) - \log(GON_{t-i} \\ &-KSN_{t-i} \cdot depr + LTI_{t-i}/400 \cdot 0.23 \cdot FWN_{t-i})) \\ &+C(2) \cdot \Delta_4 \log(GON_t) + res_t^{OPN}\end{aligned}$$

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-0.068575	0.041099	-1.668515	0.0991
C(2)	0.728521	0.105224	6.923521	0.0000
R-squared:	0.193119	Durbin-Watson stat:		0.419010

an unlimited increase of government debt. Transfers received by households (TRX denotes the ratio of transfers received by households to nominal GDP) are a function of the unemployment rate. An increase in the unemployment rate according to the EUROSTAT definition by 1 pp causes additional transfers to households of about 0.5% of nominal GDP (see table 3).

Compensations to employees are determined by wages and employment (see sections 6.1 and 7.2). Growth of other personal income (i.e. gross mixed income and property income) depends in the long run on the gross operating surplus (GON), the depreciation of the capital stock ($KSN \cdot depr$) and wealth income out of liquid assets ($LTI/400 \cdot 0.23 \cdot FWN$).[4] While income effects of interest rate changes are captured in the equation for other personal income, substitution effects are modelled in the long run equation for private consumption (see table 5). The short run dynamics of other personal income are only driven by changes of the the gross operating surplus. As sectoral National Accounts data for other personal income are only available on an annual basis the equation is estimated in annual growth rates (see table 4).

The long run behaviour of private consumption is based on the "concept of permanent income". Given backward looking behaviour by households permanent income can be approximated by current disposable income and wealth. Combining ESA95 with ESA79 data caused major problems in estimating the private consumption equation, so the sample was restricted to 1989Q1 to 2001Q4. This period is characterized by a pronounced decline in the household savings ratio from well above 10% to just above

[4]The share of liquid assets of households in total nominal wealth equals 0.23.

Table 5: Long-run Relationship of Real Private Consumption

$$\begin{aligned}\log(CSTAR_t) = \; & + \; C(1)\cdot\log(PYR_t) \\ & + \; (1-C(1))\cdot 0.23\cdot\log(FWR_t/4) \\ & + \; C(2)\cdot(10/Time) \\ & + \; C(3)\cdot(LTI_t/100)\end{aligned}$$

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	0.925828	0.008394	110.3019	0.0000
C(2)	-0.661674	0.082358	-8.034133	0.0000
C(3)	-0.607803	0.228308	-2.662206	0.0107
R-squared:	0.872928	Durbin-Watson stat:		0.900179

5%. Although the savings ratio is subject to frequent and major revisions, these usually concern only the absolute level and not changes in the savings ratio. The decline can only be partly explained by the rise in the wealth-to-income ratio and probably reflects changes in household habits and preferences. In order to capture this shift in preferences, a negative trend was introduced in the long-run consumption equation.

The bulk of financial wealth are illiquid assets. Liquid assets amount to about one fourth of total assets. Using a weighted average of liquid and illiquid assets yields an adjusted wealth variable which corresponds to one third of the original series. This results in a reasonable asset-to-income ratio of about 2, in line with other international studies (see Muellbauer and Lattimore (1995)). Finally, real interest rates were allowed to enter the long-run specification of the consumption equation capturing substitution effects and liquidity constraints. Estimates of the long-run consumption equation indicate an average household savings ratio of 7.5%. The trend and the interest rates enter the equation with the expected negative coefficients (see table 5 on page 16). Wealth effects appear in the long run equation but are limited in size.

In the dynamic specification for real private consumption the ECM term is significant with a lag of two periods. Furthermore, changes in real disposable income and an autoregressive term serve as explaining variables in the short run. Lagged growth in real private consumption captures consumer habits which offer an explanation for observed "excess smoothness" (see table 6 on page 17).

5.2 Investment

Modelling investment in Austria raised the well-known difficulties encountered elsewhere. Deviations of current from optimal capital stock led to poorly determined coefficients and implausible simulation results, so we used the ratio of the previous period's investment to the optimal capital stock as the ECM term. The optimal capital stock has been estimated separately in the supply block of the model. In the steady state the capital stock and real GDP must grow at the same pace (g_{STAR}) to ensure that the capital to GDP ratio remains constant over time as is typically the case in neoclassical growth models. Given a constant capital to GDP ratio, a constant investment share in GDP and a constant depreciation rate ($depr$), the investment to capital stock ratio converges to a constant which equals the steady state growth rate plus the depreciation

Table 6: Dynamic Specification of Real Private Consumption

$$\begin{aligned}\Delta \log(PCR_t) = &+ C(1)\\ &+ C(2)\cdot(\log(PCR_{t-2}/CSTAR_{t-2}))\\ &+ C(3)\cdot\Delta\log(PYR_{t-1})\\ &+ C(4)\cdot\Delta\log(PCR_{t-1})\\ &+ res_t^{PCR}\end{aligned}$$

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	0.003444	0.000890	3.871969	0.0004
C(2)	-0.094520	0.046460	-2.034435	0.0481
C(3)	0.191638	0.050607	3.786783	0.0005
C(4)	0.263034	0.128457	2.047647	0.0467
R-squared:	0.312365	Durbin-Watson stat:		2.030268

rate of real capital:

$$\frac{ITR_t}{KSTAR_{t-1}} = g_{STAR} + depr.$$

This ratio is used to determine the long run behaviour of investment. Since the interest rate has a strong influence on the optimal capital stock via the user cost of capital, the investment equation represents the main transmission channel of monetary policy in the model. Cost factors have a direct influence in the ECM term but are not relevant in the short-run dynamics, which are dominated by accelerator effects represented by an autoregressive term and a coefficient on real output growth that is larger than one.

5.3 Foreign Trade

In the equations for real exports and real imports, market shares with respect to foreign (WDR) and domestic demand (WER) are used as dependent variables in the long run. Specifically, real exports are modelled with unit elasticity to demand on markets for Austrian exports. In turn, these export market shares are explained by a price-competitiveness indicator and a time trend (see table 10 on pages 19). Competitiveness is measured by the ratio of Austrian export prices to competitors' prices. This indicator has the expected negative impact on market shares. The trend term contributes about 0.2 percentage points to real export growth, reflecting rapidly increasing trade links.

Import demand was modelled by aggregating real GDP components weighted by their respective import content as appears in the current input-output table.

$$WER_t = 0.197\cdot PCR_t + 0.01\cdot GCR_t + 0.298\cdot ITR_t + 0.477\cdot SCR_t + 0.536\cdot XTR_t$$

In the long run, imports depend negatively on a competitiveness variable defined as the ratio of import prices to the deflator of GDP at factor cost. Due to the relatively high weight of exports in the domestic demand indicator, the impact of intensified trade links is better captured than in the export equation. Nevertheless, a time trend starting in 1997 had to be introduced to capture the recent surge in trade volumes. Moreover the special role of oil prices had to be considered. Real imports are very inelastic with respect to oil prices. To control for this fact the effect of the price competitiveness variable on real imports was corrected for oil prices. Otherwise oil price simulations

Table 7: Dynamic Specification of Real Gross Investment

$$\begin{aligned}\Delta\log(ITR_t) = {} & C(1)\\ & +C(2)\cdot\log(ITR_{t-1}/KSTAR_{t-1})\\ & +C(3)\cdot\Delta\log(YER_t)\\ & +C(4)\cdot\Delta\log(ITR_{t-2})\\ & +C(5)\cdot\Delta\log(ITR_{t-3})\\ & +C(6)\cdot D_{861}+C(7)\cdot D_{862}\\ & +C(8)\cdot D_{871}+C(9)\cdot D_{872}\\ & +res_t^{ITR}\end{aligned}$$

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-0.070303	0.026513	-2.651644	0.0098
C(2)	-0.051604	0.020203	-2.554283	0.0127
C(3)	1.110107	0.251406	4.415586	0.0000
C(4)	0.117159	0.070883	1.652843	0.1026
C(5)	0.243847	0.075193	3.242926	0.0018
C(6)	-0.077009	0.016993	-4.531723	0.0000
C(7)	0.045352	0.017221	2.633457	0.0103
C(8)	-0.122070	0.017905	-6.817496	0.0000
C(9)	0.098917	0.017472	5.661302	0.0000
R-squared:	0.687612	Durbin-Watson stat:		2.080469

would produce the perverse result that an increase in oil prices improves the price competitiveness of the Austrian import-competing sector leading to an increase in real GDP (see table 8 on page 19).

In the dynamic specifications of real imports and exports both error-correction terms are significant with rapid adjustment of 35% and 17% respectively. Changes in demand and competitiveness variables are also relevant in the short run. In the equation for real exports, a negative autoregressive term reflects the high volatility present in the data (see tables 9 and 11).

5.4 Stocks

The inventories equation is derived from a theoretical framework developed by Holt, Modigliani, Muth, and Simon (1960) based on a cost function that includes linear and quadratic costs of production and holding inventories. Pro- or counter-cyclical inventory behaviour, depends on the relative costs of adjusting production and of holding inventories (stockout or backlog costs).

The desired long-run level of inventories (LSSTAR) is entirely determined by the normal level of production (YNR), disregarding any such cost factors, which only enter the dynamic specification. The normal or desired level of production is given by the estimated production function with the current levels of capital and employment as input factors. As reflected in the parameters of the long-run relationship, the ratio of inventories to output shows a declining trend over the nineties.

In the short run, cost factors and the economic cycle play an important role. Opportunity costs of holding inventories are approximated by the product of the normal level of production and the real interest rate ($REALI$). The real interest rate is defined as

Table 8: Long-run Relationship of Real Imports

$$\begin{aligned}\log(MSTAR_t) \;=\;& C(1) + \log(WER_t) \\ & +C(2)\cdot[(1/(1+C(3)))\cdot(\log(MTD_t) \\ & \quad +C(3)\cdot\log(POILU_t) - \log(YFD_t))] \\ & +C(4)\cdot TR971\end{aligned}$$

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-0.237770	0.047748	-4.979644	0.0000
C(2)	-0.888146	0.134797	-6.588753	0.0000
C(3)	-0.055182	0.018623	-2.963096	0.0041
C(4)	0.001202	8.76E-05	13.71960	0.0000
R-squared:	0.990162	Durbin-Watson stat:		1.399563

Table 9: Dynamic Specification of Real Imports

$$\begin{aligned}\Delta\log(MTR_t) \;=\;& C(1)\cdot\log(MTR_{t-1}/MSTAR_{t-1}) \\ & +C(2)\cdot\Delta\log(WER) \\ & +(1-C(2))\cdot\Delta\log(WER_{t-2}) \\ & +C(3)\cdot\Delta\log(MTD_t/YFD_t) \\ & +res_t^{MTR}\end{aligned}$$

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-0.351035	0.105569	-3.325150	0.0021
C(2)	0.809069	0.143118	5.653138	0.0000
C(3)	-0.374019	0.343955	-1.087408	0.2843
R-squared:	0.546213	Durbin-Watson stat:		1.839300

Table 10: Long-run Relationship of Real Exports

$$\begin{aligned}\log(XSTAR_t) \;=\;& C(1) \\ & +\log(WDR_t) \\ & +C(2)\cdot TREND \\ & +C(3)\cdot\log(XTD_t/CXD_t)\end{aligned}$$

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	8.685912	0.176453	49.22506	0.0000
C(2)	0.002383	0.000383	6.219390	0.0000
C(3)	-0.382664	0.065612	-5.832198	0.0000
R-squared:	0.988159	Durbin-Watson stat:		0.465805

Table 11: Dynamic Specification of Real Exports

$$\begin{aligned}\Delta \log(XTR_t) = \; & C(1) \cdot \log(XTR_{t-1}/XSTAR_{t-1}) \\ & + C(2) \cdot \Delta \log(WDR_t) \\ & + (1 - C(2)) \cdot \Delta \log(WDR_{t-1}) \\ & + C(3) \cdot \Delta \log(XTD_t/CXD_t) \\ & + C(4) \cdot \Delta \log(XTR_{t-1}) \\ & + res_t^{XTR}\end{aligned}$$

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-0.177244	0.075987	-2.332548	0.0230
C(2)	0.759752	0.123693	6.142254	0.0000
C(3)	-0.374163	0.097573	-3.834692	0.0003
C(4)	-0.281413	0.089575	-3.141666	0.0026
R-squared:	0.501759	Durbin-Watson stat:		2.054105

Table 12: Long-run Relationship of Real Stocks

$$\log(LSSTAR_r) = C(1) + C(2) \cdot \log(YNR_t)$$

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	2.871705	0.165589	17.34240	0.0000
C(2)	0.708023	0.015780	44.86771	0.0000
R-squared:	0.959030	Durbin-Watson stat:		0.107677

the average of real short-term and long-term interest rates. Differences between year-on-year changes in sales and year-on-year changes in normal output reflect the business cycle, since during an economic upswing growth of sales within the last year will exceed growth of normal output, while the reverse holds in recessions. Since we lack accurate data for sales on a quarterly basis the sum of real private consumption and real exports was used as a proxy. The positive coefficient found for this variable indicates that inventories behave procyclically in Austria. More inventories imply higher holding costs but reduce the probability of stockout or backlog costs. The level of inventories that equalizes this counteracting cost increases with economic activity, causing a simple accelerator effect.

6 Estimation of Labour Market Equations

6.1 Employment

The equilibrium level of employment depends solely on the supply side and is obtained by inverting the production function. The corresponding ECM term has the expected negative coefficient. In the short run, demand and cost factors have an impact on employment growth. The pro-cyclical response of employment to output fluctuations

Table 13: Dynamic Specification of Real Stocks

$$
\begin{aligned}
\Delta(SCR)_t \quad = \quad & C(1) \cdot (LSR_{t-1} - LSSTAR_{t-1}) \\
+ \quad & C(2) \cdot [(SALE_{t-1} - SALE_{t-5}) \\
& - C(3) \cdot (YNR_{t-1} - YNR_{t-5})] \\
+ \quad & C(4) \cdot REALI_t \cdot YNR_t \\
+ \quad & C(5) \cdot D004\_1 \\
+ \quad & res_t^{SCR}
\end{aligned}
$$

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-0.040781	0.008828	-4.619766	0.0000
C(2)	0.019012	0.006075	3.129633	0.0029
C(3)	0.804039	0.542437	1.482271	0.1445
C(4)	-0.000164	7.33E-05	-2.243936	0.0293
C(5)	-961.4468	30.51439	-31.50798	0.0000
R-squared:	0.956520	Durbin-Watson stat:		2.613117

is captured by contemporaneous GDP growth. Wages in Austria are typically set in a highly centralized bargaining process. Given the resulting real wage, firms choose the desired level of employment. Increases in real wages in the last two quarters lead to a lower employment level.

6.2 Labour Force

In the long run, the labour force follows demographic developments and is given exogenously by $LFNSTAR$. In the short run, cyclical fluctuations in output lead to variations in employment but also trigger responses in labour supply. The effect of output variations on the unemployment rate is cushioned by a pro-cyclical reaction of the labour force - a pattern which was especially clear in past Austrian data. The second important short run determinant in the labour supply equation is real wage growth. As real wages in Austria are known to be very flexible, they tend to reinforce the pro-cyclical behavior of labour supply.

7 Estimation of Price Equations

The long run properties of the price block are jointly determined by two key variables, the GDP deflator at factor costs and the nominal wage rate dealt with in section 7.1 and 7.2, respectively. In addition, external price developments are captured by the import price deflator. (see section 7.5). Other domestic price deflators like the private consumption deflator and the investment deflator feature a long-run unit elasticity with respect to these key variables. This assumption of static homogeneity implies that the corresponding error correction terms are modelled in terms of relative prices.

7.1 GDP-Deflator at Factor Costs

The long-run behaviour of the GDP deflator at factor costs is given by the supply block, with the corresponding error-correction term - formulated as a moving average over the

Table 14: Dynamic Specification of Labour Demand

$$\begin{aligned}\Delta\log(LNN_t^{FE}) \quad = \quad & C(1)\cdot\log(LNN_{t-1}^{FE}/LSTAR_{t-1}) \\ + \quad & C(2)\cdot\textstyle\sum_{i=0}^{1}\Delta\log(WUN_{t-i}^{FE}/YFD_{t-i}) \\ + \quad & C(3)\cdot\Delta\log YER_t \\ + \quad & C(4)\cdot D_{911} \\ + \quad & res_t^{YFD}\end{aligned}$$

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-0.112493	0.039393	-2.855634	0.0055
C(2)	-0.206512	0.065522	-3.151784	0.0023
C(3)	0.202497	0.040791	4.964290	0.0000
C(4)	0.009164	0.002785	3.290788	0.0015
R-squared:	0.318476	Durbin-Watson stat:		1.549794

Table 15: Dynamic Specification of labour supply

$$\begin{aligned}\Delta\log(LFN_t) \quad = \quad & -0.025\cdot\log(LFN_{t-1}/LFNSTAR_{t-1}) \\ & +C(1)\cdot\Delta\log(WUN_{t-1}/PCD_{t-1}) \\ & +C(2)\cdot\Delta\log LNN_t\end{aligned}$$

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	0.079683	0.023976	3.323473	0.0014
C(3)	0.711938	0.056323	12.64033	0.0000
R-squared:	0.710998	Durbin-Watson stat:		1.321416

past two periods - entering the dynamic specification significantly. The ECM-coefficient implies an adjustment to the equilibrium of 14% per period. In the short run, wages, the second key domestic price component, play a prominent role. In order to rule out explosive wage-price spirals in simulation exercises, nominal wage growth enters with a one quarter lag. This also reduces the effect of wages on prices. Since Austria is a small open economy, prices should also depend strongly on foreign developments. Foreign competitors' prices were not included in the static steady-state solution of the supply block but enter through import price inflation. The estimated coefficient of 0.10 seems rather low, but import prices tend to be more volatile than domestic prices, reflecting the high volatility of exchange rates and commodity prices.

Table 16: Dynamic Specification of the GDP-Deflator at Factor Costs

$$
\begin{aligned}
\Delta \log(YFD_t) \quad = \quad & C(1) \cdot \frac{1}{2} \cdot \sum_{i=1}^{2} \log(YFD_{t-i}/YDSTAR_{t-i}) \\
+ \quad & C(2) \cdot \Delta \log(MTD_t) \\
+ \quad & C(3) \cdot \Delta \log(WUN^{FE}_{t-1}) \\
+ \quad & C(4) \cdot D_{841} \\
+ \quad & C(5) \cdot D_{924} \\
+ \quad & C(6) \cdot D_{952} \\
+ \quad & res\_YFD_t
\end{aligned}
$$

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-0.137458	0.046980	-2.925868	0.0045
C(2)	0.101125	0.040117	2.520774	0.0137
C(3)	0.407432	0.044078	9.243519	0.0000
C(4)	0.021604	0.005602	3.856311	0.0002
C(5)	0.022381	0.005800	3.858447	0.0002
C(6)	0.020227	0.005639	3.586923	0.0006
R-squared:	0.565859	Durbin-Watson stat:		2.334825

7.2 The Nominal Wage Rate

In the AQM, the nominal wage rate is approximated by average compensation per employee as recorded in National Accounts data. These quarterly data are adjusted to full-time equivalents using interpolated annual data. During the sample period, the income share of labour dropped from almost 68% in 1980 to slightly less than 60% in 2000 (see figure 5 on page 24). The rebound in 2001 mainly reflects cyclical factors in the course of the recent economic slowdown. This is inconsistent with the assumption of a constant-returns-to-scale Cobb-Douglas production function underlying the supply side of the AQM which implies constant factor income shares in equilibrium equal to the output elasticities. We therefore included a trend in the long-run wage equation starting in 1988Q1 (see table 17 on page 24).

In the dynamic specification, nominal wages adjust only slowly to the long-run equilibrium, reflecting adjustment costs and bargaining (see table 18 on pages 25). The short-run dynamics are characterized by a Phillips curve linking wage growth to the deviation of the unemployment rate from a constant NAWRU which is exogenous to

Figure 5: Wage Share in Austria

Table 17: Long-run Relationship of Wages

$$\log(WSTAR_t) = \log(PCD) + \log((1-\beta)\cdot YER/LNNFE) + C(1)\cdot TR881 + C(2)\cdot D951$$

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-0.001735	7.36E-05	-23.56229	0.0000
C(2)	0.039370	0.018052	2.180900	0.0319
R-squared:	0.772205	Durbin-Watson stat:		0.214611

the model. However, the long-run Phillips curve is vertical. Productivity determines not only the equilibrium level of the wage rate but enter also the dynamic specification significantly. The contemporaneous inflation rate measured by the GDP deflator at factor costs is highly correlated with nominal wage growth leading to a rigid behaviour of real wages in simulation exercises. [5] We therefore decided to use only lagged inflation as this better reflects the high real wage flexibility characteristic of the centralized wage setting process in Austria.

[5] The high correlation between inflation and nominal wage growth is mainly driven by the period 1988 to 1995. As there is no economic reason why wage setting in this period should have been markedly different we interpret this mainly as a data problem.

Table 18: Dynamic Specification of Wages

$$\begin{aligned}\Delta\log(WUNFE_t) = {} & C(1)\\ & +C(2)\cdot\log(WUNFE_{t-4}/WSTAR_{t-4}\\ & +C(3)\cdot\tfrac{1}{3}\cdot\sum_{i=2}^{4}\log(URX_{t-i})\\ & +C(4)\cdot\tfrac{1}{2}\cdot\sum_{i=2}^{3}\Delta\log(YFD_{t-i})\\ & +C(5)\cdot\tfrac{1}{2}\cdot\sum_{i=0}^{1}\Delta\log(PROFE_{t-i})\\ & +C(6)\cdot D824+C(7)\cdot D924\\ & +C(8)\cdot D951+res_t^{WUNFE}\end{aligned}$$

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-0.021766	0.010780	-2.019104	0.0472
C(2)	-0.110036	0.050954	-2.159529	0.0341
C(3)	-0.007792	0.003133	-2.487079	0.0152
C(4)	0.397905	0.143749	2.768054	0.0072
C(5)	0.343437	0.200025	1.716969	0.0903
C(6)	0.018240	0.007941	2.297045	0.0245
C(7)	0.036907	0.007797	4.733148	0.0000
C(8)	0.032253	0.007854	4.106655	0.0001
R-squared:	0.496887	Durbin-Watson stat:		2.063025

7.3 Private Consumption Deflator

Within the model, we distinguish between two consumer prices: the private consumption deflator found in National Accounts data and the HICP published by Eurostat. The HICP is not modelled directly but via its two subcomponents, HICP-energy and HICP-excluding-energy, with the more volatile energy component carrying a weight of less than 10% on average in overall HICP. HICP inflation does not feed back onto other variables in the model. On the other hand, the private consumption deflator is a central variable with strong feedbacks especially via real wages and real wealth. In the long run, the private consumption deflator depends on the GDP deflator at factor costs, with static homogeneity imposed. In the short run, the private consumption deflator is affected by changes in the GDP deflator at factor costs, in the import deflator, and in nominal wages after correcting for productivity. External price pressures are captured by the difference between the import deflator and the GDP deflator at factor cost. The HICP excluding energy turned out to be very difficult to model, with equations featuring poor statistical properties and generating implausible simulation results. Therefore we decided to let the HICP excluding energy move one-to-one with the GDP deflator at factor costs. On the other hand, the HICP energy subcomponent depends mainly on oil prices.

7.4 Private Investment Deflator

Deflators for private and public investment are modelled separately. For the private investment deflator we impose a long-run unit elasticity with respect to the GDP deflator at factor costs and the import deflator. This reflects the higher import content

Table 19: Estimation of Private Consumption Deflator

$$\begin{aligned} \Delta\log(PCD_t) = & \; C(1) \\ & + C(2)\cdot\log(PCD_{t-1}/YFD_{t-1}) \\ & + C(3)\cdot\Delta\log(YFD_t) \\ & + C(4)\cdot\Delta\log(MTD_t) \\ & + C(5)\cdot\log(MTD_t/YFD_t) \\ & + C(6)\cdot\Delta\log(WUN^{FE}_{t-1}/PRO^{FE}_{t-1}) \\ & + res\_PCD_t \end{aligned}$$

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	0.001542	0.000794	1.941635	0.0562
C(2)	-0.117086	0.050117	-2.336260	0.0223
C(3)	0.684736	0.065458	10.46064	0.0000
C(4)	0.124102	0.033286	3.728411	0.0004
C(5)	0.012702	0.006309	2.013422	0.0479
C(6)	0.082176	0.039792	2.065144	0.0426
R-squared:	0.789004	Durbin-Watson stat:		2.219394

Table 20: Estimation of HICP Subcomponent Energy

$$\begin{aligned} \Delta\log(HEG_t) = & \; C(1) \\ & + C(2)\cdot\Delta\log(POIL_t) \\ & + C(3)\cdot\log(HEG_{t-1}/YED_{t-1}) \\ & + C(4)\cdot\log(POIL_{t-1}/YED_{t-1}) \\ & + res\_HEG_t \end{aligned}$$

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	0.348422	0.141734	2.458288	0.0171
C(2)	0.085448	0.015833	5.396854	0.0000
C(3)	-0.090897	0.032707	-2.779157	0.0074
C(4)	0.025025	0.009720	2.574616	0.0128
R-squared:	0.407030	Durbin-Watson stat:		2.217577

Table 21: Estimation of Private Investment Deflator

$$
\begin{aligned}
\Delta \log(OID_t) = \; & C(1) \cdot \log(MTD_{t-1}/XTD_{t-1}) \\
+ \; & C(2) \cdot [\log(OID_{t-1}) \\
& -C(3) \cdot \log(YFD_{t-1}) \\
& + (1 - C(3)) \cdot \log(MTD_{t-1})] \\
+ \; & C(4) \cdot \Delta \log(MTD_t) \\
+ \; & C(5) \cdot \Delta \log(YFD_t) \\
+ \; & C(6) \cdot D861\_2 \\
+ \; & C(7) \cdot D871\_2 \\
+ \; & res\_OID_t
\end{aligned}
$$

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	0.109373	0.059783	1.829497	0.0713
C(2)	-0.412114	0.098188	-4.197205	0.0001
C(3)	0.835710	0.015924	52.48260	0.0000
C(4)	0.106517	0.058399	1.823950	0.0721
C(5)	0.790375	0.114509	6.902321	0.0000
C(6)	0.036109	0.006189	5.834523	0.0000
C(7)	0.026018	0.005781	4.500429	0.0000
R-squared:	0.722189	Durbin-Watson stat:		2.275062

of this GDP component compared to private consumption. Changes in import prices and the GDP deflator at factor costs are also relevant in the short run. In addition, a deterioration of the terms of trade has a positive impact on the private investment deflator: an increase in import prices relative to export prices tends to increase the price pressure on investment goods. Data for the government investment deflator are only available on an annual basis. The interpolated time series has much less variation than other quarterly series, rendering estimation difficult. Therefore the government investment deflator depends solely on the GDP deflator at factor costs both in the short run and in the long run.

7.5 Import and Export Price Deflator

The export and import deflators follow competitors' export and import prices in the long run. Competitors' import prices (CMD) arecalculated as the sum of our trade partners' export prices weighted by their import shares; competitors' export prices (CXD) are a double weighted sum of the export prices of countries also exporting on Austrian export markets. The first weight is the export share of a competing country on a specific export market. The second weight is the share of that market in total Austrian exports. In modelling the steady-state import deflator, static homogeneity was imposed with respect to competitors' import prices, the GDP deflator at factor costs and oil prices. In an unrestricted version, the coefficient on the competitors' import prices was too low, leading to an unreasonably slow transmission of external price pressures to import prices. The steady-state export deflator depends on competitors' export prices and the GDP deflator at factor costs. Both ECM terms are significant in the dynamic specifications. The short-run dynamics are determined by the growth rates of the same variables that define the steady state.

Table 22: Long-run Relationship of Import Prices

$$
\begin{aligned}
\log(MDSTAR_t) = \quad & C(1) \\
+ \quad & C(2) \cdot \log(CMD_t) \\
+ \quad & C(3) \cdot \log(YFD_t) \\
+ \quad & (1 - C(2) - C(3)) \cdot \log(POILU_t) \\
+ \quad & C(4) D971P
\end{aligned}
$$

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-1.483100	0.052483	-28.25889	0.0000
C(2)	0.579128	0.031427	18.42758	0.0000
C(3)	0.375414	0.022635	16.58527	0.0000
C(4)	-0.046739	0.005866	-7.967807	0.0000
R-squared:	0.945749	Durbin-Watson stat:		0.601633

Table 23: Dynamic Specification of Import Prices

$$
\begin{aligned}
\Delta \log(MTD_t) \quad = \quad + \quad & C(1) \cdot \log(MTD_{t-1}/MDSTAR_{t-1}) \\
+ \quad & C(2) \cdot \Delta \log(POILU_t) \\
+ \quad & C(3) \cdot \Delta \log(CMD_{t-1}) \\
+ \quad & C(4) \cdot D821 \\
+ \quad & C(5) \cdot D804 \\
+ \quad & res_t^{MTD}
\end{aligned}
$$

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-0.229327	0.062757	-3.654215	0.0005
C(2)	0.039112	0.013262	2.949068	0.0042
C(3)	0.223719	0.072768	3.074421	0.0029
C(4)	0.059505	0.012657	4.701484	0.0000
C(5)	-0.034880	0.012762	-2.733048	0.0077
R-squared:	0.394654	Durbin-Watson stat:)		1.813696

Table 24: Long-run Relationship of Export Prices

$$\log(XDSTAR_t) = C(1) + C(2)\cdot\log(CXD_t) + (1-C(2))\cdot\log(YFD_t) + C(3)\cdot D971P$$

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-0.973916	0.032571	-29.90154	0.0000
C(2)	0.418123	0.012278	34.05494	0.0000
C(3)	-0.056948	0.006381	-8.924267	0.0000
R-squared:	0.957776	Durbin-Watson stat:		0.436232

Table 25: Dynamic Specification of Export Prices

$$\begin{aligned}\Delta\log(XTD_t) = &+ C(1)\cdot\log(XTD_{t-1}/XDSTAR_{t-1})\\ &+ C(2)\cdot\tfrac{1}{2}\sum_{i=0}^{1}\Delta\log(CXD_{t-i})\\ &+ C(3)\cdot\Delta\log(YFD_{t-i})\\ &+ C(4)\cdot D844\\ &+ C(5)\cdot D851\\ &+ C(6)\cdot D881\\ &+ res_t^{XTD}\end{aligned}$$

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-0.127327	0.054143	-2.351679	0.0212
C(2)	0.121622	0.045425	2.677435	0.0091
C(3)	0.367228	0.088094	4.168590	0.0001
C(4)	-0.025859	0.009279	-2.786915	0.0067
C(5)	0.047503	0.009776	4.859121	0.0000
C(6)	0.029149	0.008986	3.243953	0.0017
R-squared:	0.473967	Durbin-Watson stat:)		2.173595

8 The Long Run of the Model

8.1 The Theoretical Steady State

Assuming that factor markets are competitive and taking the Cobb-Douglas function in equation (3) as a starting point, the following relations must hold in the long run:

$$\beta \cdot YER/KSR \quad = \quad (\delta + r + RP) \tag{8}$$

$$(1-\beta) \cdot YER/LNN^{FE} \quad = \quad WUN^{FE}/YFD \tag{9}$$

The marginal product of capital must equal the sum of the depreciation rate (δ), the real interest rate (r), and the risk premium (RP). The marginal product of labour should grow in line with the real wage rate. In equations (8) and (9) the output-capital and the output-labour ratio are determined by factor input costs. Rearranging the production function yields an expression for employment growth:

$$LNN^{FE} \quad = \quad \left(YER \cdot KSR^{\beta} \cdot TFT\right)^{1/(1-\beta)} \tag{10}$$

The steady state growth of labour force ($LFNSTAR$), trend total factor productivity (TFT), and the natural unemployment rate (URT) are set exogenously. The trend labour supply (LNT) follows from the relation

$$LNT \quad = \quad LFNSTAR \cdot (1 - URT)) \tag{11}$$

The steady state level of output follows from equations (8), (10) and (11):

$$YSTAR \quad = \quad TFT^{1/(1-\beta)} \left(\beta/(r + \delta + RP)\right)^{\beta/(1-\beta)} LNT \tag{12}$$

Equation (12) refers to the steady state output, which is reached when the capital stock has converged to the steady state level. The potential output (YET) which is used in the model to calculate the output gap is defined in terms of the actual capital stock instead and can be understood as a medium term concept:

$$YET_t \quad = \quad TFT_t \cdot KSR_t^{\beta} \cdot LNT_t^{1-\beta} \tag{13}$$

Equations (8), (9), (10) and (13) define together with the condition that the unemployment rate equals the natural rate the steady state. Condition (8) is implemented in the error correction term of the investment equation (see table 7, p. 18), condition (10) in the error correction term of the equation for labour demand (see 14, p. 22) and condition (9) in the error correction terms of the wage equation (see table 18, p. 25) and the price equation (see table 16, p. 23). Finally the condition that the unemployment rate must equal the natural rate of unemployment enters the wage equation in terms of the Philips curve. These four conditions ensure that output in the long run is given by the supply side of the model.

Finally the condition that demand equals supply must be fulfilled. Actual output which in the short run is determined by the sum of the demand components enters the supply side of the model in equations ((3)) to ((5)) and bridges the gap between actual and potential output. In the long run the components of aggregate demand must sum to the steady state level of output:

$$YSTAR \quad = \quad PCR + GCR + ITR + XTR - MTR + SCR \tag{14}$$

Which mechanism ensures that (14) holds in the long run? As explained in Fagan, Henry, and Mestre (2001) the equality between supply and demand is achieved by a stock flow interaction which determines the equilibrium level of the real effective exchange rate. To see this, notice that in the long run investment is determined by the supply side, that the ratio of inventories to GDP is constant and that government consumption is given exogenously. The remaining two demand components, net exports and private consumption, are linked via the real exchange rate. Net foreign assets, defined as cumulated trade balances, enter the equation for private consumption as an integral part of wealth of households. Consistency between private consumption and net exports that ensures that equation (14) holds yields an equlibrium condition for the real effective exchange rate.

8.2 Necessary Conditions for Convergence and the Characteristics of the Steady State

In order to ensure that the model converges to its long run equilibrium a monetary and fiscal policy rule have to be included. Regarding monetary policy, keeping nominal interest rates exogenous and constant in simulation exercises either produces cyclical patterns or non-convergence to the steady state. We therefore introduced a Taylor rule with an inflation target (π^*) of two percent. Moreover it is assumed that the central bank keeps the nominal interest rate permanently below the equilibrium growth rate of nominal GDP (see Boissay and Villetelle (2004)).

$$\begin{aligned} STI &= (400 \cdot (\Delta \log(YSTAR) + \Delta \log(YDSTAR)) - 1) \\ &\quad +1.5 \cdot (\pi - \pi^*) + 0.5 \cdot YGAP \end{aligned} \tag{15}$$

Keeping nominal interest rates below the nominal growth rate of the economy rules out explosive debt paths as the debt burden grows slower than the economy. Regarding the public sector, we used a fiscal closure rule that limits growth in public debt. We calibrated the public debt to GDP ratio to be equal to 50 percent. Any deviation from this ratio triggers an adequate adjustment of the direct tax rate of households. As can be seen in section (8.3) the fiscal rule causes a slight cyclical pattern in the adjustment to the steady state.

To construct a steady state balanced growth path the AQM was simulated for 500 years. As outlined above potential output in the AQM follows a medium term concept and the output gap mirrors deviations of the unemployment rate from the NAIRU. To guarantee that the output gap actually closes and the unemployment rate reaches the NAIRU in the steady state, dynamic homogeneity had to be imposed on the price, wage, labour demand and labour supply equations. Otherwise the long run solution would depend on arbitrary constants and the unemployment rate could deviate from the exogenous NAIRU. Consequently also the output gap would not close.[6]

[6] An equation fulfills the condition of dynamic homogeneity if the sum of the coefficients of the explanatory variables/terms weighted by their steady state growth rates plus the constant equals the steady state growth rate of the dependent variable. Usually this implies a constraint on the constant in the estimation. Dynamic homogeneity is only imposed throughout section (8) to derive a theoretical consistent steady state baseline. For forecasting and short to medium term simulations typically the unconstrained version of the AQM as presented in the remaining sections is used.

In simulation exercises with the AQM it turned out that price elasticities in the trade block and the coefficient of the Philips curve in the wage equation are crucial for assuring convergence towards the steady state. Regarding the trade block we found that the transition to the steady state is typically much smoother and faster when the Marshall Lerner condition is satisfied, i.e. if the sum of the absolute values of the price elasticities in the static real import and export equations is larger than one. This result is not surprising. In the long run the equilibrium is determined by supply factors and prices adjust fully. Real variables converge to their steady state values as they respond to relative price changes. The adjustment of trade variables to price changes is one main mechanism that supports the convergence towards the steady state. Furthermore, if the Philips curve coefficient in the wage equation is too high the model typically produces cycles in simulation exercises which can be explosive. A small coefficient on the other hand leads to long adjustment periods to the new equilibrium and unreasonable simulation results in the short run. [7] [8] Furthermore assumptions for the exogenous foreign variables have to be made to construct a steady state baseline. For the sake of simplicity it is assumed that the rest of the world grows at the same pace as the home economy and that real interest rates are equal. Relaxing these assumptions would make an endogenous risk premium in the exchange rate equation necessary in order to rule out an explosive path for net foreign assets. Finally, we let all residuals return to zero by using an autoregressive process of order one with an coefficient of 0.2. This constitutes a major shock to the economy and triggers an adjustment process to the steady state equilibrium.

In the steady state real variables grow by the sum of technological progress γ and growth in labour supply n, both given exogenously. The domestic inflation rate π is determined by foreign inflation π^f. As the steady state unemployment rate equals the NAIRU employment growth is equal to labour supply growth (n). Under the conditions outlined above the AQM converges to its long run equilibrium. This steady state can be described by the following important economic ratios. The GDP shares of exports and imports rise to more than 60 percent, the GDP share of investment to 25 percent. The size of these shares crucially depend on price elasticities and the real interest rate, respectively. The output gap closes and the unemployment rate is equal to the NAIRU.

The ratio of investment to the capital stock is determined by the depreciation rate (see section 5.2) and equal to 7.6 percent. The capital stock to GDP and wealth (defined as the sum of physical capital, net foreign assets and public debt) to GDP ratios are equal 322 and 372 percent, respectively. Government debt is calibrated to 50 percent of GDP. Giving a growth rate of nominal GDP of 0.0678 percent per quarter, net lending of the public sector in percent of GDP must equal 2.113. The trade balance and the current account in percent of GDP are close to zero. The latest result is not a necessary condition for convergence but evolved by chance.

Finally in the steady state the wage share (excluding self employed incomes) rises

[7] For the steady state baseline and the long run simulations a modified equation for the GDP deflator at factor costs was used in order to ensure that the output gap closes. Similar to the wage equation, the first order condition of the profit maximizing representative firm with respect to labour directly acts as the ECM-term instead of the one derived in section 3. This ECM-term in the equation for the GDP deflator at factor costs assures that the first-order-labour-demand condition holds, while the Philips curve in the wage equation assures that the unemployment rate converges to the NAIRU. By using this modified specification the long run properties of the model become better apparent, but since the short run dynamics are less satisfying this specification will only be used in section (8).

[8] For long run simulations the Philips curve coefficient had to be calibrated. Its value of -0.001 is significantly lower than the estimated value and implies that a 1 percentage points deviation of the unemployment rate from the NAIRU triggers an adjustment of the wage rate of 0.1 percentage points per period.

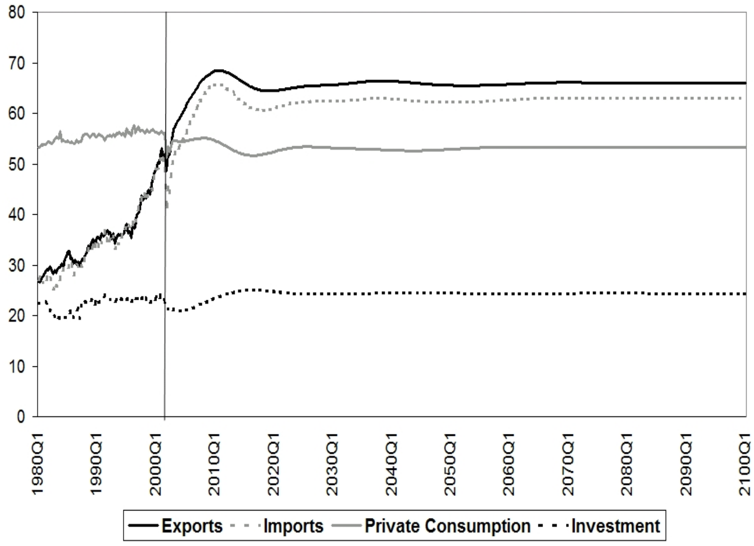

Figure 6: GDP Shares in the Long-run (in %)

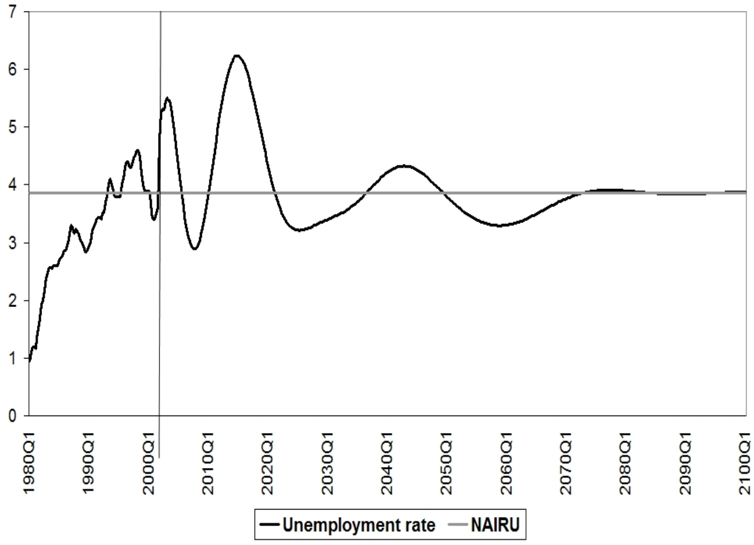

Figure 7: Unemployment Rate in the Long-run (in %)

Table 26: GDP Ratios in the Steady State (in %) I

	ITR/YER	PCR/YER	XTR/YER	MTR/YER	GCR/YER
1982-2001	22.3	55.6	36.7	35.8	20.3
2001Q3	22.6	56.1	52.0	50.3	19.0
steady state	24.4	53.4	66.2	63.3	19.0

Table 27: GDP Ratios in the steady state (in %) II

	(4·ITR)/ KSR	KSR/ (4·YER)	FWR/ (4·YER)	GLN/ YEN	GDN/ (4·YEN)	NFA/ (4·YEN)	BTN/ YEN	CAN/ YEN
1982-2001	6.5	347.7	407.9	-3.1	58.1	-7.86	-0.48	-1.95
2001Q3	6.6	340.4	399.5	0.3	66.2	-26.14	-0.19	-2.17
steady state	7.6	321.9	372.2	-2.1	50.0	0.53	0.00	0.022

to 57% as the effect of the ad hoc trend, introduced in the wage equation to capture the decline in the wage shares in the 1980ies and 1990ies, fades out. The share of transfers is determined by the evolution of the unemployment rate, the share of direct taxes by the fiscal rule. Overall, most economic ratios are remarkably stable.

8.3 Long Run Simulations

The best way to illustrate the long run properties of a model is via simulation results. We therefore present two exemplary simulations: a foreign price shock (i.e. prices outside of Austria) and a labour supply shock. The foreign price shocks shows the neutrality of the model with respect to the price level and the labour supply shock demonstrates how a disequilibrium on the labour market is resolved. In all simulations interest rates are set according to the Taylor rule specified in section (8.2) while the fiscal policy rule is not activated. The Simulations are run around the steady state baseline described in section 8.2.

8.3.1 Foreign Price Shock

All foreign prices outside Austria, i.e. competitors prices on the import and the export side and oil and non-oil commodity prices, are permanently increased by 1%. Due to

Table 28: GDP Ratios in the Steady State (in %) III

	WIN/ YEN	OPN/ YEN	TRN/ YEN	TPN/ YEN	TIN/ YEN	PDN/ YEN	ODN/ YEN
1982-2001	54.1	18.2	24.3	21.7	10.9	10.8	9.1
2001Q3	52.9	18.2	24.0	22.3	10.3	12.0	10.7
steady state	56.9	18.0	24.5	22.0	10.5	10.9	7.8

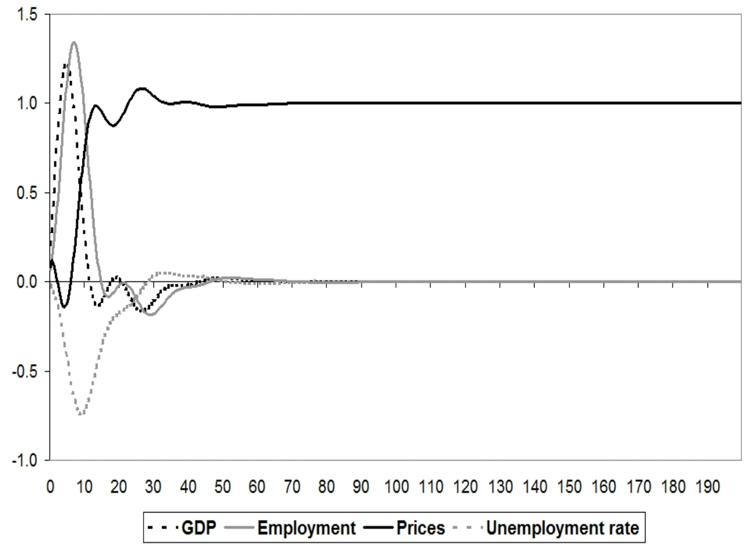

Figure 8: Permanent Increase of Foreign Prices by 1 Percent (deviations from the baseline level in percentage points)

rigidities on goods and labour markets domestic agents do not immediately adjust to the new equilibrium price level. Thus the international price competitiveness increases in the short run and causes output and employment to rise above baseline levels. In the long run all domestic prices increase by one percent and real variables return to baseline. Since the supply side is not affected by the price level in the long run there is no shift in the composition of output as regards the demand components.

8.3.2 Labour Supply Shock

The level of labour supply is increased permanently by one percent above the baseline. To resolve the disequilibrium on the labour market nominal wages have to decline according to the Philips curve. In the long run the unemployment rate slowly returns to the NAIRU and the output gap closes. Both employment and output increase by one percent. The level of nominal wages and consequently also the overall level of domestic prices as measured by the GDP deflator at factor costs remain below baseline levels in the long run. Since foreign prices and world demand for Austrian exports are assumed to be exogenous price competitiveness increases permanently. Consequently the composition of output changes not only in the short run but also in the long run. Real net exports remain permanently above baseline. Nevertheless the (nominal) trade balance worsens slightly as export prices react more sensitive to domestic prices than import prices. This causes net foreign assets to fall below the baseline level. Consequently the increase in wealth and private consumption remain below one percent.

9 Short Run Simulation Results

For a better understanding of the short run dynamics characteristics of the AQM, three representative simulation exercises are performed to analyse fiscal, monetary and exter-

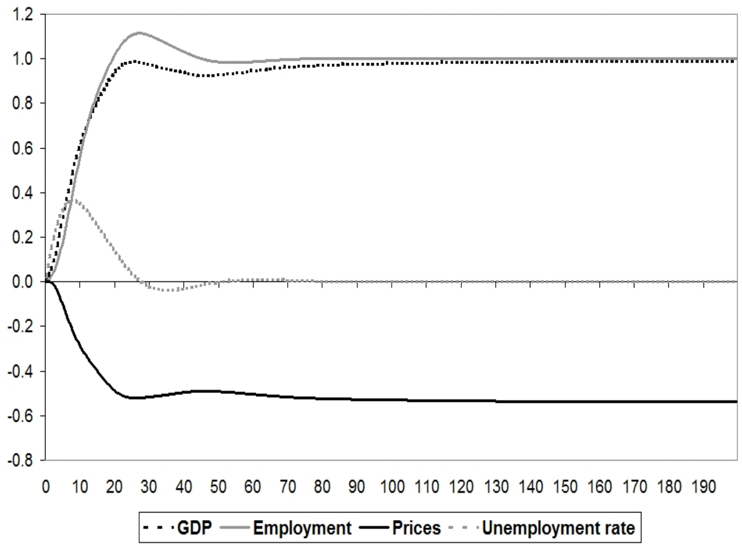

Figure 9: Permanent Increase of Labour Supply by 1 Percent (deviations from the baseline level in percentage points)

nal shocks. All simulations are run without imposing the fiscal closure rule that limits growth in public debt or the monetary closure rule that stabilises prices. Thus interest rates and nominal exchange rates are assumed to remain constant at their baseline levels over the whole simulation horizon as well as direct taxes and transfers paid by households as a percentage of GDP. Automatic stabilizers work only through transfers received by households and are assumed to depend positively on the unemployment rate. Exogenous (i.e. constant) nominal interest rates imply that real interest rates are endogenous via changes in inflation. The backward-looking behaviour of inflation expectations can thus lead to highly variable real interest rates and user costs of capital in simulations. This can generate a relatively strong reaction of real investment to a shock. All simulations are run within the sample and cover a period of 40 quarters. The following five simulations were carried out:

1. An temporary increase of government consumption for five years.
2. A temporary increase of the nominal interest rate for two years.
3. A temporary increase in world demand for Austrian exports for five years.

9.1 Simulation 1: Public Consumption Shock

(See table 10 and figure 13 on pages 45 and 48)

Real government consumption which is strictly exogenous in the model is assumed to increase for five years by 1% of GDP. A surge in government consumption automatically causes an increase in output and employment is affected with a certain lag. Demand side pressures lead to an increase in inflation reinforced by the labour market via the Phillips curve. Real investment activity is boosted for two reasons. First, output expansion operates directly by the common accelerator effect and second, higher inflation rates imply lower real interest rates and therefore a lower user cost of capital. Households' real

Table 29: Assumptions for the Monetary Policy Shock

	Y1	Y2	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8
Short term interest rate (increase in basis points)	100	100	100	100	100	100	100	100	100	100
Long term interest rate (increase in basis points)	16.3	6.3	20	17.5	15.0	12.5	10.0	7.5	5.0	2.5
Nominal exchange rates (appreciation in %)	1.63	0.63	2.0	1.75	1.50	1.25	1.0	0.75	0.5	0.25

disposable income rises as employment expands and other personal income increases. This is only partly offset by slightly lower real wages in the first years. Increased prices lead to an erosion of international competitiveness which - together with higher domestic demand - reduces the contributions to growth of net exports, thereby dampening the positive output effect. After five years government consumption is assumed to return to baseline. This constitutes a major negative demand shock and reverses most of the results. Domestic demand drops, prices follow with some lag. The stickiness of prices causes long lasting dampening effects on real GDP and employment over the following five years.

9.2 Simulation 2: Monetary Policy Shock

(See table 11 and figure 14 on pages 46 and 48)

In the monetary policy shock the short term interest rate is raised by 100 basis points for two years and then returned to its baseline level for the next eight years. Nominal exchange rates move according to a simple uncovered interest rate parity condition (UIP). The euro area share in total trade is approximately 40%. The long term interest rate (10 years) is assumed to move according to a simple interest rate parity condition, by which agents trade in different maturity assets in the knowledge of future movements of short-term interest rates. The corresponding risk premia are kept at pre-shock levels. (See table 29)

The most important transmission channel of monetary policy is through the user cost of capital. Real investment reacts very sensitive to changes in capital costs and in the real long-term interest rate. The direct effect of monetary tightening on the user cost of capital via nominal interest rates is amplified by the indirect effect via lower inflation. After three years real investment levels are almost 0.7% below their baseline values. Other direct transmission channels are mainly present in the household sector. The substitution effect which reflects the increase in relative costs of present versus future consumption dominates the wealth effect which captures the fall of the market value of household's financial wealth. Income out of wealth increases as a rise in financial yields increases the disposable income of households, who are net lenders. But the overall effect of the income channel is small. The fall in households' real disposable income is mainly due to weaker employment and lower other personal incomes. Overall real private consumption falls much less than investment activity. The appreciation of the exchange rate causes a drop in net-exports in the first year of the simulation. From the second year onwards increased price competitiveness and weaker domestic demand translate into higher growth contributions of net-exports. After two years the interest rate shock is assumed to end. Prices return only slowly to their baseline levels while the effect on real GDP fades out faster. [9]

9.3 Simulation 3: World Demand Shock

(See table 12 and figure 15 on pages 47 and 49)

An increase in demand for Austrian exports by 1% triggers a rise in exports and in all other GDP components. Due to the high import content in exports and the increase in domestic demand, the effect on real imports of the positive foreign demand shock is also substantial. The additional contribution of net exports to GDP growth remains rather low, peaking at 0.13% in the first year. From the second year onwards, GDP is dominated by the positive effect of rising domestic demand. Private consumption grows in line with employment and investment is boosted by accelerator effects and the impact of higher inflation on the user cost of capital. Higher domestic demand and lower unemployment increase the pressure on prices. The associated loss in competitiveness gradually reduces the contribution to growth of net exports. After five years world demand is assumed to return to baseline. This negative shock triggers reverse adjustment processes. Exports fall not only because of the drop in world demand but also due to lower competitiveness caused by sticky prices. Austrian exporters loose market shares while imports remain above the baseline. This causes a small drop in output and employment. Investments are supported by lower user costs of capital over the whole simulation period as the slow adjustment of prices keeps real interest rates relatively low and financing conditions favourable. Nevertheless weaker demand causes investments to return to baseline levels at the end of the simulation horizon.

10 Conclusions

The AQM in its current versions has already proved to be a very versatile tool within the range of models used at the Oesterreichische Nationalbank. Possible directions for further developments are obvious. One involves developing a more detailed representation of the trade block by distinguishing between goods and services on the one hand and different regions on the other hand. Another project currently underway addresses a further disaggregation of of the public finance block. Finally, an extension to forward-looking behaviour is planned for a later stage.

[9] International trade spillovers of a monetary tightening in the euroarea on the Austrian economy are not considered. Results in the course of the WGEM Monetary Policy Transmission Exercise show that for a small open economy like Austria the impact of these transmission channels can be substantial.

A List of Variables

Table 30: Endogenous Variables - Part1/4

ATX	Austrian Stock Index
BTN	Balance of trade of goods and services
CAN	Current account
CC0	User cost of capital
CEX	WIN / LEN
CMD	Competitor's import price in domestic currency
CPN	Credit, privat, amount outstanding, nominal
CXD	Competitor's export price in domestic currency
DDR	Domestic Demand, real
FWN	Financial wealth, nominal
FWR	Financial wealth, real
GB	Government balance
GCD	Government consumption deflator
GCN	Government consumption, nominal
GDN	Government debt, gross
GDNRAT	Ratio of government debt to nominal GDP
GID	Government investment deflator
GIN	Government investment, nominal
GLN	Government net lending
GON	Gross operating surplus
GPB	Government primary balance
GSN	Government gross savings
GTE	Government total expenditure
GTR	Government total receipts
GYN	Government disposable income
HEG	HIC - energy
HEX	HIC - non-energy
HIC	Harmonised index of consumption prices
IER	Equipment investment, real
IHR	Housing (residential) investment, real
IHX	Housing Price Index
INFA	Annual rate of inflation
INFE	Inflation expectatios, adaptive
INFQ	Quarterly rate of inflation
INN	Interest payments on government debt
IOR	Other investment, real
IPD	Private sector non-residential investment, deflator
IPN	Private sector non-residential investment, nominal

Table 30: Endogenous Variables - Part2/4

IPR	Private sector non-residential investment, real
ITD	Total investment deflator
ITN	Total investment, nominal
ITR	Total investment, real
KGN	Government capital stock, nominal
KGR	Government capital stock, real
KSN	Total capital stock, nominal
KSR	Total capital stock, real
LEN	Employees
LENFE	Employees, full time equivalents
LFN	Total labour force
LNN	Total employment
LNNFE	Total employment, full time equivalents
LNNFE_W	LNNFE / LNN
LNT	Trend employment
LPN	Total employment, private sector
LSN	Self employed
LSNFE	Self employed, full time equivalents
LSNFE_W	LSNFE / LSN
LSR	Stock of inventories
LTI	Long-term nominal interest rate
LTR	Long-term real interest rate
MTD	Import deflator
MTN	Imports, nominal
MTR	Imports, real
NFA	Net foreign assets
NFN	Net factor income
NXR	Netexports, real
ODN	Other direct taxes
OID	Private investment deflator
OIN	Private investment, nominal
OIR	Private investment, real
OLN	Net lending by other private sector
OPN	Other personal income
OWN	Private compensation to employees
OYN	GON+TWN+NFN+INN - ODN+OPN+OGN)
PCD	Private consumption deflator
PCN	Private consumption, nominal
PCR	Private consumption, real
PDN	Income tax and social security contributions, paid by households
PDNB	Tax base for direct taxes
PDX	Ratio between direct taxes and its tax base
PEI	Price of energy and raw materials, domestic currency
PLN	Net lending by private sector

Table 30: Endogenous Variables - Part3/4

POIL	Oil price in domestic currency
PRO	Average labour productivity
PROFE	Average labour productivity, full time equivalents
PSN	Private sector savings
PSNQ	Private sector savings ratio
PYN	Private sector disposable income, nominal
PYR	Private sector disposable income, real
REALI	The real interest rate for inventories
SALE	Sales of storable goods (PCR + XTR)
SCAN	Cumulated current account
SCD	Changes in inventories, deflator
SCN	Changes in inventories, nominal
SCR	Changes in inventories, real
SGLN	Cumulated government net lending
SMC	Short-run marginal cost of production
STI	Short-term nominal interest rate
SZD	Inventories and statistical discrepancies deflator
SZR	Inventories plus statistical discrepancies
TIN	Indirect taxes less subsidies, total
TIR	Indirect taxes less subsidies, real
TIX	Ratio between TIN and YEN
TOT	Terms of Trade
TPN	Transfers from households to government
TRN	Transfers from government to households
TPX	Ratio between TPN and YEN
TRX	Ratio between TRN and YEN
ULA	ULC adjusted (employees)
UNN	Total unemployment
URX	Unemployment rate
WER	Import demand indicator
WGN	Compensations to employees, government
WPN	Compensations to employees, private
WIN	Total compensation to employees, nominal
WUN	Compensation per employee
WUNFE	Compensation per employee, full time equivalents
WUP	Compensations per employees, private
WURPD	Real compensation per employee, with PCD deflator
WURYD	Real compensation per employee, with YED deflator
XTD	Exports deflator
XTN	Exports, nominal
XTR	Exports, real
YED	GDP expenditure deflator

Table 30: Endogenous Variables - Part4/4

YEN	GDP expenditure, nominal
YER	GDP expenditure, real
YFD	GDP at factor cost deflator
YFN	GDP at factor cost, nominal
YFR	GDP at factor cost, real
YFT	Potential output
YGA	Output gap
YNR	Production using available inputs
ZYEN	Inventories and statistical discrepancies, nominal

Table 31: Definition-Variables

CSTAR	Long-run equilibrium level of private consumption
CDSTAR	Long run behaviour of Consumption deflator
GDSTAR	Long run behaviour of Government investment deflator
KSTAR	Long-run equilibrium level of capital stock
LSSTAR	Long-run equilibrium level of real stocks
LSTAR	Long-run equilibrium level of employment
MDSTAR	Nominal effective exchange rate on the import side
MSTAR	Long-run equilibrium level of imports
WSTAR	Long run wage rate
XDSTAR	Government investment, real
XSTAR	Long-run equilibrium level of exports
YDSTAR	Long-run equilibrium level of GDP deflator at factor costs

Table 32: Exogenous Variables

CMD_EX	Competitor's import price - extra Euro Area
CMD_IN	Competitor's import price - intra Euro Area
CXD_EX	Competitor's export price - extra Euro Area
CXD_IN	Competitor's export price - intra Euro Area
D8	Change in net equity of households in pension funds reserves (D.8)
EEN	Nominal effective exchange rate on the export side
EEN0	Nominal effective exchange rate on the import side
GCR	Government consumption, real
GDNRAT	Ratio of Gov. debt to nominal GDP
GIR	Government investment, real
HICWE	Weights for HICP
IHN	Housing investment (private and gov't), nominal
IPX	Industrial production to GDP ratio
LEX	Employees to employment ratio
LFNSTAR	Total labour force, hp filtered with lamda = 40
LGN	Government employment
OGN	Other sector transfers to/from government
PEX	Ratio between MTD and WUN, exogenous in forecast
POILU	Oil price in USD
RP	Risk premium
TWN	Transfer from rest of the world
URT	Trend unemployment rate
USD	Exchange Rate US dollar for 1 Euro
WDR	World demand indicator
WDR_EX	World demand indicator - extra Euro Area
WDR_IN	World demand indicator - intra Euro Area
WUG	Compensation per goverenment employee
ZCC0	Statistical discrepancy on user cost of capital
ZGDN	Statistical discrepancy on government debt
ZGYN	Discrepancy in gov disp income equation
ZHIC	Discrepancy in HICP equation
ZKGN	Statistical discrepancy on gov capital stock, nominal
ZKGR	Statistical discrepancy on capital stock
ZKSN	Statistical discrepancy on capital stock, nominal
ZKSR	Statistical discrepancy on capital stock
ZUNN	Statistical discrepancy on labour force
ZNFA	Statistical discrepancy on net foreign assets
ZPSN	Statistical discrepancy on private saving
ZURX	Statistical discrepancy on unemployment rate
ZYER	Statistical discrepancy on GDP expenditure

B Simulation Results - Tables

C Simulation Results - Figures

Government Consumption Shock	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10
Prices	*Levels, percentage deviations from baseline*									
HICP	0.20	0.63	1.10	1.57	2.01	2.21	2.12	1.93	1.68	1.44
Consumption Deflator	0.13	0.54	1.02	1.52	1.98	2.28	2.25	2.05	1.79	1.53
GDP Deflator	0.08	0.54	1.03	1.52	1.97	2.31	2.22	2.00	1.73	1.48
Investment Deflator	0.14	0.51	0.94	1.36	1.77	1.98	1.94	1.75	1.53	1.31
ULC	-0.59	-0.09	0.53	1.21	1.93	3.14	3.27	3.09	2.77	2.40
Compensation per employee	0.16	0.42	0.88	1.38	1.93	2.33	2.55	2.54	2.43	2.31
Productivity	0.75	0.51	0.35	0.17	0.00	-0.79	-0.69	-0.53	-0.33	-0.09
Export Deflator	0.04	0.23	0.46	0.72	0.97	1.18	1.21	1.16	1.05	0.92
Import Deflator	0.01	0.11	0.26	0.43	0.60	0.76	0.82	0.80	0.73	0.64
GDP and Components	*Levels, percentage deviations from baseline*									
GDP	1.12	1.30	1.48	1.57	1.55	0.47	0.14	-0.13	-0.32	-0.41
Consumption	0.17	0.49	0.71	0.88	0.99	0.89	0.60	0.33	0.10	-0.07
Investment	1.40	2.12	2.88	3.64	4.06	2.96	2.14	1.23	0.39	-0.19
Of which: Residential Inv.	1.13	1.71	2.32	2.94	3.27	2.38	1.74	0.99	0.32	-0.15
Gov. Consumption	5.04	4.87	4.70	4.56	4.50	0.00	0.00	0.00	0.00	0.00
Exports	-0.01	-0.06	-0.13	-0.21	-0.28	-0.35	-0.37	-0.36	-0.34	-0.30
Imports	0.83	1.30	1.70	2.03	2.20	1.52	1.05	0.67	0.38	0.25
Contributions to Shock	*Percentage of GDP, absolute deviations from baseline*									
Domestic Demand	1.41	1.73	2.02	2.28	2.42	1.20	0.84	0.47	0.15	-0.08
Inventories	0.01	0.05	0.09	0.10	0.06	-0.01	-0.10	-0.16	-0.14	-0.05
Trade Balance	-0.30	-0.47	-0.63	-0.81	-0.93	-0.72	-0.60	-0.45	-0.33	-0.28
Labour Market	*Levels, percentage deviations from baseline, except unemployment: perc*									
Total employment	0.37	0.79	1.13	1.40	1.55	1.27	0.84	0.40	0.01	-0.32
Employees in employment	0.37	0.79	1.13	1.40	1.55	1.27	0.84	0.40	0.01	-0.32
Unemployment rate	-0.09	-0.24	-0.38	-0.52	-0.63	-0.63	-0.55	-0.45	-0.32	-0.19
Household Accounts	*Levels, percentage deviations from baseline, except the savings rate: per*									
Disposable income	0.74	0.89	1.06	1.16	1.18	0.51	0.22	-0.02	-0.18	-0.24
Saving rate	0.48	0.36	0.33	0.25	0.18	-0.36	-0.36	-0.33	-0.27	-0.17

Figure 10: Simulation 1: Increase of Government Consumption for Five Years

Interest Rate Shock

	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10
Prices	*Levels, percentage deviations from baseline*									
HICP	-0.04	-0.10	-0.16	-0.19	-0.19	-0.17	-0.14	-0.13	-0.12	-0.11
Consumption Deflator	-0.06	-0.11	-0.16	-0.19	-0.20	-0.18	-0.16	-0.13	-0.12	-0.11
GDP Deflator	-0.06	-0.12	-0.17	-0.20	-0.20	-0.18	-0.15	-0.13	-0.12	-0.11
Investment Deflator	-0.06	-0.12	-0.16	-0.18	-0.18	-0.16	-0.13	-0.11	-0.10	-0.10
ULC	0.05	0.01	-0.12	-0.22	-0.27	-0.27	-0.23	-0.19	-0.16	-0.15
Compensation per employee	-0.02	-0.08	-0.15	-0.20	-0.22	-0.23	-0.22	-0.21	-0.20	-0.20
Productivity	-0.08	-0.09	-0.04	0.02	0.05	0.04	0.01	-0.02	-0.04	-0.04
Export Deflator	-0.16	-0.20	-0.16	-0.15	-0.13	-0.12	-0.10	-0.09	-0.08	-0.07
Import Deflator	-0.19	-0.18	-0.10	-0.08	-0.08	-0.08	-0.07	-0.06	-0.05	-0.05
GDP and Components	*Levels, percentage deviations from baseline*									
GDP	-0.12	-0.19	-0.17	-0.11	-0.05	-0.02	-0.01	-0.02	-0.03	-0.02
Consumption	-0.02	-0.09	-0.13	-0.12	-0.10	-0.07	-0.04	-0.03	-0.03	-0.03
Investment	-0.23	-0.57	-0.68	-0.59	-0.42	-0.28	-0.17	-0.11	-0.07	-0.04
Of which: Residential Inv.	-1.88	-2.15	-0.55	-0.47	-0.34	-0.23	-0.14	-0.09	-0.05	-0.03
Gov. Consumption	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Exports	-0.18	-0.05	0.03	0.04	0.04	0.04	0.03	0.03	0.03	0.02
Imports	-0.11	-0.17	-0.20	-0.15	-0.08	-0.04	-0.05	-0.08	-0.11	-0.09
Contributions to Shock	*Percentage of GDP, absolute deviations from baseline*									
Domestic Demand	-0.07	-0.18	-0.23	-0.21	-0.15	-0.10	-0.07	-0.04	-0.03	-0.02
Inventories	-0.03	-0.05	-0.02	0.03	0.06	0.06	0.02	-0.02	-0.05	-0.05
Trade Balance	-0.03	0.04	0.08	0.07	0.04	0.03	0.03	0.05	0.06	0.06
Labour Market	*Levels, percentage deviations from baseline, except unemployment: perc*									
Total employment	-0.04	-0.10	-0.14	-0.13	-0.10	-0.05	-0.02	0.00	0.02	0.03
Employees in employment	-0.04	-0.10	-0.14	-0.13	-0.10	-0.05	-0.02	0.00	0.02	0.03
Unemployment rate	0.01	0.03	0.05	0.05	0.05	0.04	0.03	0.02	0.02	0.01
Household Accounts	*Levels, percentage deviations from baseline, except the savings rate: per*									
Disposable income	-0.05	-0.12	-0.13	-0.10	-0.05	-0.02	-0.01	-0.02	-0.02	-0.02
Saving rate	-0.03	-0.02	0.00	0.02	0.04	0.04	0.03	0.01	0.01	0.01

Figure 11: Simulation 3: Increase of Short Term Interest Rates for Two Years

Export Demand Shock

	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10
Prices	*Levels, percentage deviations from baseline*									
HICP	0.04	0.13	0.23	0.33	0.42	0.46	0.45	0.41	0.37	0.33
Consumption Deflator	0.03	0.11	0.22	0.32	0.42	0.48	0.47	0.43	0.39	0.35
GDP Deflator	0.04	0.13	0.24	0.34	0.44	0.48	0.47	0.43	0.38	0.34
Investment Deflator	0.03	0.10	0.20	0.29	0.37	0.42	0.41	0.37	0.34	0.30
ULC	-0.12	-0.03	0.10	0.25	0.40	0.64	0.67	0.63	0.57	0.52
Compensation per employee	0.03	0.09	0.18	0.29	0.40	0.48	0.52	0.53	0.51	0.50
Productivity	0.15	0.12	0.08	0.04	0.00	-0.16	-0.14	-0.10	-0.06	-0.01
Export Deflator	0.01	0.05	0.11	0.16	0.22	0.26	0.26	0.25	0.23	0.21
Import Deflator	0.00	0.02	0.05	0.09	0.13	0.16	0.17	0.17	0.16	0.14
GDP and Components	*Levels, percentage deviations from baseline*									
GDP	0.23	0.28	0.32	0.34	0.33	0.11	0.05	0.00	-0.02	-0.04
Consumption	0.04	0.11	0.16	0.21	0.23	0.22	0.16	0.10	0.06	0.04
Investment	0.28	0.45	0.61	0.76	0.85	0.63	0.46	0.29	0.14	0.04
Of which: Residential Inv.	0.23	0.37	0.49	0.62	0.69	0.51	0.38	0.24	0.12	0.03
Gov. Consumption	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Exports	0.85	0.93	0.94	0.94	0.93	0.06	-0.02	-0.05	-0.06	-0.06
Imports	0.51	0.70	0.79	0.85	0.88	0.39	0.23	0.18	0.15	0.13
Contributions to Shock	*Percentage of GDP, absolute deviations from baseline*									
Domestic Demand	0.09	0.17	0.23	0.29	0.33	0.27	0.20	0.13	0.07	0.03
Inventories	0.01	0.03	0.02	0.01	-0.01	-0.03	-0.04	-0.02	0.00	0.03
Trade Balance	0.13	0.09	0.06	0.03	0.01	-0.13	-0.11	-0.10	-0.10	-0.10
Labour Market	*Levels, percentage deviations from baseline, except unemployment: perc*									
Total employment	0.07	0.17	0.24	0.30	0.33	0.28	0.19	0.11	0.04	-0.02
Employees in employment	0.07	0.17	0.24	0.30	0.33	0.28	0.19	0.11	0.04	-0.02
Unemployment rate	-0.02	-0.05	-0.08	-0.11	-0.14	-0.14	-0.12	-0.10	-0.08	-0.06
Household Accounts	*Levels, percentage deviations from baseline, except the savings rate: per*									
Disposable income	0.16	0.21	0.24	0.26	0.26	0.12	0.06	0.02	0.00	-0.01
Saving rate	0.11	0.09	0.07	0.05	0.03	-0.09	-0.09	-0.08	-0.06	-0.05

Figure 12: Simulation 5: Increase in World Demand for Five Years

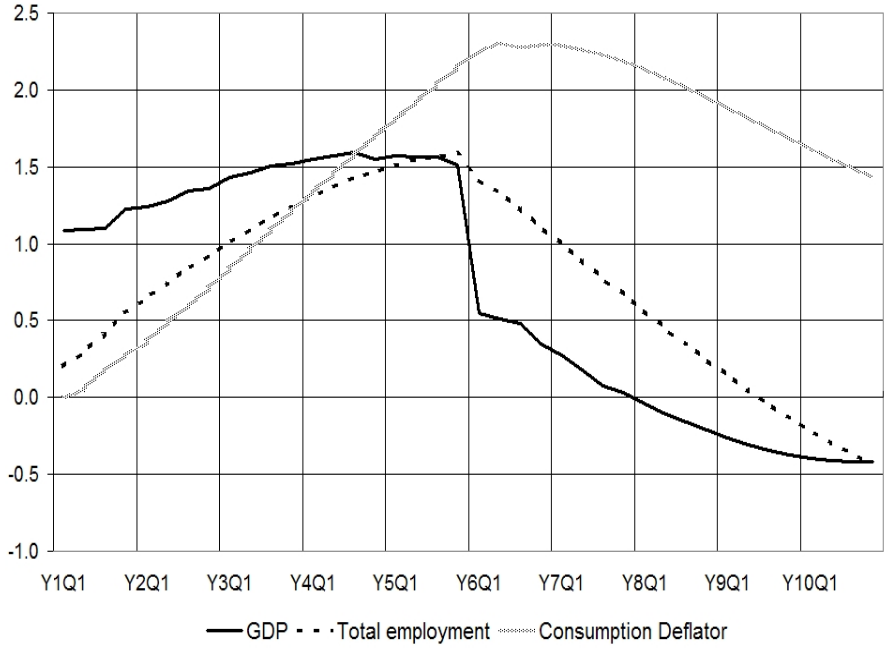

Figure 13: Simulation 1: Increase of Government Consumption for Five Years (deviations from the baseline level in percentage points)

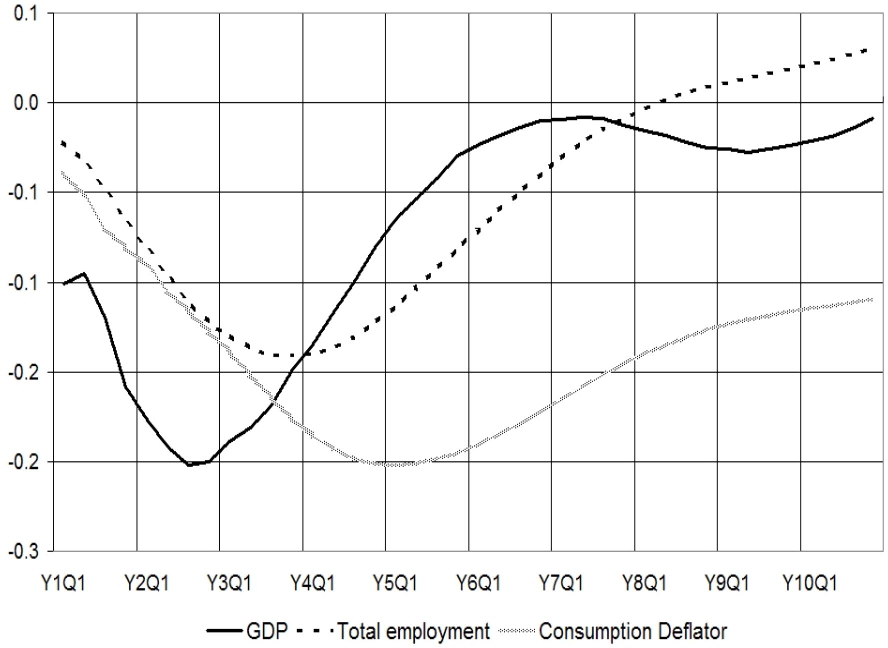

Figure 14: Simulation 2: Increase of Short Term Interest Rates for Two Years (deviations from the baseline level in percentage points)

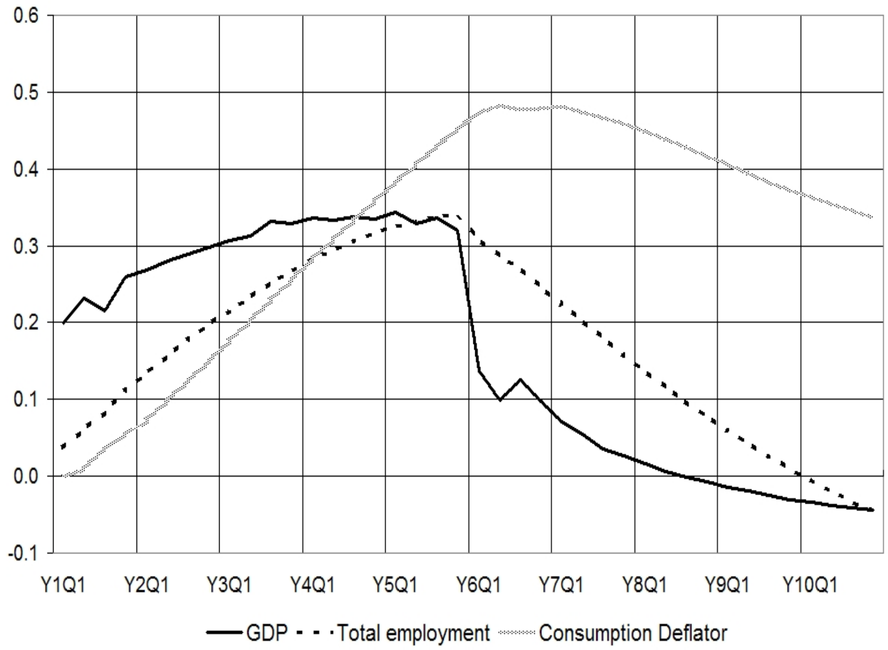

Figure 15: Simulation 3: Increase in World Demand for Five Years (deviations from the baseline level in percentage points)

References

Boissay, F., and J.-P. Villetelle (2004): "The Fench block of the ESCB-Multi-County model," *mimeo*.

ECB (2001): "A Guide to Eurosystem staff macroeconomic projection exercise," *ECB Working Paper Series*.

Engle, R., and C. Granger (1987): "Co-Integration and error correction representation, estimation, and testing," *Econometrica*, (55), 251–276.

Fagan, G., J. Henry, and R. Mestre (2001): "An Area Wide Model (AWM) for the Euro Area," *ECB Working Paper Series*, (42).

Fagan, G., and J. Morgan (2005): *ESCB Structural Models Report*. Edward Elgar Publishing, forthcoming.

Fenz, G., and M. Spitzer (2005): *The Austrian Quarterly Model,*chap. 15, ESCB Structural Models Report. Gabriel Fagan and Julian Morgan, Edward Elgar Publishing.

Holt, C. C., F. Modigliani, J. F. Muth, and H. A. Simon (1960): *Planning Production, Inventories and Work Force*. Englewood Cilffs, NJ: Prentice-Hall, 1th edn.

McAdam, P., and A. Willman (2002): "Production, Supply and factor shares: An application to estimating German long run supply," *Economic Modelling*, forthcoming.

Muellbauer, J., and R. Lattimore (1995): *The consumption function: A theoretical and empirical overview,*chap. 5, pp. 221–311, Handbook of applied econometrics - Macroeconomics. M.Hashem Pesaran and Mike Wickens, Blackwell Publishers Ltd., Cambridge USA.

Samuelson, P. (1967): *Economics, An Introductory Analysis*. McGraw-Hill Book Company, 7th edn.

West, K. D. (1995): *Inventory models: The estimation of Euler equations,*chap. 4, pp. 188–220, Handbook of applied econometrics, Macroeconomics. M.Hashem Pesaran and Mike Wickens, Blackwell Publishers Ltd., Cambridge USA.

Willman, A., and A. Estrada (2002): "The Spanish block of the ESCB-Multi-County model," *ECB Working Paper Series*, (149).

Index of Working Papers:

August 28, 1990	Pauer Franz	1 [1)]	Hat Böhm-Bawerk Recht gehabt? Zum Zusammenhang zwischen Handelsbilanzpassivum und Budgetdefizit in den USA [2)]
March 20, 1991	Backé Peter	2 [1)]	Ost- und Mitteleuropa auf dem Weg zur Marktwirtschaft - Anpassungskrise 1990
March 14, 1991	Pauer Franz	3 [1)]	Die Wirtschaft Österreichs im Vergleich zu den EG-Staaten - eine makroökonomische Analyse für die 80er Jahre
May 28, 1991	Mauler Kurt	4 [1)]	The Soviet Banking Reform
July 16, 1991	Pauer Franz	5 [1)]	Die Auswirkungen der Finanzmarkt- und Kapitalverkehrsliberalisierung auf die Wirtschaftsentwicklung und Wirtschaftspolitik in Norwegen, Schweden, Finnland und Großbritannien - mögliche Konsequenzen für Österreich [3)]
August 1, 1991	Backé Peter	6 [1)]	Zwei Jahre G-24-Prozess: Bestandsaufnahme und Perspektiven unter besonderer Berücksichtigung makroökonomischer Unterstützungsleistungen [4)]
August 8, 1991	Holzmann Robert	7 [1)]	Die Finanzoperationen der öffentlichen Haushalte der Reformländer CSFR, Polen und Ungarn: Eine erste quantitative Analyse
January 27, 1992	Pauer Franz	8 [1)]	Erfüllung der Konvergenzkriterien durch die EG-Staaten und die EG-Mitgliedswerber Schweden und Österreich [5)]
October 12, 1992	Hochreiter Eduard (Editor)	9 [1)]	Alternative Strategies For Overcoming the Current Output Decline of Economies in Transition
November 10, 1992	Hochreiter Eduard and Winckler Georg	10 [1)]	Signaling a Hard Currency Strategy: The Case of Austria

1) vergriffen (out of print)
2) In abgeänderter Form erschienen in Berichte und Studien Nr. 4/1990, S 74 ff
3) In abgeänderter Form erschienen in Berichte und Studien Nr. 4/1991, S 44 ff
4) In abgeänderter Form erschienen in Berichte und Studien Nr. 3/1991, S 39 ff
5) In abgeänderter Form erschienen in Berichte und Studien Nr. 1/1992, S 54 ff

March 12, 1993	Hochreiter Eduard (Editor)	11	The Impact of the Opening-up of the East on the Austrian Economy - A First Quantitative Assessment
June 8, 1993	Anulova Guzel	12	The Scope for Regional Autonomy in Russia
July 14, 1993	Mundell Robert	13	EMU and the International Monetary Sy-stem: A Transatlantic Perspective
November 29, 1993	Hochreiter Eduard	14	Austria's Role as a Bridgehead Between East and West
March 8, 1994	Hochreiter Eduard (Editor)	15	Prospects for Growth in Eastern Europe
June 8, 1994	Mader Richard	16	A Survey of the Austrian Capital Market
September 1, 1994	Andersen Palle and Dittus Peter	17	Trade and Employment: Can We Afford Better Market Access for Eastern Europe?
November 21, 1994	Rautava Jouko	18[1)]	Interdependence of Politics and Economic Development: Financial Stabilization in Russia
January 30, 1995	Hochreiter Eduard (Editor)	19	Austrian Exchange Rate Policy and European Monetary Integration - Selected Issues
October 3, 1995	Groeneveld Hans	20	Monetary Spill-over Effects in the ERM: The Case of Austria, a Former Shadow Member
December 6, 1995	Frydman Roman et al	21	Investing in Insider-dominated Firms: A Study of Voucher Privatization Funds in Russia
March 5, 1996	Wissels Rutger	22	Recovery in Eastern Europe: Pessimism Confounded ?
June 25, 1996	Pauer Franz	23	Will Asymmetric Shocks Pose a Serious Problem in EMU?
September 19, 1997	Koch Elmar B.	24	Exchange Rates and Monetary Policy in Central Europe - a Survey of Some Issues
April 15, 1998	Weber Axel A.	25	Sources of Currency Crises: An Empirical Analysis

May 28,1998	Brandner Peter, Diebalek Leopold and Schuberth Helene	26	Structural Budget Deficits and Sustainability of Fiscal Positions in the European Union
June 15, 1998	Canzeroni Matthew, Cumby Robert, Diba Behzad and Eudey Gwen	27	Trends in European Productivity: Implications for Real Exchange Rates, Real Interest Rates and Inflation Differentials
June 20, 1998	MacDonald Ronald	28	What Do We Really Know About Real Exchange Rates?
June 30, 1998	Campa José and Wolf Holger	29	Goods Arbitrage and Real Exchange Rate Stationarity
July 3,1998	Papell David H.	30	The Great Appreciation, the Great Depreciation, and the Purchasing Power Parity Hypothesis
July 20,1998	Chinn Menzie David	31	The Usual Suspects? Productivity and Demand Shocks and Asia-Pacific Real Exchange Rates
July 30,1998	Cecchetti Stephen G., Mark Nelson C., Sonora Robert	32	Price Level Convergence Among United States Cities: Lessons for the European Central Bank
September 30, 1998	Christine Gartner, Gert Wehinger	33	Core Inflation in Selected European Union Countries
November 5, 1998	José Viñals and Juan F. Jimeno	34	The Impact of EMU on European Unemployment
December 11, 1998	Helene Schuberth and Gert Wehinger	35	Room for Manoeuvre of Economic Policy in the EU Countries – Are there Costs of Joining EMU?
December 21, 1998	Dennis C. Mueller and Burkhard Raunig	36	Heterogeneities within Industries and Structure-Performance Models
May 21, 1999	Alois Geyer and Richard Mader	37	Estimation of the Term Structure of Interest Rates – A Parametric Approach
July 29, 1999	José Viñals and Javier Vallés	38	On the Real Effects of Monetary Policy: A Central Banker´s View
December 20, 1999	John R. Freeman, Jude C. Hays and Helmut Stix	39	Democracy and Markets: The Case of Exchange Rates

March 01, 2000	Eduard Hochreiter and Tadeusz Kowalski	40	Central Banks in European Emerging Market Economies in the 1990s
March 20, 2000	Katrin Wesche	41	Is there a Credit Channel in Austria? The Impact of Monetary Policy on Firms' Investment Decisions
June 20, 2000	Jarko Fidrmuc and Jan Fidrmuc	42	Integration, Disintegration and Trade in Europe: Evolution of Trade Relations During the 1990s
March 06, 2001	Marc Flandreau	43	The Bank, the States, and the Market, A Austro-Hungarian Tale for Euroland, 1867-1914
May 01, 2001	Otmar Issing	44	The Euro Area and the Single Monetary Policy
May 18, 2001	Sylvia Kaufmann	45	Is there an asymmetric effect of monetary policy over time? A Bayesian analysis using Austrian data.
May 31, 2001	Paul De Grauwe and Marianna Grimaldi	46	Exchange Rates, Prices and Money. A Long Run Perspective
June 25, 2001	Vítor Gaspar, Gabriel Perez-Quiros and Jorge Sicilia	47	The ECB Monetary Strategy and the Money Market
July 27, 2001	David T. Llewellyn	48	A *Regulatory Regime* For Financial Stability
August 24, 2001	Helmut Elsinger and Martin Summer	49	Arbitrage Arbitrage and Optimal Portfolio Choice with Financial Constraints
September 1, 2001	Michael D. Goldberg and Roman Frydman	50	Macroeconomic Fundamentals and the DM/$ Exchange Rate: Temporal Instability and the Monetary Model
September 8, 2001	Vittorio Corbo, Oscar Landerretche and Klaus Schmidt-Hebbel	51	Assessing Inflation Targeting after a Decade of World Experience
September 25, 2001	Kenneth N. Kuttner and Adam S. Posen	52	Beyond Bipolar: A Three-Dimensional Assessment of Monetary Frameworks

October 1, 2001	Luca Dedola and Sylvain Leduc	53	Why Is the Business-Cycle Behavior of Fundamentals Alike Across Exchange-Rate Regimes?
October 10, 2001	Tommaso Monacelli	54	New International Monetary Arrangements and the Exchange Rate
December 3, 2001	Peter Brandner, Harald Grech and Helmut Stix	55	The Effectiveness of Central Bank Intervention in the EMS: The Post 1993 Experience
January 2, 2002	Sylvia Kaufmann	56	Asymmetries in Bank Lending Behaviour. Austria During the 1990s
January 7, 2002	Martin Summer	57	Banking Regulation and Systemic Risk
January 28, 2002	Maria Valderrama	58	Credit Channel and Investment Behavior in Austria: A Micro-Econometric Approach
February 18, 2002	Gabriela de Raaij and Burkhard Raunig	59	Evaluating Density Forecasts with an Application to Stock Market Returns
February 25, 2002	Ben R. Craig and Joachim G. Keller	60	The Empirical Performance of Option Based Densities of Foreign Exchange
February 28, 2002	Peter Backé, Jarko Fidrmuc, Thomas Reininger and Franz Schardax	61	Price Dynamics in Central and Eastern European EU Accession Countries
April 8, 2002	Jesús Crespo-Cuaresma, Maria Antoinette Dimitz and Doris Ritzberger-Grünwald	62	Growth, Convergence and EU Membership
May 29, 2002	Markus Knell	63	Wage Formation in Open Economies and the Role of Monetary and Wage-Setting Institutions
June 19, 2002	Sylvester C.W. Eijffinger (comments by: José Luis Malo de Molina and by Franz Seitz)	64	The Federal Design of a Central Bank in a Monetary Union: The Case of the European System of Central Banks

July 1, 2002	Sebastian Edwards and I. Igal Magendzo (comments by Luis Adalberto Aquino Cardona and by Hans Genberg)	65	Dollarization and Economic Performance: What Do We Really Know?
July 10, 2002	David Begg (comment by Peter Bofinger)	66	Growth, Integration, and Macroeconomic Policy Design: Some Lessons for Latin America
July 15, 2002	Andrew Berg, Eduardo Borensztein, and Paolo Mauro (comment by Sven Arndt)	67	An Evaluation of Monetary Regime Options for Latin America
July 22, 2002	Eduard Hochreiter, Klaus Schmidt-Hebbel and Georg Winckler (comments by Lars Jonung and George Tavlas)	68	Monetary Union: European Lessons, Latin American Prospects
July 29, 2002	Michael J. Artis (comment by David Archer)	69	Reflections on the Optimal Currency Area (OCA) criteria in the light of EMU
August 5, 2002	Jürgen von Hagen, Susanne Mundschenk (comments by Thorsten Polleit, Gernot Doppelhofer and Roland Vaubel)	70	Fiscal and Monetary Policy Coordination in EMU
August 12, 2002	Dimitri Boreiko (comment by Ryszard Kokoszczyński)	71	EMU and Accession Countries: Fuzzy Cluster Analysis of Membership
August 19, 2002	Ansgar Belke and Daniel Gros (comments by Luís de Campos e Cunha, Nuno Alves and Eduardo Levy-Yeyati)	72	Monetary Integration in the Southern Cone: Mercosur Is Not Like the EU?
August 26, 2002	Friedrich Fritzer, Gabriel Moser and Johann Scharler	73	Forecasting Austrian HICP and its Components using VAR and ARIMA Models

September 30, 2002	Sebastian Edwards	74	The Great Exchange Rate Debate after Argentina
October 3, 2002	George Kopits (comments by Zsolt Darvas and Gerhard Illing)	75	Central European EU Accession and Latin American Integration: Mutual Lessons in Macroeconomic Policy Design
October 10, 2002	Eduard Hochreiter, Anton Korinek and Pierre L. Siklos (comments by Jeannine Bailliu and Thorvaldur Gylfason)	76	The Potential Consequences of Alternative Exchange Rate Regimes: A Study of Three Candidate Regions
October 14, 2002	Peter Brandner, Harald Grech	77	Why Did Central Banks Intervene in the EMS? The Post 1993 Experience
October 21, 2002	Alfred Stiglbauer, Florian Stahl, Rudolf Winter-Ebmer, Josef Zweimüller	78	Job Creation and Job Destruction in a Regulated Labor Market: The Case of Austria
October 28, 2002	Elsinger, Alfred Lehar and Martin Summer	79	Risk Assessment for Banking Systems
November 4, 2002	Helmut Stix	80	Does Central Bank Intervention Influence the Probability of a Speculative Attack? Evidence from the EMS
June 30, 2003	Markus Knell, Helmut Stix	81	How Robust are Money Demand Estimations? A Meta-Analytic Approach
July 7, 2003	Helmut Stix	82	How Do Debit Cards Affect Cash Demand? Survey Data Evidence
July 14, 2003	Sylvia Kaufmann	83	The business cycle of European countries. Bayesian clustering of country-individual IP growth series.
July 21, 2003	Jesus Crespo Cuaresma, Ernest Gnan, Doris Ritzberger-Gruenwald	84	Searching for the Natural Rate of Interest: a Euro-Area Perspective
July 28, 2003	Sylvia Frühwirth-Schnatter, Sylvia Kaufmann	85	Investigating asymmetries in the bank lending channel. An analysis using Austrian banks' balance sheet data

September 22, 2003	Burkhard Raunig	86	Testing for Longer Horizon Predictability of Return Volatility with an Application to the German DAX
May 3, 2004	Juergen Eichberger, Martin Summer	87	Bank Capital, Liquidity and Systemic Risk
June 7, 2004	Markus Knell, Helmut Stix	88	Three Decades of Money Demand Studies. Some Differences and Remarkable Similarities
August 27, 2004	Martin Schneider, Martin Spitzer	89	Forecasting Austrian GDP using the generalized dynamic factor model
September 20, 2004	Sylvia Kaufmann, Maria Teresa Valderrama	90	Modeling Credit Aggregates
Oktober 4, 2004	Gabriel Moser, Fabio Rumler, Johann Scharler	91	Forecasting Austrian Inflation
November 3, 2004	Michael D. Bordo, Josef Christl, Harold James, Christian Just	92	Exchange Rate Regimes Past, Present and Future
December 29, 2004	Johann Scharler	93	Understanding the Stock Market's Response to Monetary Policy Shocks
Decembert 31, 2004	Harald Grech	94	What Do German Short-Term Interest Rates Tell Us About Future Inflation?
February 7, 2005	Markus Knell	95	On the Design of Sustainable and Fair PAYG - Pension Systems When Cohort Sizes Change.
March 4, 2005	Stefania P. S. Rossi, Markus Schwaiger, Gerhard Winkler	96	Managerial Behavior and Cost/Profit Efficiency in the Banking Sectors of Central and Eastern European Countries
April 4, 2005	Ester Faia	97	Financial Differences and Business Cycle Co-Movements in A Currency Area
May 12, 2005	Federico Ravenna	98	The European Monetary Union as a Committment Device for New EU Member States

May 23, 2005	Philipp Engler, Terhi Jokipii, Christian Merkl, Pablo Rovira Kaltwasser, Lúcio Vinhas de Souza	99	The Effect of Capital Requirement Regulation on the Transmission of Monetary Policy: Evidence from Austria
July 11, 2005	Claudia Kwapil, Josef Baumgartner, Johann Scharler	100	The Price-Setting Behavior of Austrian Firms: Some Survey Evidence
July 25, 2005	Josef Baumgartner, Ernst Glatzer, Fabio Rumler, Alfred Stiglbauer	101	How Frequently Do Consumer Prices Change in Austria? Evidence from Micro CPI Data
August 8, 2005	Fabio Rumler	102	Estimates of the Open Economy New Keynesian Phillips Curve for Euro Area Countries
September 19, 2005	Peter Kugler, Sylvia Kaufmann	103	Does Money Matter for Inflation in the Euro Area?
September 28, 2005	Gerhard Fenz, Martin Spitzer	104	AQM – The Austrian Quarterly Model of the Oesterreichische Nationalbank