A Long-run Macroeconomic Model of the Austrian Economy (A-LMM)

2nd Interim Report - Model Documentation

Table of Contents

Josef Baumgartner (WIFO)

1. Introduction and overview 1

Serguei Kaniovski (WIFO)

2. Firm behaviour 4

2.1 The modified neoclassical investment function 4

2.2 Capital stock and depreciation 6

2.3 The neoclassical production function 6

Thomas Url (WIFO)

3. Consumption of private households 8

3.1 The model of perpetual youth 8

3.2 The implementation of the perpetual model of youth in our model 11

Helmut Hofer (IHS) 14

4. The labour market 14

4.1 Labour supply 15

4.2 Labour demand 18

4.3 Wage setting and unemployment 18

Serguei Kaniovski (WIFO)

5. Domestic prices **23**

Thomas Url (WIFO)

6. Income determination **24**

Thomas Url (WIFO)

7. The public sector **27**

Andreas Ulrich Schuh (IHS)

8. Social security **33**

8.1 Social Expenditures *33*

8.2 Social security contributions *36*

Serguei Kaniovski (WIFO)

9. Foreign trade and the terms of trade **39**

References **41**

Appendix **43**

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Josef Baumgartner (WIFO)

1. Introduction and overview

A-LMM is a long-run macroeconomic model (LMM) developed jointly by the Austrian Institute of Economic Research (WIFO) and the Institute for Advanced Studies (IHS). This annual model has been designed to analyse the macroeconomic impact of long-term issues on the Austrian economy by developing long-term scenarios and performing simulation studies. The current version of the model foresees a projection horizon until the year 2050. The model puts an emphasis on financial flows of the social security system.

Should the current demographic trends continue, the long-term sustainability of old-age pension provision and its consequences for public finances will remain of high priority for economic policy in the future[1]. Social security reforms have usually long lasting consequences. These consequences depend on demographic developments, the design of the social security system, and last, but not least, on long-term economic developments.

The presence of lagged and long lasting effects of population aging and the infeasibility of real world experiments in economics justifies the need for a long-run economic model in which the main determinants and interactions of the Austrian economy are mapped. Different scenarios for the economy could then be developed as simulation experiments contingent on exogenous and policy variables in a flexible way.

So far the main focus of existing models developed by both institutes has been on the short-run to medium-run economic forecasts. In these models, the demand side of the economy is very prominent. However, the analysis of long-run consequences of policy actions requires greater attention to modelling the supply side of the economy. Therefore, it is necessary to develop a self-contained long-run empirical growth model for the Austrian economy.

This introduction highlights the main features of A-LMM. It is followed by a detailed discussion of the methodology used in constructing the model which is presented in the following sections. A-LMM is theory-based model, with two types of private agents – firms and private households. Private agents' behavioural equations are derived from dynamic optimisation principles under constraints and based on perfect foresight. The third major actor we consider the general government. The government is constrained by the requirement of the long-term solvency for the public debt.

[1] Since the beginning of the nineties, macroeconomic consequences of population aging, especially for public budgets, are an issue of concern to international organisations like the OECD or the IMF (see *Leibfritz et al.,* 1995, *Koch – Thiemann,* 1997). In the context of the Stability and Growth Pact of the European Union, the budgetary challenges posed by aging populations have become a major concern in the European Union under the headline 'Long-term Sustainability of Public Finances' (see *Economic Policy Committee,* 2001, 2002, *European Commission,* 2001, 2002). For an Austrian perspective see *Part – Stefanits* (2001) and *Part* (2002).

In the economics profession it is a widespread notion, that long-run economic development (the long-run growth path) is determined by supply side factors. Thus, the modelling of firm behaviour becomes decisive for the properties of our model[2]. Firms are assumed to produce goods and services using capital and labour as inputs. Factor demand is derived under the assumption of profit maximisation subject to resource constraints and production technology. The technology is given by a constant elasticity of substitution (CES) production function with Hicks-neutral technical progress. Capital accumulation is based on a modified neoclassical investment function with forward looking properties. In particular, the rate of investment depends on the ratio of the market value of new additional investment goods to their replacement costs. This ratio (Tobin's Q) is influenced by expected future profits and business taxes. Labour demand is derived directly from the first order condition of the production function.

Private households' behaviour is derived from intertemporal utility maximisation according to an intertemporal budget constraint. In this set-up decisions about consumption and savings (financial wealth accumulation) are formed in a forward looking manner. Consumption depends on current disposable income, discounted expected future disposable income (human wealth) and financial wealth (see Chapter 3).

To afford consumption goods, household supply their labour force and receive income in return. A special characteristic of A-LMM is the focused on disaggregated labour supply. In general, the labour force can be represented as a product of the size of population and the labour market participation ratio. In the model we implement a highly disaggregated (by sex and age groups) model for the participation ratios. This gives us the opportunity to account for differences of behaviour of male and female (where part-time work is a major difference) and young and old employees (here early retirement comes into consideration).

Another special characteristic of WIFO-IHS-LMM is a disaggregated model of the social security system as part of the public sector. We explicitly model the expenditure and revenue side for unemployment insurance, pension insurance, health, and accident insurance. Demographic developments are the main explanatory variables in the social security model. For the public sector as a whole, the long-run balanced-budget condition is forced to hold via a policy reaction function.

These features of A-LMM ensure that its long-run behaviour resembles the results of standard neoclassical growth theory. That is, the model attains a steady state growth path determined by the growth rate of the labour force and technical progress.

Because of the long projection horizon and a comparatively short record of sensible economic data for Austria, the parameterisation of the model draws extensively on

[2] See, for example, *Allan - Hall* (1997).

economic theory[3]. This shifts the focus towards theoretical foundations, economic plausibility, and long-run stability conditions and away from statistical inference. As a consequence, many model parameters are either calibrated or estimated under theory based constraints[4].

The report is structured as follows. First, firm behaviour is presented in Section 2, where investment determination, capital accumulation and the properties of the production function are analysed. Section 3 discusses private household consumption and savings decisions. In Sections 4 and 5 we consider the labour market and domestic prices determination. The public sector as a whole and the social security system are dealt with in Sections 6 and 7 respectively. The connection to the rest of the world is the focus of Section 8. Finally we summarise and discuss further extensions of the model in Section 9.

[3] Any consistent empirical macroeconomic model must rely on the system of national accounts. On the basis of the current European System of National Accounts framework (*ESNA*, 1995), official data are available from 1976, in part only from 1995, onwards. The projection outreaches the estimation period by a factor of two.

[4] "[S]o called 'calibrated' models [...] are best described as numerical models without a complete and consistent econometric formulation [...]" *Dawkins et al.* (2001, p. 3655). Parameters are usually calibrated so as to reproduce the benchmark data as an equilibrium. A typical source for calibrated parameters is empirical studies which are not directly related to the model at hand, for example cross section analysis or estimates for other countries, or simple rules of thumb that guarantee model stability. For a broader introduction and discussion of the variety of approaches subsumed under the term 'calibrated models' see *Hansen – Heckman* (1996), *Watson* (1993) and *Dawkins et al.* (2001).

Serguei Kaniovski (WIFO)

2. Firm behaviour

2.1 The modified neoclassical investment function

Lucas – Prescott (1971) were the first to recognise that adding the costs of installing new investment goods to the neoclassical theory of investment by *Jorgenson* (1963) not only alleviates some problems in that theory but also allows it to be reconciled with the Q-theory of investment by *Tobin* (1969). *Hayashi* (1982) shows how this can be done in a formal model. Our modelling of investment behaviour closely follows Hayashi's approach but, in addition, incorporates some aspects of Austria's fiscal system. These are included primarily to widen the scope of simulations that can be performed using the model.

Jorgenson (1963) postulates a representative firm with perfect foresight. The firm chooses the rate of investment so as to maximise the present discounted value of future net cash flows subject to the technological constrains and market prices (output and factor prices). *Lucas* (1967) and others noted the following two problems in the early versions of that theory: the indeterminacy of the investment rate and the exogeneity of output, the latter being inconsistent with perfect competition. The former problem was addressed later by including a distributed lag function for investment. This inclusion can be motivated by the presence of adjustment costs. Adding a new capital good to the existing stock of capital incurs a cost. This cost can be thought of as the cost of adjusting the capital stock or the cost of installing the new capital good.

Tobin (1969) explains the rate of investment by the ratio of the market value of new additional investment goods to their replacement costs: the higher the ratio, the higher the rate of investment. This ratio is known as Tobin's marginal Q. Without resorting to optimisation, Tobin argued that, when unconstrained, the firm will increase or decrease its capital until Q is equal to unity. *Hayashi* (1982) offers a synthesis of Jorgenson's neoclassical model of investment with Tobin's approach by introducing an installation function to the neoclassical optimisation problem of the firm. The installation function gives the portion of gross investment that turns into capital. The vanishing portion is the cost of installation. The installation function is strictly monotone increasing and concave in investment with the obvious property of taking the value of zero when no investment is taking place. It is increasing because for a given stock of capital, the cost of installment per unit of investment is greater, the greater the rate of investment, and concave because of diminishing marginal costs of installment. The installation function is commonly defined via its inverse, which exists by monotonicity.

For an installation function that is linear homogenous in investment and the capital stock, *Hayashi* (1982) derives the following general investment function:

$$\frac{I_t}{K_{t-1}} = F\left(\frac{Q_t}{1-Z_t}\right), \tag{2.1}$$

where I_t is gross investment, K_t the stock of capital, and Z_t is the present value of the depreciation tax allowance. Neoclassical theory assumes a representative firm with perfect foresight of future net cash flows. This is reflected in Q_t and Z_t. Both are present values that are computed as follows:

$$Q_t = \sum_{i=0}^{T} \frac{(1 - RKOST_t - RDIRT_t)GOS_{t+i}}{P_{t+i}K_{t+i}(1 + R_{t+i} + RD_t)^i} \text{ and } Z_t = \sum_{i=0}^{T} \frac{RA_t}{(1 + R_{t+i})^i}, \tag{2.2}$$

where i=0,2,...,T. These variables introduce a forward looking element into our model. Here, the theoretically infinite sums are approximated by their first 21 terms, or T=20. The numerator in Q_t is a proxy for the market value of new additional investment. It is given by the operating surplus GOS_t after taxes. Here $RKOST_t$ is the average rate of corporation tax and $RDIRT_t$ the average rate of all other direct taxes paid by the business sector. In the denominator we have a proxy for replacement costs and a discount rate. The former is given by the value of the capital stock at current prices (inflated by the GDP deflator P_t). The relevant discount rate is the sum of real rate of interest, R_t, and the rate of physical depreciation of capital RD_t. The present value of depreciation tax allowance, Z_t, depends on the average rate of depreciation tax allowance RA_t discounted by the real rate of interest R_t. The fiscal policy variables $RKOST_t$, $RDIRT_t$, RA_t, and the rate of physical depreciation of capital, RD_t, are exogenous and are held constant in the baseline. Since depreciation is deduced from the tax base, the investment function becomes

$$\frac{I_t}{K_{t-1}} = F\left(\frac{Q_t}{1-(RKOST_t + RDIRT_t)Z_t}\right). \tag{2.3}$$

For a particular inverse installation function

$$\psi(I_t, K_{t-1}) = I_t\left(1 + \frac{\phi}{2}\frac{I_t}{K_{t-1}}\right)\frac{PI_t}{P_t}, \tag{2.4}$$

the investment function becomes

$$\frac{I_t}{K_{t-1}} = \frac{1}{\phi}\left(\frac{Q_t \cdot P_t}{(1-(RKOST_t + RDIRT_t)Z_t)PI_t} - 1\right), \tag{2.5}$$

where P_t denotes the GDP deflator, PI_t the investment deflator, and the constant parameter $\phi \geq 0$ reflects adjustment costs of capital.

2.2 Capital stock and depreciation

The capital stock at constant 1995 prices is accumulated according to the perpetual inventory method:

$$K_t = (1 - RD_t)^{0.5} I_t - (1 - RD_t) K_{t+1}, \tag{2.6}$$

subject to a constant rate of physical depreciation RD_t=0.039 and an initial stock. This value implies that an average investment good is scrapped after 25.6 years. The factor $(1\text{-}RD_t)^{0.5}$ accounts for the fact that investment goods depreciate already in the year of their purchase. Specifically, we assume that new investment goods depreciate uniformly in the year of their purchase as well as in each of the following years. Physical depreciation at current prices is thus given by

$$DPN_t = RD_t K_{t-1} PI_t = \left((1 - RD_t)^{0.5} I_t - \Delta K_t\right) PI_t, \tag{2.7}$$

where RI_t denotes the investment deflator and Δ the first-difference operator[5]. For a comprehensive discussion of methodology for measuring the capital stock in Austria see *Böhm et al.* (2001) and *Statistik Austria* (2002).

2.3 The neoclassical production function

Output is produced by combining labour and physical capital under constant returns to scale and a constant elasticity of substitution (CES) between the input factors. Technical progress is Hicks-neutral. That is, technical progress augments total factor productivity as opposed to labour productivity only. After taking the natural logarithm, the CES production function is given by:

$$\log(Y_t) = \alpha_0 + TFP\, t - \frac{1}{\rho} \log(\delta K_t^{-\rho} + (1-\delta) LH_t^{-\rho}), \tag{2.8}$$

where Y_t denotes the GDP at constant 1995 prices, LH_t the number of full-time equivalent employees[6], and K_t the stock of capital. The parameter δ=0.4 is the factor share (or input intensity) of capital. The parameter ρ=0.57 is the substitution parameter, so that the elasticity of substitution between capital and labour $\sigma=(1+\rho)^{-1}$=0.64. The elasticity of substitution is a local measure of technological flexibility. It characterises alternative combinations of capital and labour which generate the same level of output. In addition, under the assumption of cost minimisation on the part of the representative firm, the elasticity of substitution measures the percentage change in the relative factor input as a consequence of a change in the

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5 The difference operatior is defined as $\Delta X_t = X_t - X_{t-1}$.

6 Following the convention of the National Accounts, the compensation of self-employed are included in gross operating surplus and therefore are not a part of the compensation of employees. We therefore exclude labour input by the self-employed from the production function.

relative factor prices. In our case, factor prices are the real wage per full-time equivalent *WHR*$_t$ and the user costs of capital *UCC*$_t$. Thus, other things being equal, an increase of 1 percent of the ratio of real wage to the user costs will lower the ratio of the number of employees to capital by 0.64 percent.

In the baseline, we assume the annual rate of change of the total factor productivity *TFP*$_t$ to be constant at 1.8 percent. This assumption of exogenous and constant technical progress is made for simplicity only; it facilitates the testing of the model and will be readdressed in a future version of the model.

By duality, profit maximisation and cost minimisation yield the same optimal behaviour. Input intensities and elasticity of substitution are estimated with Maximum Likelihood method from a pair of first order conditions to the problem of cost minimisation for a given set of output and factor prices:

$$\log(WHR_t) = \log(0.6) + 0.57(2.9032 + TFP_t\,t) + (1+0.57)\left(\frac{Y_t}{LH_t}\right)^{1+0.57} \quad (2.9)$$

$$\log(UCC_t) = \log(0.4) + 0.57(2.9032 + TFP_t\,t) + (1+0.57)\left(\frac{Y_t}{K_t}\right)^{1+0.57}. \quad (2.10)$$

For the user costs of capital in Austria we use the time series constructed by *Kaniovski* (2002). After substituting factor shares and the elasticity of substitution into the production function, the constant a_0 and the rate of change of factor productivity *TFP*$_t$ are estimated directly from the production function.

Thomas Url (WIFO)

3. Consumption of private households

3.1 The model of perpetual youth

The consumption behaviour of private households is based on the model of perpetual youth as presented in *Blanchard – Fischer* (1989). This is a continuous time version of an overlapping generations model. For simplicity, the individual in this model faces a constant probability of dying, *PRD,* at any moment throughout his life. This implies that the individual life time is uncertain but independent of age. The assumption of a constant probability of death, although unrealistic, allows for tractability of the model and generates reasonable steady state characteristics.

At every instant of time a new cohort is born. The size of the new born cohort declines at the rate *PRD* over time. If the size of a newly born cohort is normalised such that it equals *PRD* and the remaining life time has an exponential distribution, then the size of the total population equals 1 at any point in time.

We impose that individuals consume their total life time income, which implies that there are no bequests left over to potential heirs. To achieve this, we suppose a reverse insurance scheme with full participation of the total population. The insurance pays out the rate $PRD\ hwf_t$ per unit of time in exchange for the amount of financial wealth, *hwf,* accumulated by the individual at his time of death[7]. This insurance scheme works because the individual probability of death is uncertain, while the probability of death in the aggregate is deterministic, and because the size of newly born cohorts is kept constant. The insurance fund receives bequests from those who die at the rate $PRD\ hwf_t$, and pays out claims at the rate $PRD\ hwf_t$ to all surviving individuals. This allows all individuals to consume their total expected life time income.

The individual maximises the objective function

$$\int_t^\infty \log(cp_{t+i}) e^{-(RTP+PRD)i} di , \qquad (3.1)$$

which describes expected utility as the discounted sum of instantaneous utilities from current and future consumption (cp_{t+i}) for i=0,...,∞ with *RTP* as the rate of time preference, i. e. the subjective discount factor. In this case the utility function is logarithmic, which imposes a unit elasticity of substitution between consumption across different periods. The only source of

[7] In this section, lower case letters indicate individual specific values, whereas upper case letters refer to aggregate values.

uncertainty in this model comes from the possibility of dying. Given an exponential distribution for the probability of death, the probability of surviving until period *t+i* is:

$$e^{-PRD(t+i-t)} = e^{-PRDi}, \tag{3.2}$$

This equation shows that the discount function in (3.1) accounts for the effect of uncertain life time on consumption. Because of this uncertainty future consumption has a lower present value, i.e., the discount factor is smaller as compared to a certain world.

For a given level of financial wealth in period *t+i,* interest is accrued at the real rate of R_{t+i}. Additionally, the individual receives the claims payment from the insurance fund to the extent of *PRD* hwf_{t+i}. Consequently, during life time the budget constraint is given by

$$\frac{d}{d}\frac{hwf_{t+i}}{(t+i)} = (R_{t+i} + PRD)hwf_{t+i} + yl_{t+i} - cp_{t+i}, \tag{3.3}$$

where *yl* represents the individual's labour income. The change in financial wealth thus depends on interest income, the claims payment, and current savings. The following No-Ponzi-Game-Restriction prevents individuals from borrowing infinitely:

$$\lim_{t+i\to\infty} hwf_{t+i} \exp\left(-\int_t^{t+i}(R_j + PRD)dj\right) = 0. \tag{3.4}$$

An individual cannot accumulate debt at a rate higher than the effective rate of interest he faces. Households have to pay regular interest, R_t, on debt and a life insurance premium at rate *PRD* to cover the uncertainty of dying while indebted. Human wealth is given by the discounted value of future labour income hwh_t:

$$hwh_t = \int_t^{\infty} yl_{t+i} \exp\left(-\int_t^{t+i}(R_j + PRD)dj\right)di, \tag{3.5}$$

where the discount factor corresponds to the risk adjusted interest rate (R_t+*PRD*). The individual maximises expected utility (3.1) subject to the accumulation equation (3.3) and the tranversality condition (3.4). The resulting first order condition:

$$\frac{d}{d}\frac{cp_{t+i}}{(t+i)} = \{(R_{t+i} + PRD) - (RTP + PRD)\}cp_{t+i} = (R_{t+i} - RTP)cp_{t+i}. \tag{3.6}$$

This Euler equation states that individual consumption varies positively with the difference between the real rate of interest and the rate of time preference. Interest rates above the subjective discount rate will be associated with higher levels of consumption, while interest rates below it, will cause lower consumption levels. Integrating (3.6) gives the optimal level of individual consumption in period *t*:

$$cp_t = (RTP + PRD)(hwf_t + hwh_t). \tag{3.7}$$

Thus, the consumption level depends on the sum of financial and human wealth in period *t*, from which a constant fraction (*RTP+PRD*) will be consumed. The propensity to consume is independent of the interest rate because of the logarithmic utility function. It is also independent from the individual's age because the probability of death is assumed to be constant.

Since individuals of a generation are identical, the individual optimality condition holds for the whole generation. In order to achieve a representation of aggregate consumption we have to sum over generations of different size which does not affect the shape of the optimal consumption function (3.7), rather, different concepts for financial and human wealth must be used. The optimal level of aggregate consumption CP_t is:

$$CP_t = (RTP + PRD)(HWF_t + HWH_t), \tag{3.8}$$

where HWF_t represents aggregate financial wealth and HWH_t aggregate human wealth.

The formulas for the accumulation of aggregate financial wealth recognise that the effect of uncertain life time cancels throughout generations because financial wealth at death is collected by the insurance scheme and redistributed to surviving individuals. The accumulation equation for the society is:

$$\frac{dHWF_t}{dt} = R_t HWF_t + YL_t - CP_t, \tag{3.9}$$

where YL_t is aggregate labour income in period *t*. Aggregate financial wealth accumulates only at the rate R_t because $PRD\ HWF_t$ is a pure transfer from dying individuals to survivors through the insurance fund. Consequently, the individual rate of return on wealth is above social returns.

In order to derive the behaviour of aggregate human wealth, HWH_t, we have to define the distribution of labour income among individuals at any point in time. Since labour income may depend on the age profile of an individual, we will introduce an additional parameter, φ, that characterises the curvature of labour income with increasing age. Aggregate human wealth then corresponds to the present value of future labour income:

$$HWH_t = \int_t^{\infty} HYNSI_{t+i} \exp\left(\int_t^{t+i} (\varphi + PRD + r_j) dj\right) di, \tag{3.10}$$

where the discount factor now includes the change in labour income with increasing age. This formulation allows for exponentially growing or falling age income profiles. If $\varphi=0$ the age income profile is flat and labour income is independent of age. Any positive value of φ results in a falling individual income over time and, thereby, will increase the discount factor and reduce the value of aggregate human wealth relative to the case of age independent income profiles. A falling age income profile over time is consistent with a reduction in income levels after retirement.

This small scale consumption model implies that the propensity to consume and the discount rate for human wealth are increasing functions of the probability of death. If individuals face a longer life horizon, the probability of death, *PRD*, will get smaller and the propensity to consume will decrease, while at the same time the value of human wealth will increase because of the lower discount factor.

The introduction of a negative slope in the age income profile has implications for the dynamics and the steady state behaviour of the model. Assuming a stationary economy or, equivalently, subtracting the constant trend growth from all relevant variables, *Blanchard – Fischer* (1989) show that this model is saddle path stable. This property holds if the production function has constant returns to scale and the rate of capital depreciation is constant. Both assumptions are satisfied in our model.

3.2 The implementation of the perpetual model of youth in A-LMM

The perpetual youth model is based on an economy without state intervention. To achieve a realistic framework, we will have to introduce taxes and transfers into the definition of income. The optimal level of aggregate consumption is given by equation (3.8). If aggregate consumption follows such a rule, households will smooth their consumption over life time. If actual income is below its expected value, households will accumulate debt, while they start saving in periods when actual income is in excess of expected income. If one allows for uncertainty about future labour income and returns on assets by introducing stochastic shocks with zero mean and assumes a quadratic utility function the time series for aggregate consumption follows a random walk (*Hall*, 1978). Such a process for private consumption implies that there is no significant correlation between actual disposable income and private consumption. Actually, the correlation between both variables in Austria is 0.99 (1976 through 2002) and many empirical studies on the behaviour of consumption, however, find a stable and long run relation between consumption and disposable income, which is only a fraction of human wealth and which fluctuates more strongly.

Davidson et al. (1978) develop the workhorse for empirical consumption functions, which is still widely tested and applied, cf. *Clements – Hendry* (1999). *Wüger – Thury* (2001) base their consumption model also on the error correction mechanism approach. Their estimation results for quarterly data are the most recent for Austria.

Models based on the error correction mechanism clearly contradict the notion of consumption following a pure random walk. Thus for a better fit of data we will follow *Campbell – Mankiw* (1989) and introduce two groups of consumers. The first group follows the optimal consumption rule resulting from the solution of the above maximisation problem. A fraction λ of the population belongs to the second group which follows a different rule. The second group may be called rule-of-thumb consumers, because they consume their real disposable income YDN_t/P_t. Nominal disposable income, YDN_t, will be divided into two components:

$$YDN_t = HYNSI_t + \left(HYS_t + HYI_t\right), \tag{3.11}$$

where by definition:

$$HYNSI_t = YDN_t - \left(HYS_t + HYI_t\right). \tag{3.11'}$$

These two components differ according to their source of income. The variable HYS_t represents income from entrepreneurial activity and HYI_t corresponds to interest earnings, both at current prices. All other nominal income components are for simplicity related to labour market participation and are summarised as $HYNSI_t$ (cf. Section 6). This distinction follows our definition of human and financial wealth.

The rule of thumb behaviour can be motivated by liquidity constraints that prevent households from borrowing the amount necessary to finance the optimal consumption level (*Deaton*, 1991). Quest II, the multi country business cycle model of the European Commission also uses this approach (*Roeger – In't Veld*, 1997).

By assuming two groups of consumers, we arrive at the following consumption function:

$$CP_t = (1-\lambda)(RTP + PRD)(HWH_t + HWF_t) + \lambda \frac{YDN_t}{P_t}, \tag{3.12}$$

where the fraction of liquidity constrained households $\lambda=0.3$, the rate of time preference $RTP=0.0084$ and $PRD=0.02$ are set in accordance with *Roeger – In't Veld* (1997). The value for *PRD* implies a fifty year forward looking horizon. We also tried a time variable version for *PRD* that accounts for the increase in the expected average age of the Austrian population (*Hanika*, 2001), but the difference is minimal.

Human capital is computed as the discounted sum of future disposable non-entrepreneurial income, $HYNSI_t$. The discount factor comprises not only the interest rate but also the probability of death:

$$HWH_t = \sum_{i=0}^{30} \frac{HYNSI_{t+i}}{P_{t+i}} \frac{1}{\left(1 + R_{t+i} + PRD\right)^i}. \tag{3.13}$$

Because a forward looking horizon of 30 years with a real rate of interest of 3 percent and a probability of death of 2 percent captures already 80 percent of the present value of the future income stream, we choose 30 years as the cut off date. As can be seen from (3.13) we assume a constant age income profile, i.e., $\alpha=0$. Actually, age income profiles for blue collar workers are of this shape, whereas white collar workers have hump shaped profiles, and civil servants show increasing age income profiles (*Alteneder – Révész – Wagner-Pinter*, 1997; *Url*, 2001).

There is a trade off between achieving more accuracy in the computation of human capital and a longer forward looking period needed in this case. The cut off date of 30 years implies comparatively short forward looking solution periods. This is preferable in our situation because the available horizon of the population forecast is 2070 and we have to extrapolate the population by simple measures.

Financial wealth is computed as the sum of the initial net foreign asset position of Austria at current prices at the beginning of period *t*, NFA_t. The present value of future gross operating surplus, GOS_t, as well as the future trade surplus, (X_t-M_t), is the forward looking component of aggregate financial wealth HWF_t:

$$HWF_t = \frac{NFA_t}{P_t} + \frac{HYS_t + HYI_t}{P_t} \sum_{i=1}^{30} \left(\frac{GOS_{t+i}}{P_{t+i}} + X_{t+i} - M_{t+i} \right) \frac{1}{\left(1 + r_{t+i} + PRD\right)^i} . \quad (3.14)$$

In order to avoid double counting we only include income from entrepreneurial activity and interest income into to the computation of financial wealth for period *t*. This formulation somehow departs from equation (3.9), which uses initial financial wealth and adds interest as well as national savings. The reason is, first, that we have to capture the open economy characteristic of Austria. Today's negative net foreign asset position will result in a transfer of future interest payment abroad and thus reduce future income from wealth.

Second, by including the gross operating surplus, GOS_{t+i}, into (3.14) we use the standard valuation formula for assets. Assets are valued by their discounted stream of future income. This formulation has the big advantage that all sources of capital income enter the calculation of financial wealth. This includes also hard to measure items like the value of small businesses not quoted on a stock exchange and retained earnings. We also draw no distinction between equity and bonds. Bonds will be regarded net wealth as long as the stream of interest payments has a positive value.

Because individuals only consider after tax income in their consumption decision, the impact of deficit financed government spending on the households' consumption level depends on the timing between spending and taxation. Equivalently to human wealth our discount horizon is cut off at 30 years. This implies that compensatory fiscal and social policy decisions which are delayed beyond this cut off date will not affect the actual consumption decision and thus, Ricardian equivalence does not hold in our model.

Helmut Hofer (IHS)

4. The labour market

The labour market block of the model contains three parts. In the first part aggregate labour supply is projected for the next fifty years. Trend labour supply is determined by activity rates of disaggregated sex-age cohorts and the respective population shares. Actual labour supply depends on the economic development and on trend labour supply. Optimal labour demand is derived from a CES-production function. Real wages are assumed to be determined in a bargaining framework and depend on the level of (marginal) labour productivity, the unemployment rate, and a vector of so-called wage push factors (labour taxation and the replacement rate).

We use the following data with respect to labour. The economically active population (EP) contains the dependent employed (LE), the self-employed (LES), and the unemployed (LU). In modelling the Austrian labour market we concentrate on dependent employment and unemployment. Therefore, in our definition of labour supply ($LSACT_t$) the self-employed are excluded, but LES_t can always be calculated as difference between EP_t and $LSACT_t$. The unemployment rate UR is calculated as:

$$UR_t = \frac{LU_t}{LE_t + LU_t}. \qquad (4.1)$$

Due to administrative reasons LE contains persons on maternity leave and persons in military service (Karenzgeld- bzw. Kindergeldbezieher und Kindergeldbezieherinnen und Präsenzdiener mit aufrechtem Beschäftigungsverhältnis) (LENA). In the projection of LENA we assume a constant relationship (FLENA) between LENA and the population from 0 to 15 years. We use the number of dependent employed in full-time equivalents (LH) as labour input in the production function. The data source for employment in full-time equivalents is Statistik Austria. Employment (in persons) is converted into employment in full-time equivalents through the factor FLH_t, which is defined in the following way:

$$FLH_t = \frac{LH_t}{\left(LE_t - LENA_t\right)}. \qquad (4.2)$$

In the current version FLH_t is kept constant over the whole forecasting period. The parameter can be used to take into account growing part-time work. This will be addressed in a future version of the model.

4.1 Labour supply

The aim of this section is to develop a long-run scenario for the development of labour supply in Austria. The projections for the labour force depend on the development of the activity rates and the population scenario. In our model population dynamics is exogenous and we use the population projections 2000 to 2050 (medium variant) from 2001 by Statistik Austria (*Hanika,* 2001). Data source is the ISIS-data base. We model the development of labour supply as a two-step process. In the first step trend labour supply (EPT) is estimated. In the second step we account for repercussions of the economic development on the labour supply.

EPT_t consists of the dependent employed, the self-employed, and the unemployed. We project the activity rates for 6 male (EQM_1 to EQM_6) and female (EQF_1 to EQF_6) age cohorts separately. The following age groups are used (EQM_i and EQF_i: 15 to 24 years; 25 to 49 years; 50 to 54 years; 55 to 59 years; 60 to 64 years and 65 years and older). $POPM_1$ to $POPM_6$ and $POPF_1$ to $POPF_6$ denote the corresponding population groups.

$$EPT_t = \sum_{i=1}^{6} EQM_{it} POPM_{it} + EQF_{it} POPF_{it} \qquad (4.3)$$

Similarly to most other industrialized countries, Austria experiences a rapid decrease in old age labour-force participation (see, e.g., *Hofer – Koman,* 2001). Male labour force participation declined steadily for all ages over 55 since 1955. This decrease accelerated between 1975 and 1985. In the 1990s, the labour force participation rate for males between age 55 and 59 stayed almost constant, but at a low level of 62 percent in 2001. The strongest decrease can be observed in the age group 60 to 64. In 1970, about 50 percent of this age group was in the labour market, as opposed to 15 percent in 2001. The pattern of female labour force participation is different. For age groups younger than 55 labour force participation increased, while for the age group 55 to 59 a strong tendency for early retirement can be observed. One should keep in mind that the statutory retirement age is 60 for women and 65 for men. In the period 1975 to 1985 the trend towards early retirement due to long-time insurance coverage or unemployment shows a strong upward tendency. This reflects up to a certain extent the deterioration of the labour market situation in general. Early retirement was supported by the introduction of new law. Given the relatively high pension expenditures and the aging of the population, the government introduced reforms with the aim to raise the actual retirement age and to curb growth of pension expenditures. For example, the reform in 2000 gradually extended the age limit for early retirement due to long-time insurance coverage to 56½ years for female and 61½ years for male. The recent pension reform abolishes early retirement due to long-time insurance coverage gradually until 2014. Starting from the second half of 2004, the early retirement age will be raised by 1 month every quarter.

In the first step we model the participation rates outside the macro-model. One methodology used for long-term labour force projections is to extrapolate trends for various age and sex groups (see, e.g., *Toossi,* 2002). This method assumes that past trends will continue.

We follow this methodology to derive scenarios for the female labour supply in the age group 25 to 49. In general, we project that the trend of rising female labour force participation will continue. We use data on labour force participation rates for age groups 20 to 24, 25 to 30, 30 to 40, and 40 to 50 since 1970 and estimate a fixed effects panel model to infer the trend. In our model labour force participation depends on a linear trend, a human capital variable (average years of schooling) and GDP growth. We apply a logistic transformation to the participation rates (see *Briscoe – Wilson,* 1992). The panel regression gives a trend coefficient of 0.06. Using this value for forecasting female participation rates and the projected increase in human capital of one additional school year would imply an increase in the female participation rate of 15 percentage points until 2050. Given the increase in female participation in the last 30 years and the already relatively high level now, we assume that trend growth will slow down and only $^2/_3$ of the projected increase will be realised. This implies that the female participation rate in the 20 to 49 year cohort will increase from 73 percent in 2000 to 83 percent in 2050. With respect to male labour force participation in the age group 25 to 49 years we assume stable rates. Given these projections the gender differential in labour force participation would decrease from 15 percentage points in 2000 to 7 percentage points in 2050 in the age group 25 to 49. For the age cohort 15 to 24 year we project stable rates for male and a slight reduction for females.

Austria is characterised by a very low participation rate of older workers. In the past big incentives built in the Austrian pension system to retire early, have contributed to the sharp drop in labour force participation among the elderly (*Hofer – Koman,* 2001). In our scenario the measures taken by the federal government to abolish early retirement due to long-time insurance coverage reverse the trend of labour force participation of the elderly.

We project the following scenario for the different age cohorts. For the male 50 to 54 age cohort we observe a drop from 87 percent to 80 percent in the last ten years. We project a slight recovery between 2010 and 2025 to 85 percent and a constant rate afterwards. A similar tendency can be observed for the age cohort 55 to 60. The participation rate is expected to increase from 68 percent in 2002 to 77 percent in 2030. The activity rate of 77 percent corresponds to the values in the early eighties. The abolishment of the possibility for early retirement due to long-time insurance coverage should lead to a strong increase in the participation rate of the age group 60 to 64. We project an increase to 50 percent until 2025. Note that the higher participation rates in the age cohorts under the age of 60 automatically lead to a higher stock of employees in the age group of 60 to 64 in the future. For the age group 64 plus we assume a slight increase. These projections imply for the male participation rate a steady increase to 82 percent until the end of the projection period.

Therefore, our projections imply that male participation revert to the values recorded in the early eighties.

The long-run projections of female participation rates for the elderly are characterised by cohort effects and by changes in pension laws. For the age group of 50 to 54 we project a steady increase from 65 percent to 76 percent in 2050. We project an increase from 33 percent in 2002 to 57 percent in 2050 for the age group 55 to 59. For the age cohort 60 to 64 years we expect a slight increase until 2025 mainly due to cohort effects. In the period 2024 to 2033 the female statutory retirement age will be gradually increased from 60 to 65 years. Therefore we expect a strong increase in the participation rate of this group from 20 percent in 2025 to 38 percent in 2040. Our projections imply for the female participation rate of the age group 15 to 64 a slight increase from 60 percent in 2002 to 63 percent in 2025. Due to cohort effects and the change in statutory retirement age the trend in the activity rate increases in the following years. At the end of the projection period the participation rate of females amounts to 70 percent.

One should note that we have projected a relatively optimistic scenario for the trend activity rate. This scenario implies that the attachment of females to the labour market will be considerably strengthened and the pension reform leads to a considerable increase in the labour force. As the activity rate is very important for economic growth in our model, one simulation alternative is to investigate the effect of different labour force scenarios on economic growth.

In a second step we investigate repercussions from economic conditions on labour supply. In the following we model trend of dependent labour supply (LS) as the sum of the dependent employed and the unemployed. We assume that the share of self-employed in EPT remains constant:

$$LS_t = EPT_t \ FEP_t \,. \tag{4.4}$$

For the formulation of actual labour supply and the wage equation we have borrowed some elements of neo-classical labour supply hypothesis. We briefly introduce the basic elements of the theory (*Borjas,* 1999). In the standard neo-classical model supply of labour is derived from a household utility function where households value leisure positively. Supplied hours of work depend positively on the net real wage rate (substitution effect) and negatively on the household wealth (income effect). Households choose their optimal labour supply such that the net real consumption wage is equal to the ratio between marginal utility of leisure and the marginal utility of consumption.

In our model actual labour supply (LSACT) depends on wages, unemployment, and trend labour supply. We postulate the following error-correction model for LSACT:

$$\begin{aligned}\Delta \log(LSACT_t) = \alpha_0 + \alpha_1 \Delta \log(UR_t) + \alpha_2 \Delta \log(WHRN_t) \\ + \alpha_3 \big(\log(LSACT_{t-1}) - \log(LS_{t-1})\big). \end{aligned} \tag{4.5}$$

We estimate the effects of the change in the (logged) unemployment rate and in the real wage, net of taxes, on labour supply. We find a negative coefficient of –0.0049 for unemployment and a coefficient of 0.42 for the real wage, implying a dominant substitution effect. We assume a speed of adjustment of 5 years (i.e., a_3=0.2). a_0 is currently fixed at a level that on average over the whole forecasting period LS is equal to LSACT.

4.2 Labour demand

In our model the production technology is expressed in terms of a two-factor (labour and capital) constant returns-to-scale CES production function. Labour input (LH) is measured as the number of dependent employed persons in full-time equivalents. Consistent with the production technology optimal labour demand (LH*) can be derived from the first order conditions (FOC of the cost minimisation problem) as follows.

$$\log(LH_t^*) = \frac{\log(1-\delta)}{\sigma} - \sigma \log(WHR_t) - \frac{\rho}{\sigma}(\alpha_0 + TFP_t\, t) + \log(Y_t) \qquad (4.6)$$

Labour demand is a positive function of output and is negatively related to real wages. Labour is a quasi-fixed factor of production since it takes time for firms to adjust to their optimal workforce (*Hamermesh,* 1993). Taking that into account, we assume the following partial adjustment process for employment, where the partial adjustment parameter s denotes the speed of adjustment:

$$\left(\frac{LH_t}{LH_{t-1}}\right) = \left(\frac{LH_t^*}{LH_{t-1}}\right)^s, \qquad (4.7)$$

with 0 < s < 1. Actual labour demand is given by

$$\log(LH_t) = s\left(\frac{\log(1-\delta)}{\sigma} - \sigma \log(WHR_t) - \frac{\rho}{\sigma}(\alpha_0 + TFP_t\, t)\log(Y_t)\right) + (1-s)\log(LH_{t-1})\,. \qquad (4.8)$$

The speed of adjustment parameter s is set to $^1/_3$.

4.3 Wage setting and unemployment

OECD and IMF have pointed out repeatedly the high aggregate real wage flexibility in Austria as a major reason for the favourable labour market performance. The characteristics of the wage determination process in Austria can be summarised as follows (see, e.g., *Hofer – Pichelmann,* 1996, *Hofer – Pichelmann – Schuh,* 2001). The development of producer wages essentially follows an error correction model, whereby the share of national income claimed by wages serves as the error correction term. This implies that the labour share remains constant in long-term equilibrium. In terms of dynamics, this corresponds to the well-known relationship of real wage growth (based on producer prices) being equal to the increase in productivity. Inflation shocks triggered by real import price increases or indirect tax increases were fully absorbed in the process of setting wages to the extent that such price shocks apparently did not exert any significant influence on real producer wages. However, the increase in the direct tax burden on labour (primarily in the form of higher social security contributions) seems to have exerted significant pressure on real product wages (see also *Sendlhofer,* 2001).

Theoretical considerations

We present a simple theoretical framework to motivate the wage equation in our model. Assume that logged real wages (w/p) are determined in a bargaining framework and depend in the long run on the level of (trend) labour productivity, the unemployment rate, and a vector x of wage push factors (e.g., taxes). Those variables cause producer real wages

$$\log\left(\frac{w_t}{p_t}\right) = \gamma_0 + \log(prod^*) - \gamma_1 UR_t + \delta X_t, \qquad (4.9)$$

to diverge from the net real consumption wage.

Note that for an economy consistent with Cobb-Douglas technology equilibrium real wages log (w/p)* are in steady state equal to log (prod*)+a, where a is the log of the labour share parameter (see e.g., Turner et al. 1996). Under the condition that in the long run real wages have to be equal to equilibrium real wages, it can be shown that the unique equilibrium rate of unemployment (UR*) is given by

$$UR^* = \frac{(\gamma_0 - \alpha + \delta X_t)}{\gamma_1}. \qquad (4.10)$$

Blanchard – Katz (1999) develop a theoretical framework, explaining that wage inflation depends not only on expected inflation and the unemployment rate, but also on an error correction term, defined as the difference between lagged real wages and lagged labour productivity. Wage setting models imply, in general, that the tighter the labour market, the higher the real wage, given the workers' reservation wage. The real wage relation can be represented as[8]

$$\log\left(\frac{w_t}{p_t}\right) = \mu \log(b_t) + (1-\mu)\log(prod_t) - \gamma_1 UR_t, \qquad (4.11)$$

where b_t denotes the reservation wage and $prod_t$ the labour productivity. The parameter μ ranges from 0 to 1. The replacement rate of unemployment benefits is one important

[8] In the following we assume no expectational errors with respect to price expectations and we replace $E(p_t)$ by p_t.

determinant of the reservation wage. The dependency of unemployment benefits on previous wages implies that the reservation wage will move with lagged wages. Another determinant of the reservation wage is the utility of leisure that includes home production and earning opportunities in the informal sector. Assume that increases in productivity in home production and in the informal sector are closely related to those in the formal sector. This implies that the reservation wage depends on lagged productivity. Furthermore, the condition that technological progress does not lead to a persistent trend in unemployment implies that the reservation wage is homogeneous of degree 1 in the real wage and productivity in the long run. *Blanchard – Katz* (1999) state the following simple relation among the reservation wage, the real wage, and the level of productivity, where λ is between 0 and 1.

$$\log(b_t) = \alpha + \lambda \log\left(\frac{w_{t-1}}{p_{t-1}}\right) + (1-\lambda)\log(prod_t) \tag{4.12}$$

Substituting b_t into the wage equation and rearranging we receive the following equation:

$$\Delta\log(w_t) = \mu\alpha + \Delta\log(p_t) - (1-\mu\lambda)\log\left(\frac{w_{t-1}}{p_{t-1}prod_{t-1}}\right) + (1-\mu\lambda)\Delta\log(prod_t) - \gamma_1 UR_t \tag{4.13}$$

This reformulation shows the connection between the wage curve, a negative relation between the level of the real wage and unemployment, and the (wage) Philips-curve relationship as a negative relationship between the expected change of the real wage and the unemployment rate.

Empirical evidence indicates the presence of an error correction term for Europe but not for the USA (*Blanchard – Katz,* 1999). This suggests that μλ=1 is a reasonable approximation for the USA, whereas in Europe (1 – μλ) is on average around 0.25. Whether μ and λ are close to 1 or smaller has important consequences for the determination of equilibrium unemployment. We close our model of the labour market with the following demand wage relation, where z_t represents any factor, e.g., energy prices, payroll taxes, interest rates, that decreases the real wage level conditional on the technology used:

$$\log\left(\frac{w_t}{p_t}\right) = \log(prod_t) - z_t. \tag{4.14}$$

For constant z and prod the equilibrium unemployment rate (u*) is:

$$u^* = \left(\frac{1}{\gamma_1}\right)\left[\mu\alpha + (1-\mu\lambda)z\right]. \tag{4.15}$$

If μλ is less than unity, the higher the level of z, the higher will be the natural rate.

Based on the aforementioned empirical findings for Austria and the theoretical considerations we set up a wage equation for Austria. We assume no errors in price expectations and model only real wages per full-time equivalent (WHR). WHR are determined in a bargaining framework and depend in the long run on the level of (marginal) labour productivity (MPL), the unemployment rate (UR), and as several wage push factors, such as the tax wedge on labour taxes (TWT) and the gross replacement rate GRR (i.e., the relation of unemployment benefits to gross wages). We postulate the following wage equation in error correction form in our model:

$$\Delta \log(WHR_t) = \alpha_0 + \alpha_1 \Delta \log(WHR_{t-1}) + \alpha_2 \left(\log(WHR_{t-1}) - MPL_{t-1}\right) + \alpha_3 UR_t + \alpha_4 GRR_t + \alpha_5 TWT_t \,. \qquad (4.16)$$

Real wages depend on the unemployment rate and on an error correction term, defined as the difference between the lagged real wage and lagged marginal labour productivity. MPL denotes the log of the marginal product of labour and is derived from the CES production function:

$$MPL_t = \log(1-\delta) - \rho\left(\alpha_0 + TFP_t\, t\right) - \sigma \log\left(\frac{LH_t}{Y_t}\right). \qquad (4.17)$$

We estimate α_2 the coefficient of the error correction term to be –0.23. α_3, the coefficient of the dampening influence of unemployment on wages is estimated to be around –0.5. Note that a higher coefficient implies a lower equilibrium unemployment rate. TWT is defined as the log of gross compensation of employees over net wages and salaries. The wedge includes social security contributions and the tax on labour income. For α_5 we assume a coefficient of 0.1. In our estimation we obtain a slightly higher coefficient, implying unreasonably high increases in unemployment due to an increasing tax wedge. The data for the gross unemployment benefit replacement rate are taken from the OECD. In our estimation we cannot find any significant effect from GRR on wages (see also *Sendlhofer,* 2001). This could be caused by measurement errors. Due to theoretical reasons, we include GRR in our wage equation and calibrate α_4 such that we receive a slightly smaller effect of changes in GRR on unemployment as compared to the tax wedge.

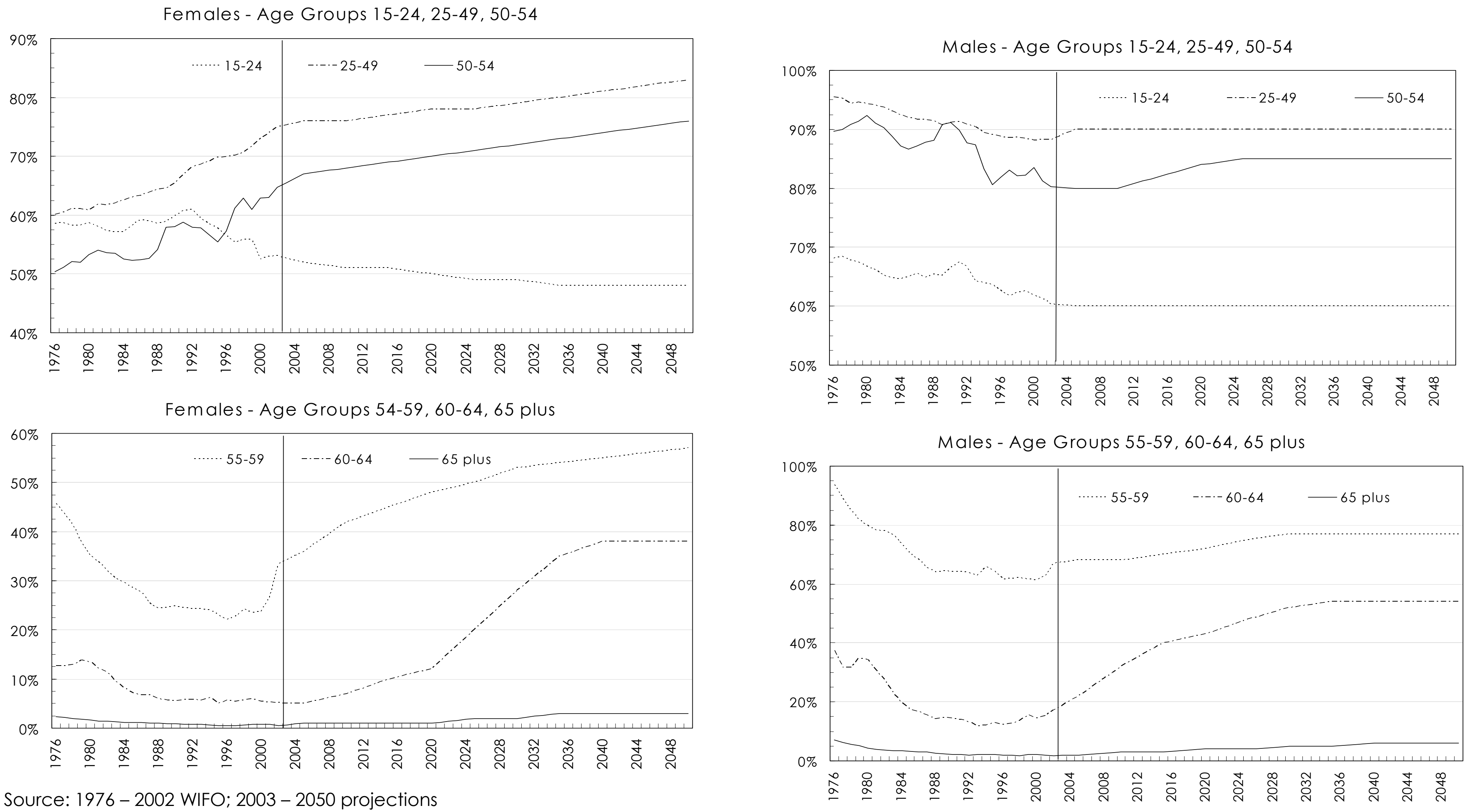
Note that in our model real wages (WHR) depend in the long run on the level of (marginal) labour productivity (MPL), the unemployment rate (UR), and a vector X of wage push factors:

$$WHR_t = \gamma_0 + MPL_t - \gamma_1 UR_t + \delta X_t \,. \qquad (4.18)$$

In our model the real wage is equal to the marginal productivity of labour in the long run, therefore the unique equilibrium rate of unemployment (UR*) is given by

$$UR^* = \frac{(\gamma_0 + \delta X)}{\gamma_1}\,. \qquad (4.19)$$

Figure 1: Activity rates of different sex and age groups on the Austrian labour market (1976-2050)



Source: 1976 – 2002 WIFO; 2003 – 2050 projections

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5. Domestic prices

The domestic price dynamics is determined by unit-labour costs and import prices. The following simple specification reflects a sluggish cost-markup price-setting behaviour of the firms:

$$\Delta \log(PD_t) = \alpha_1 \Delta \log\left(\frac{YI_t}{Y_t}\right) + \alpha_2 \Delta \log(PM_t) + (1 - \alpha_1 - \alpha_2) \Delta \log(PD_{t-1}) . \qquad (5.1)$$

In the above equation PD_t denotes the deflator for domestic demand, YL_t compensation of employees at current prices, Y_t the GDP at constant prices, PM_t the import price deflator in domestic currency, and Δ the first-difference operator. First differences of logarithms of a variable yield the percentage change of the respective variable. Note that the above equation is specified in terms of inflation rates. The above equation with the imposed restrictions has been estimated by OLS. The coefficients are a_1=0.33 and a_2=0.23. Thus, other things being equal, a 1 percentage point increase in unit-labour costs (import price) inflation leads in the short-run to a 0.33 percentage point (0.23 percentage point) increase in the rate of domestic inflation, whereas the long run increase in the rate of domestic inflation equals 0.59 percentage point (0.41 percentage point). The equation is constrained so that a simultaneous 1 percent increase in unit-labour costs and import price inflation leads in the long run to a 1 percentage point increase in domestic inflation.

Inflation rates of all components of domestic demand such as that of private consumption, PC_t, government consumption GC_t, and investment, PI_t, as well as that of the GDP, P_t, are set to be identical to the inflation rate of domestic demand PD_t. This assumption ensures price homogeneity on the demand side of the national accounts. This simplification is appropriate in view of our focus on the economic development in the long run.

Thomas Url (WIFO)

6. Income determination

In this section we show, how disposable income is related to gross domestic product. The first step in income determination is to model factor shares in national income. Starting from the production function we use the fact that aggregate labour demand, LD_t, is set by firms at the optimal level and the real per capita wage, W_t, results from sluggish adjustment in the labour market. Since disposable income is usually measured at current prices we transform real variables by multiplication with the GDP-deflator, P_t, into nominal variables. The biggest component of national income is compensation to employees or labour income:

$$YL_t = W_t \; LD_t \; P_t \,. \tag{6.1}$$

For our particular purpose we do not use the standard definition of national income, rather we include capital depreciation into national income. The gross operating surplus, GOS_t, thus corresponds to the sum of proprietors' income, the rental income of persons, corporate profits, net interest income, and capital depreciation. For its computation we use the identities from the national income accounting. Starting from GDP at current prices we subtract indirect taxes, $TIND_t$, and add subsidies SUB_t (cf. Section 7). The CES production function does not guarantee that factor shares will remain constant in the steady state of the model, because it depends on the capital labour ratio (*Layard – Walters*, 1978). The gross operating surplus is thus:

$$GOS_t = Y_t P_t - YL_t - (INDT_t \; - SUB_t)\,, \tag{6.2}$$

which includes capital depreciation into the gross operating surplus. This formulation has two specific purposes. First, it corresponds to the aggregate cash flow of firms and consequently we allow firms to distribute their full cash flow to households, i.e., we allow for the consumption of the capital stock at the rate of depreciation. Second, the investment decision of firms is based on cash flow considerations, cf. Section 2.1.

The next step is to compute disposable income from the nominal compensations of labour and capital.

Labour income is supposed to be fully attributable to private households:

$$HYL_t = QHYL_t \; YL_t \,, \tag{6.3}$$

thus $QHYL_t$ is equal to 1. This assumption is fully backed by column one in Table 6.1.

Table 6.1: Adjustment factors and shares to compute disposable income of private households

	Labour income QHYL	Capital income QHYS	Interest income QHYI	Monetary transfers QHTRM	Social security contributions QHSC	Direct taxes QHTDIR	Other transfers QHTRO
1995	1.007	0.331	0.158	1.254	1.110	0.858	0.014
1996	1.007	0.331	0.189	1.235	1.110	0.829	0.016
1997	1.006	0.329	0.200	1.212	1.112	0.836	0.011
1998	1.006	0.331	0.202	1.192	1.111	0.828	0.014
1999	1.005	0.335	0.203	1.192	1.111	0.851	0.012
2000	1.006	0.327	0.198	1.196	1.116	0.833	0.011
2001	1.006	0.327	0.195	1.185	1.128	0.782	0.023
2002	1.003	0.330	0.192	1.185	1.128	0.828	0.020
Mean	1.006	0.330	0.192	1.206	1.116	0.831	0.015
Standard dev.	0.001	0.003	0.015	0.026	0.008	0.022	0.004
Minimum	1.003	0.327	0.158	1.185	1.110	0.782	0.011
Maximum	1.007	0.335	0.203	1.254	1.128	0.858	0.023

The computation of entrepreneurial income attributable to private households needs one more step. We have to recognise retained profits, interest income, as well as capital depreciation. For this reason income accrued by private households from entrepreneurial activity, HYS_t, is substantially lower than the gross operating surplus. We use the average share of 0.33 from Table 6.1 for simulations:

$$HYS_t = QHYS_t \; GOS_t \, . \tag{6.4}$$

Again this assumption results in a constant legal environment for simulations. The amount of interest income is similarly modelled by the share of interest income going to private households, $QHYI_t$, in the gross operating surplus:

$$HYI_t = QHYI_t \; GOS_t \, . \tag{6.5}$$

This ratio varied between 0.158 and 0.203 (cf. Table 6.1). The average value is biased from years with a lower tax rate (1995 and 1996). Therefore, we set $QHYI_t$ equal to 0.20 throughout the simulation period.

The fourth important component of disposable income of private households is monetary transfers received from the government, $HTRM_t$. We model transfer income mainly in the social security block of the model (cf. Section 8) and adjust the sum of payments by the health, pension, accident, and unemployment insurance system, STR_t, by a factor, $QHTRM_t$, to the level given by national accounts:

$$HTRM_t = QHTRM_t \; STR_t \, . \tag{6.6}$$

This factor slowly decreased from 1995 through 2002 (Table 6.1). In simulations of future scenarios we will set the factor equal to 1.185.

Two components reduce disposable income of private households. These are social security contributions, HSC_t, and direct taxes, $HTDIR_t$. Both variables will be determined as ratios to total social contributions, SC_t, and total direct taxes, $TDIR_t$, according to the national accounts definition:

$$HSC_t = QHSC_t \; SC_t \,, \tag{6.7}$$

$$HTDIR_t = QHTDIR_t \; TDIR_t \,, \tag{6.8}$$

where $QHSC_t$ and $QHTDIR_t$ are those ratios. Table 6.1 shows that $QHSC_t$ increased in 2001 and 2002, reflecting revenue increasing reforms in the social security system. We use this fact and fix it for simulations at 1.13. $QHTDIR_t$ shows much more variation in the past, especially at the end of our sample period. We assume a value of 0,831 which corresponds to the mean over the period 1985 through 2002. Other net transfers to private households, $HTRO_t$, follow a rule that relates this item to total government revenues GR_t:

$$HTRO_t = QHTRO_t \; GR_t \,. \tag{6.9}$$

As can be seen from Table 6.1 the ratio is small but experiences a jump in 2001 and 2002. We assume a value of 0.02, which is slightly above the mean from the sample period.

Finally all these components are aggregated into the disposable income of private households YDN_t:

$$YDN_t = HYS_t + HYL_t + HYI_t + HTRM_t - HSC_t - HTDIR_t + HTRO_t \,. \tag{6.10}$$

Thomas Url (WIFO)

7. The public sector

This section describes the modelling of the public sector. The details of the social security system are dealt with in Section 8. The public sector block is modelled by using constant quotas relating either taxes or expenditures to reasonable bases. Thus, in simulations those ratios will be extrapolated into the future, reflecting the consequences of constant long run revenue and expenditure elasticities. We close the government sector by a simple policy target:

$$GE_t = GR_t , \qquad (7.1)$$

which states that government expenditures at current prices, GE_t, must equal revenues, GR_t, in each period. This simple target corresponds to a balanced budget for the government in compliance with the Pact on Stability and Growth (SGP). Although it is not reasonable to impose this policy rule in a business cycle model, we believe this to be a good assumption for the long run position of government finances. Since the Austrian government already accumulated substantial debt in the past, this assumption imposes a surplus in the primary budget balance. The debt level, however, will decline as a share of GDP, since no new debt is accumulated in the future. An alternative rule would be to stabilise the debt to GDP ratio at the 60 percent value mentioned in the Maastricht treaty. This policy rule would violate the balanced budget rule of the SGP, thus we disregard it.

We will model the public sector as being restricted from the revenue side. The government cannot spend more money then it receives from imposing taxes, social security contributions SC_t, and other minor revenue components. We express other minor revenues simply as a surcharge, $QGRO_t$. Government revenues, GR_t, are thus equal to:

$$GR_t = \frac{INDT_t + DIRT_t + SC_t}{1 - QGRO_t} , \qquad (7.2)$$

where SC_t are social contributions according to the national accounts. The ratio $QGRO_t$ decreased substantially from 1995 onwards. Table 7.1 shows that the observation for 2002 represents only two thirds of the maximum value from 1995. We fix this factor at 0.11 which is clearly below the mean but only slightly above the last observation from 2002.

Indirect taxes, $TIND_t$, move in line with GDP at current prices:

$$TIND_t = RTIND_t \; Y_t \; P_t , \qquad (7.4)$$

where the average tax rate varies in a narrow band between 14.2 and 16.3 (Table 7.2). We choose 0.149 for the simulation to reflect the fact that observations from the last few years are below the mean value. Direct taxes, $TDIR_t$, depend on the two main tax bases: labour income net of social security contributions and capital income net of depreciation:

$$TDIR_t = RTW_t(YL_t - QSCL_t SC_t) + (RTC_t + RTDIR_t)(GOS_{t-1} - DPN_{t-1}), \quad (7.5)$$

where RTW_t represents the average tax rate on wages, $QSCL_t$ is the part of social security contributions attributable to wages. For the simulation we assume that $QSCL_t$=1.067 (cf. Table 7.1). RTC_t is the average corporate tax rate, $RTDIR_t$ the average direct tax rate on profits, and DPN_t is the aggregate capital depreciation at current prices. The computation of wage taxes recognises the fact that social security contributions are fully tax deductible. Because we assume that the tax code will be constant over the full simulation period, we usually use the last realization of an average tax rate for simulations. For a simulation of a change in the tax code we will have to compute the effect of such a measure on the average tax rates RTW_{t+i}, RTC_{t+i} or $RTDIR_{t+i}$. Equation 7.5 reflects the fact, that depreciation is usually a tax deductible item and that last period's profits are the base for tax payments by firms and the self employed. This formula may suffer from the discrepancy between the taxable result and commercial financial statements on accrual basis.

Subsidies, SUB_t, are also simply modelled as a ratio to government revenues excluding social contributions:

$$SUB_t = QSUB_t \left(GR_t - SC_t\right). \quad (7.6)$$

After the substantial drop in subsidies in the year after joining the European Union, the ratio $QSUB_t$ is steadily climbing towards its long run mean value (cf. Table 7.1). We choose $QSUB_t$=0.08 for our simulation.

Social expenditures, SE_t, are composed of monetary transfers and non-monetary services of the pension, SEP_t, the health insurance, SEH_t, the accident insurance, SEA_t, and the unemployment insurance system, TRU_t (cf. Section 8):

$$SE_t = SEP_t + SEH_t + SEA_t + TRU_t. \quad (7.7)$$

Social security contributions according to the national accounts, SC_t, are related to contributions to health, SCH_t, pension, SCP_t, accident, SCA_t, and unemployment insurance, SCU_t. The difference between numbers from the social security system and the national accounts is captured by a constant factor, QSC_t:

$$SC_t = QSC_t(SCH_t + SCP_t + SCA_t + SCU_t) \quad (7.8)$$

This factor is assumed to be equal to 1.35 throughout the simulation period.

Public spending on interest for government debt is based on the implicit rate of interest RGD_t:

$$RGD_t = \frac{1}{2}\left(\frac{1}{6}\sum_0^5 RN_{t-i} + RGD_{t-1}\right). \quad (7.9)$$

This equation recognizes the fact that the average maturity of Austria's government debt is 5.5 years. Thus the implicit interest rate depends on a moving average of the nominal interest rate with five lags. Averaging between the lagged implicit rate and the weighted nominal interest rate improves the fit, because the federal debt agency uses the slope of the yield curve – which is not modelled here – in managing public debt. Government expenditures on interest, GEI_t, are then:

$$GEI_t = RGD_t GD_{t-1}\,. \tag{7.10}$$

where GD_t represents the level of public debt.

Thus we model the following parts of total government expenditures explicitly: social expenditures, subsidies and other monetary transfers to private households. The remainder is summarized as other government expenditures GEO_t. Total government expenditures are:

$$GE_t = SE_t + SUB_t + HTRO_t + GEI_t + GEO_t\,. \tag{7.11}$$

The policy rule for the government sector is to adjust one of the components of other government expenditures, GEO_t:

$$GEO_t = GR_t - \left(SE_t + SUB_t + HTRO_t + GEI_t\right), \tag{7.1'}$$

such that equation 7.1 holds in each simulation period. The share of GEO_t in GE_t was in 2002 roughly 51 percent. Other government expenditures comprise items like purchases from the private sector, compensations for employees and pensioners (civil servants), interest payments for government debt, asset transactions, public investment, and transfers to the European Union. Our policy rule requires that any of those components must be adjusted in order to achieve a balanced budget.

One important feature of this policy rule arises in combination with the production technology and the supply side driven structure of the model. Any reduction in other government expenditures, GEO_t, does not feed back into disposable income of private households, nor does it change the level of production in the economy. This results from the fact, that we do not distinguish government production from private sector production (cf. Section 2.3), and therefore, public sector wage income and purchases from the private sector do not respond to variations in GEO_t. By changing GEO_t, however, the government affects aggregate demand and thus the level of imports, the level of private households' financial wealth, and finally private consumption.

The level of government debt, GD_t, evolves according to:

$$GD_t = GD_{t-1} + \left(GR_t - GE_t\right) + GDMV_t\,, \tag{7.12}$$

where $GDMV_t$ represents the effects of government debt management, exchange rate revaluations, and swap operations on the nominal value of government debt. We assume that GDMVt follows:

$$GDMV_t = QGDMV_t GD_t \,, \tag{7.13}$$

where $QGDMV_t$ is the ratio of the value of ex-budgetary transactions to government debt. We fix $QGDMV_t$ at the long run mean value of 0.029 for simulations (cf. Table 7.1).

We also simulate a contradictory scenario where other government expenditures, $GEOC_t$, are held constant as a share of nominal GDP:

$$GEOC_t = QGEOC_t YN_t \,, \tag{7.14}$$

where $QGEOC_t$ represents the share of nominal other government expenditures from the last year of the pre-simulation period. In this case government debt and hence interest payment on government debt will take on alternative values. This policy rule implies that the current setting of government expenditures will not be changed in the future and, given increasing expenditures on social security, the public sector will be in deficit.

General government consumption, GC_t, is only a fraction of government expenditures. It consists of the public sector gross value added excluding market oriented activities of public sector enterprises and intermediary demand. Since social expenditures, subsidies, and expenditures on interest are not part of government consumption, we exclude them from the base for the computation:

$$GC_t = \frac{QGCN_t \left(GE_t - SE_t - SUB_t - GEI_t \right)}{PC_t} \,, \tag{7.15}$$

where $QGCN_t$ is the ratio of government consumption to government expenditures less social security expenditures, subsidies and expenditures on interest. This ratio increases over time (cf. Table 7.1). We fix $QGCN_t$ at the last observed value. Because all items of government expenditures are measured at current prices we have to deflate by the deflator of government consumption PC_t.

Table 7.1: Adjustment factors and ratios to compute variables in the government sector

	Other govern-ment revenues	Social security contribu-tions attri-butable to wages	Subsidies	Social contri-butions accor-ding to national accounts	Debt manage-ment and valuation changes	Other govern-ment expen-ditures	Govern-ment consump-tion	Inventory change, change in valuable, and statistical difference
	QGRO	QSCL	QSUB	QSC	QGDMV	QGEOC	QGCN	QSDIFF
1976	0.1410	1.1852	0.0941	1.3126	-	-	-	0.0156
1977	0.1397	1.1548	0.0914	1.3019	0.0944	-	-	0.0126
1978	0.1400	1.1257	0.0937	1.2883	0.0770	-	-	0.0136
1979	0.1419	1.1032	0.0887	1.2886	0.0684	-	-	0.0252
1980	0.1469	1.0909	0.0905	1.4218	0.0648	-	-	0.0243
1981	0.1525	1.0936	0.0877	1.4410	0.0563	-	-	0.0036
1982	0.1527	1.0743	0.0904	1.4550	0.0397	-	-	0.0042
1983	0.1526	1.0627	0.0897	1.4853	0.0548	-	-	0.0016
1984	0.1491	1.0531	0.0834	1.5301	0.0388	-	-	0.0161
1985	0.1471	1.0439	0.0866	1.3485	0.0372	-	0.6112	0.0102
1986	0.1467	1.0384	0.0978	1.3435	0.0585	-	0.6167	0.0102
1987	0.1488	1.0326	0.0979	1.3436	0.0304	-	0.6256	0.0109
1988	0.1502	1.0326	0.0934	1.3425	0.0040	-	0.6310	0.0076
1989	0.1538	1.0295	0.0914	1.3430	-0.0056	-	0.6420	0.0071
1990	0.1549	1.0217	0.0877	1.3455	0.0204	-	0.6404	0.0067
1991	0.1526	1.0188	0.0933	1.3490	0.0187	-	0.6421	0.0059
1992	0.1581	0.9988	0.0904	1.3345	0.0172	-	0.6545	0.0035
1993	0.1542	0.9963	0.0919	1.3426	0.0368	-	0.6301	-0.0009
1994	0.1577	0.9933	0.0826	1.3585	0.0171	-	0.6259	0.0036
1995	0.1606	1.0701	0.0598	1.3617	0.0260	0.3233	0.6181	0.0091
1996	0.1464	1.0718	0.0659	1.3645	-0.0267	0.3134	0.6303	0.0030
1997	0.1225	1.0782	0.0592	1.3492	-0.0722	0.2959	0.6525	0.0073
1998	0.1174	1.0623	0.0706	1.3611	0.0058	0.2953	0.6457	0.0066
1999	0.1201	1.0601	0.0637	1.3632	0.0354	0.2994	0.6484	0.0100
2000	0.1182	1.0586	0.0644	1.3546	0.0142	0.2831	0.6654	0.0027
2001	0.1054	1.0635	0.0689	1.3244	0.0318	0.2678	0.6753	0.0016
2002	0.1085	1.0696	0.0808	1.3230	0.0154	0.2611	0.6826	0.0034
Mean	0.1422	1.0624	0.0836	1.3621	0.0292	0.2924	0.6410	0.0083
Stand.Dev.	0.0158	0.0448	0.0122	0.0572	0.0339	0.0212	0.0198	0.0064
Minimum	0.1054	0.9933	0.0592	1.2883	-0.0722	0.2611	0.6112	-0.0009
Maximum	0.1606	1.1852	0.0979	1.5301	0.0944	0.3233	0.6826	0.0252

Table 7.2: Average tax rates, 1976-2002

	Wage tax	Tax on capital income	Corporate tax	Indirect taxes	Total taxes surcharge
	RTW	RTDIR	RTC	RTIND	QGRO
			In percent		
1976	10.5	-	-	15.9	14.1
1977	11.4	30.4	7.9	16.3	14.0
1978	13.7	31.3	7.8	15.8	14.0
1979	13.6	34.0	9.3	15.7	14.2
1980	13.8	30.1	8.4	15.7	14.7
1981	14.3	32.7	8.1	15.8	15.3
1982	13.8	34.9	7.4	15.6	15.3
1983	13.6	30.6	6.7	15.7	15.3
1984	14.1	29.1	6.5	16.3	14.9
1985	14.9	32.6	7.3	16.2	14.7
1986	15.1	31.8	6.6	16.0	14.7
1987	13.9	31.2	6.0	16.1	14.9
1988	14.5	30.1	7.0	16.0	15.0
1989	11.6	30.5	7.7	15.9	15.4
1990	12.8	31.5	7.0	15.6	15.5
1991	13.5	31.4	6.7	15.4	15.3
1992	14.1	31.8	7.7	15.5	15.8
1993	14.7	33.7	4.5	15.6	15.4
1994	13.9	29.2	5.2	15.5	15.8
1995	15.4	28.8	6.4	14.2	16.1
1996	16.4	30.6	9.1	14.5	14.6
1997	17.9	27.4	9.3	14.9	12.2
1998	18.0	28.6	10.4	14.9	11.7
1999	18.3	27.0	8.2	15.0	12.0
2000	17.9	27.4	9.7	14.6	11.8
2001	18.1	29.0	14.1	14.6	10.5
2002	18.3	27.2	9.9	14.9	10.8
Mean	14.7	30.5	7.9	15.5	14.2
Standard dev.	2.2	2.1	1.9	0.6	1.6
Minimum	10.5	27.0	4.5	14.2	10.5
Maximum	18.3	34.9	14.1	16.3	16.1

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8. Social security

The social security sector in Austria comprises the publicly provided Pension, Health and Accident Insurance. In the European System of national accounts (ESA) these three sectors form the main components of monetary social transfers (contributions) to (from) households. As ESA also includes the unemployment insurance as one part of social transfers (contributions) it was added to the Social Security Sector in the model.

As there is no disaggregated information on the development of the individual components of social security revenues and expenditures available at the National Accounts level, the model uses administrative data from the Social Security Administration and the Employment Services. Administrative figures are then transformed into the corresponding ESA aggregates using historical ratios.

For every sector of social security, expenditures and revenues are modelled separately. For expenditures a distinction is made between transfers and other expenditures of the respective social insurance fund. On the revenue side, the model depicts the development of contributions of insured persons.

8.1 Social Expenditures

As mentioned above the model contains four components of social expenditures (pensions, health, accidents, unemployment).

Total social expenditures SE_t is the sum of expenditures of the pensions insurance SEP_t health insurance SEH_t, accident insurance SEA_t, and the transfer expenditures of unemployment insurance TRU_t:

$$SE_t = SEP_t + SEH_t + SEA_t + TRU_t \,. \tag{8.1}$$

Total expenditures of Pension Insurance SEP_t contain transfer expenditures TRP_t and other expenditures of the Pension Insurance $SEPO_t$:

$$SEP_t = TRP_t + SEPO_t \,. \tag{8.2}$$

Transfer expenditures of the pension system include all expenditures on pensions (direct pensions, invalidity pensions and pensions for widows/widower and orphans) for retirees from the private sector (employees, self employed, and farmers). Public sector pensions (civil servants) are not included. The development of expenditures on pension transfers depends on the change in the number of pensions *PEN* and on the growth rate of the average pension payment.

The number of pensions depends both on the demographic development and on labour market participation:

$$PEN_t = QPP^1{}_t(POP^0{}_t + POP^{1TO3}{}_t) + (QPP^{4to5}{}_t - PR^{4to5}{}_t)POP^{4TO5}{}_t + \left[POP^6{}_t - (\alpha_t PR^6{}_t)POP^6{}_t\right]. \qquad (8.3)$$

The equation implies that the number of pensions is a fraction $QPP^1{}_t$ of the number of people aged below 55 $(POP^0 + POP^{1TO3})$ and that it develops proportional with demography (depicted by the population between 55 and 64, POP^{4to5}) and employment participation at the age above 54 PR^{4to5} and PR^6 for participation rates for persons aged 55 to 64 and 65+ respectively). It is assumed that a rise of employment participation reduces the number of pensions one to one at the age 55 to 64 and by a factor of a above the age of 65. The parameter *a*, which is strictly smaller than one, reflects the fact, that for the age group older than 65 it is possible for employees to receive direct pension payments.

The number of employees and pensions do not necessarily add up to 100 percent for a number of reasons:

- The model depicts the development of pensions rather than the number of retirees (the difference is around 2 percent),
- pensions of civil servants are not included,
- persons living abroad can receive pension payments,
- persons may be temporarily out of the labour force.

The parameter $QPP^{4to5}{}_t$ adjusts for the difference between total population and the sum of pensions and the active labour force.

Since the pension reform of the year 1993, pensions are indexed to net wages. The annual adjustment of existing pension claims is based on the principle that the average pension and the average wage, both net of social contributions, should increase at the same rate. Pension adjustment accounts for the fact that new pensions are considerably higher than benefits for persons leaving the pension system. The pension formula implies that the average net benefit develops proportional to the average net wage. In the model it is assumed that the government will continue to stick to this form of indexation of average pension benefits.

$$\Delta \log\left(\frac{TRP_t}{PEN_t} QSCP_t\right) = QPEN_t \; \Delta \log(W_t \; P_t \; QSCE_t) \qquad (8.4)$$

The percentage change in benefits per pension (TRP_t/PEN_t) adjusted by the social (health) contribution rate of pensioners $QSCP_t$ is equal to the change in gross nominal wages (W_t*P_t) adjusted by social contribution rates of employees to social security $QSCE_t$. The pension adjustment formula applies to direct pensions. Pensions for orphans and widows/widower usually grow by less then direct pensions. Consequently average pension benefits grow somewhat less than average net wages. The adjustment factor $QPEN_t$ (with $QPEN_t$ being equal or less than one) reflects this fact. The indexation of average pensions to average wages net of social security contributions implies that the development of pension expenditures as a percentage of output is determined by the development of the number of pensions. Specifically changes in the level of productivity do not affect the evolution of pension expenditures as a share of GDP[1].

Other expenditures of the Pension Insurance Funds $SEPO_t$ comprise mainly expenditures on administration. Given historical experience, administrative expenditures depend on overall pension expenditures (α_1 is estimated to be 0.004) but the share of these expenditures in total pension expenditures is likely to fall over time (α_2 is estimated to be significantly smaller than one):

$$\log(SEPO_t) = \alpha_1 LOG(TRP_t) + \alpha_2 LOG(SEPO_{t-1}) . \qquad (8.5)$$

Total Expenditures of Health Insurance Funds SEH_t consist of transfer expenditures TRH_t and other expenditures $SEHO_t$:

$$SEH_t = TRH_t + SEHO_t . \qquad (8.6)$$

Riedel et. al. (2002) show that public health expenditures in Austria are determined by demographic developments, the size of the health sector and country specific institutional factors (i.e., number of specialists, number of hospital beds, relative costs of health services). Based on the results of this study transfer expenditures of the health sector in the model depend on the first two factors holding the impact of institutional factors constant:

$$\Delta \log\left(\frac{TRH_t}{P_t}\right) = \alpha_0 + \Delta \log(POP_t) + \alpha_1 \Delta \log\left(\frac{POPM^6{}_t + POPF^6{}_t}{POP_t}\right) - \alpha_2 \log\left(\frac{TRK_{t-1}}{YN_{t-1}}\right).$$

(8.7)

The equation implies that growth of real transfer expenditures TRH_t/P_t is increasing with the growth of the share of persons aged above 65 ($POPM^6{}_t+POPF^6{}_t/POP_t$) and declining with the overall share of health expenditures in GDP (TRH_t/YN_t). The constant α_0 is estimated to be negative in sign and reflects efficiency improvements in the public health sector partly offsetting the upward pressure on expenditures stemming from demographic trends.

Other expenditures of the public health insurance funds comprise mainly administrative expenditures. Given historical trends it is assumed that other expenditures are influenced by aggregate transfer expenditures of the health sector (α_1 being strictly positive) but that their share of total health expenditures will decline over time (reflected by the estimated negative coefficient for α_2):

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[1] Note that in the model the wage share is constant in the long run and that wages correspond to marginal productivity

$$\log(SEHO_t) = -\alpha_0 + \alpha_1 \log(TRH_t) - \alpha_2 \log(SEHO_{t-1}) . \qquad (8.8)$$

Expenditures for Accident Insurance SEA_t consist of transfer expenditures TRA_t and other expenditures $SEAO_t$:

$$SEA_t = TRA_t + SEAO_t . \qquad (8.9)$$

Transfer payments of the Accident Insurance Funds include accident benefits and therapies of casualties as main components. Based on historical developments these payments rise proportionally to the wage bill (YI_t):

$$\Delta \log(TRA_t) = \Delta \log(YI_t) . \qquad (8.10)$$

Other expenditures are determined by transfer payments but their share in total expenditures is also assumed to decline over time (indicated by a negative coefficient for α_2.implying a negative impact of the trend variable on this expenditures component):

$$\log(SEAO_t) = \alpha_0 + \alpha_1 \log(TRA_t) + \alpha_2 TREND_t . \qquad (8.11)$$

Finally expenditures on unemployment benefits TRU_t depend on the number of unemployed persons and the replacement rate. Econometric evidence points to unit elasticities of the change of expenditures on unemployment benefits with respect to unemployment LU_t and nominal wages (W_t*P_t).

$$\Delta \log(TRU_t) = \Delta \log(LU_t) + \Delta \log(W_t \ P_t) \qquad (8.12)$$

This equation implies that the structure of unemployment and the replacement rate remain constant over time.

8.2 Social security contributions

Social security benefits in Austria are financed by contributions of employees and employers to the respective social insurance funds, which are supplemented by transfers from other systems and federal contributions. Contributions by insured persons are a fraction of the contributory wage, which is equivalent to the gross wage below the upper earnings threshold (Höchstbeitragsgrundlage).

Total social contributions are the sum of contributions to pensions insurance SCP_t, health insurance SCH_t, accident insurance SCA_t and unemployment insurance SCU_t:

$$SC_t = QSC_t (SCP_t + SCH_t + SCA_t + SCU_t) . \qquad (8.13)$$

The sum of all contributions is transformed by the parameter QSC_t into the respective aggregate used in national accounts.

Revenues of the pension insurance funds SCP_t have been modelled separately for the dependent employed $SCPE_t$ and the self employed $SCPS_t$, because both contribution rates and contribution bases are different:

$$SCP_t = SCPE_t + SCPS_t\,. \qquad (8.14)$$

The change in pension insurance contributions of employees $SCPE_t$ depends on the change in contribution rates ($RSPE_t$, $RSPC_t$ for the rates of employees and employers respectively), the change in the wage bill YL_t and the change in the relationship of the upper earnings threshold $UTPA_t$ with respect to the average wage level (YL_t/LE_t). The elasticity of revenues with respect to the wage bill is estimated to be equal to one. For the parameters α_1 and α_2 positive values smaller than one are estimated:

$$\Delta\log(SCPE_t) = \alpha_1\Delta\log(RSPE_t + RSPC_t) + \Delta\log(YL_t) + \alpha_2\Delta\log\left(\frac{UTPA_t}{YL_t / LE_t}\right). \qquad (8.15)$$

The change in contributions of self employed to pension insurance $SCPS_t$ depends with unit elasticity (α_1 is equal to one) on the change of the respective contribution rate $RSPS_t$, the current and lagged change in gross operating surplus of firms minus depreciation (GOS_t-DPN_t) which is used as a proxy for income of self employed (where α_2 and α_3, sum up to 0.9) and the change of the minimum contribution basis of self employed $MCBS_t$ relative to the upper earnings threshold $UTPA_t$ with an elasticity of 0.65):

$$\Delta\log(SCPS_t) = \alpha_1\Delta\log(RSPS_t) + \alpha_2\Delta\log(GOS_t - DPN_t) + \alpha_3\Delta\log(GOS_{t-1} - DPN_{t-1}) + \alpha_4\Delta\log(MCBS_t / UTPA_t)\,. \qquad (8.16)$$

Contribution revenues of health insurance funds SCH_t originate from two large sources: contributions of active employed $SCHE_t$ and contributions of pensioners $SCHR_t$. Total contributions to pension insurance are the sum of these two aggregates:

$$SCH_t = SCHE_t + SCHR_t\,. \qquad (8.17)$$

The change in the contributions of active employed $SCHE_t$ depends positively on the change of the contribution rates RSH_t, with unit elasticity on the change in the wage bill YL_t and positively on the change of the relation between the upper earnings threshold in health insurance UTH_t and the average wage (YL_t/LE_t):

$$\Delta\log(SCHE_t) = \alpha_1\Delta\log(RSH_t) + \Delta\log(YL_t) + \alpha_2\Delta\log\left(\frac{UTH_t}{YL_t / LE_t}\right). \qquad (8.18)$$

The change of the contributions of the pensioners to the health insurance depends on the variation of contribution rates of the pension insurance funds $RSPF_t$ plus the contribution rate of pensioners $RSHR_t$ and with unit elasticity on the change in aggregate pension transfers TRP_t

$$\Delta\log(SCHR_t) = \alpha_1 \Delta\log(RSPF_t + RSHR_t) + \Delta\log(TRP_t)\,. \tag{8.19}$$

The change in contributions to the accident insurance SCA_t is determined by the change in the contribution rate RSA_t, the change in the wage bill YL_t and the change in the relation between the upper earnings threshold UTH_t and the average wage (YL_t/LE_t)

$$\Delta\log(SCA_t) = \alpha_1 \Delta\log(RSA_t) + \Delta\log(YL_t) + \alpha_2 \Delta\log\left(\frac{UTH_t}{YL_t / LE_t}\right). \tag{8.20}$$

Finally the change in contributions to unemployment insurance SCU_t, similarly depends on the change in the contribution rates RSU_t, with unit elasticity on the growth of the wage bill YL_t and on the relative size of the upper earnings threshold

$$\Delta\log(SCU_t) = \alpha_1 \Delta\log(RSU_t) + \Delta\log(YL_t) + \alpha_2 \Delta\log\left(\frac{UTU_t}{YL_t / LE_t}\right). \tag{8.21}$$

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9. Foreign trade, the terms of trade and aggregate demand

Trade flows are explained in terms of aggregate per capita incomes of the 25 trading partners[2] and the terms of trade. For exports X_t at constant 1995 prices we have

$$\log\left(\frac{X_t}{POPW_t}\right)=\alpha_0+\alpha_1\log\left(\frac{YW_t}{POPW_t}\right)-\alpha_2\log\left(\frac{PX_t}{PM_t}\right), \tag{9.1}$$

where $POPW_t$ is the population and YW_t the aggregate GDP of 25 OECD countries measured in US-Dollars at constant 1995 prices and exchange rates. The terms of trade are defined as the ratio of export PX_t and import PM_t price deflators. Here we make two simplifying assumptions. First, we assume a constant exchange rate and, second, we assume that Austria imports an average bundle of goods produced and traded in the OECD. Consequently, in the export equation, we take Austria's import prices PM_t as a proxy for price levels of the OECD competitors.

Similarly for imports M_t at constant 1995 prices we have

$$\Delta\log\left(\frac{M_t}{POP_t}\right)=\alpha_0+\alpha_1\Delta\log\left(\frac{Y_t}{POP_t}\right)-\alpha_2\Delta\log\left(\frac{PM_t}{P_t}\right)-\alpha_3\log\left(\frac{M_{t-1}}{X_{t-1}}\right)+\left(\frac{YGAP_t}{POP_t}\Big/\frac{M_{t-1}}{POP_{t-1}}\right), \tag{9.2}$$

where POP_t is the population and Y_t the GDP in Austria, and P_t is the GDP deflator. The above behavioural equations for exports and imports are not estimated; rather we assume unit elasticity with respect to income and relative prices. Coefficients α_1 and α_2 in above equation are, respectively, the income and price elasticity of demand for foreign goods. The third term in equation 9.2 represents an error correction term, which insures a balanced current account in the long run. The speed of adjustment parameter α_3 is equal to 0.4 implying a reduction of a current account deficit by 40 percent a year.

If aggregate demand, DE_t, is equal to aggregate supply, the output gap $YGAP_t$:

$$YGAP_t=DE_t-Y_t, \tag{9.3}$$

[2] The 25 OECD countries included are: Australia, Belgium, Canada, Switzerland, Germany, Denmark, Spain, Finland, France, United Kingdom, Greece, Ireland, Iceland, Italy, Japan, South Korea, Luxembourg, Mexico, The Netherlands, Norway, New Zealand, Portugal, Sweden, Turkey, and United States of America.

is equal to zero and imports are driven only by domestic per capita GDP growth, the change in relative prices, and the cointegration term. Real aggregate demand defined as the sum over demand components:

$$DE_t = CP_t + GC_t + I_t + X_t - M_t + SDIFF_t, \quad (9.4)$$

where $SDIFF_t$ corresponds to the sum of inventory changes, acquisition and disposal of valuables, and the statistical discrepancy and is determined according to:

$$SDIFF_t = QSDIFF_t Y_t. \quad (9.5)$$

The ratio $QSDIFF_t$ is set equal to zero throughout the simulation period (cf. Table 7.1).

The equilibrium condition (9.3) states that a difference between aggregate demand and supply, as determined by the production function, will be eliminated by a corresponding current account imbalance. Imports will be adjusted such that demand is equal to supply. The resulting current account imbalance will cumulatively change the net foreign asset position of the Austrian economy. The net foreign asset position evolves according to

$$NFA_t = NFA_{t-1} + \left(PX_t X_t - PM_t M_t\right), \quad (9.6)$$

where every year the current account balance is added to the previous year stock of assets. This characterization does not take account of changes in the valuation of net foreign assets. Together with the definition of financial wealth of private households this condition closes our model. Disequilibria in the model will be corrected by the build up or run down of net foreign assets, respectively, which in turn affect the level of consumption of private households.

Since the A-LMM is a small open economy model, YW_t, POP_t, and PM_t are exogenous. In the baseline, we assume that in the period between 2002 and 2050 the aggregate real GDP of the 25 OECD countries grows on average by 2.4 percent per annum. In the same period, import prices are assumed to increase at an annual rate of 2 percent.

For export prices we use a dynamic specification similar to that for domestic demand

$$\Delta\log(PX_t) = \alpha_1 \Delta\log(P_t) + \alpha_2 \Delta\log(PM_t) + (1-\alpha_1-\alpha_2)\Delta\log(PX_{t-1}). \quad (9.7)$$

In the short run, the price adjustment is sluggish. The coefficients α_1=0.09 and α_2=0.35 imply that a 1 percentage point increase in domestic rate of inflation leads in the short-run to a 0.09 percentage point increase in the rate of export price inflation. The long run effect of a 1 percentage point increase in domestic rate of inflation is 0.16 percentage point. The extent to which export prices are determined by domestic conditions is called pricing to market. This is a measure of the competitive position of a country with respect to trading partners. For Austria the pricing to market measure is equal to α_1/α_2=0.26. That is, in the long run Austria's exporters are able, on average, to pass on 26 percent of an increase in costs of production to export prices.

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Appendix

Table A1: Variable list

Exogenous Variables

New	English	German
RD	Rate of physical depreciation	Ökonomische Abschreibung, Durchschnittssatz
RTD	Rate of tax depreciation allowance	Steuerliche Abschreibung, Durchschnittssatz
TFP	Total factor productivity, rate of change	Veränderungsrate d. Gesamtfaktorproduktivität
PRD	Probability of death (Inverse of life - expectancy), private households	Sterbewahrscheinlichkeit (Kehrwert d. Lebenserwartung) d. priv. Haushalts
RTP	Rate of time preference	Zeitpräferenzrate
GRR	Gross replacement rate	Ersatzrate d. Arbeitslosenversicherung
POP	Population, Austria, in million persons	Bevölkerung von Österreich, Mio. Personen
POP0	Population, age group 0 to 14, in million persons	Bevölkerung im Alter von 0 bis 14
POP1_3	Population, age group15 to 55, in million persons	Bevölkerung im Alter von 15 bis 55
POP4_5	Population, age group 55 to 65, in million persons	Bevölkerung im Alter von 55 bis 65
POP6	Population, age group 65 and older, in million persons	Bevölkerung im Alter von 65+
POPE	Population, age group 15 to 65, in million persons	Erwerbsfähige Wohnbevölkerung im Alter von 15 bis 65
POPF	Population, Austria, females, in million persons	Gesamtbevölkerung von Österreich, Frauen
POPF0	Population, females, age group 0 to 14, in million persons	Bevölkerung Frauen im Alter von 0 bis 14
POPF1	Population, females, age group 15 to 24, in million persons	Bevölkerung Frauen im Alter von 15 bis 24
POPF2	Population, females, age group 25 to 49, in million persons	Bevölkerung Frauen im Alter von 25 bis 49
POPF3	Population, females, age group 50 to 54, in million persons	Bevölkerung Frauen im Alter von 50 bis 54
POPF4	Population, females, age group 55 to 59, in million persons	Bevölkerung Frauen im Alter von 55 bis 59
POPF5	Population, females, age group 60 to 64, in million persons	Bevölkerung Frauen im Alter von 60 bis 64
POPF6	Population, females, age group 65 and older, in million persons	Bevölkerung Frauen im Alter von 65+
POPM	Population, Austria, males, in million persons	Gesamtbevölkerung von Österreich, Männer
POPM0	Population, males, age group 0 to 14, in million persons	Bevölkerung Männer im Alter von 0 bis 14
POPM1	Population, males, age group 15 to 24, in million persons	Bevölkerung Männer im Alter von 15 bis 24
POPM2	Population, males, age group 25 to 49, in million persons	Bevölkerung Männer im Alter von 25 bis 49
POPM3	Population, males, age group 50 to 54, in million persons	Bevölkerung Männer im Alter von 50 bis 54
POPM4	Population, males, age group 55 to 59, in million persons	Bevölkerung Männer im Alter von 55 bis 59
POPM5	Population, males, age group 60 to 64, in million persons	Bevölkerung Männer im Alter von 60 bis 64
POPM6	Population, males, age group 65 and older, in million persons	Bevölkerung Männer im Alter von 65+

Table A1 / continued:

PRT	Trend-participation rate	Trend Erwerbsquote
PRTF1	Trend participation rate, females, age group 15 to 24	Trend Erwerbsquote Frauen im Alter von 15 bis 24
PRTF2	Trend participation rate, females, age group 25 to 49	Trend Erwerbsquote Frauen im Alter von 25 bis 49
PRTF3	Trend participation rate, females, age group 50 to 55	Trend Erwerbsquote Frauen im Alter von 50 bis 54
PRTF4	Trend participation rate, females, age group 55 to 59	Trend Erwerbsquote Frauen im Alter von 55 bis 59
PRTF5	Trend participation rate, females, age group 60 to 64	Trend Erwerbsquote Frauen im Alter von 60 bis 64
PRTF6	Trend participation rate, females, age group 65 and older	Trend Erwerbsquote Frauen im Alter von 65+
PRTM1	Trend participation rate, males, age group 15 to 24	Trend Erwerbsquote Männer im Alter von 15 bis 24
PRTM2	Trend participation rate, males, age group 25 to 49	Trend Erwerbsquote Männer im Alter von 25 bis 49
PRTM3	Trend participation rate, males, age group 50 to 54	Trend Erwerbsquote Männer im Alter von 50 bis 54
PRTM4	Trend participation rate, males, age group 55 to 59	Trend Erwerbsquote Männer im Alter von 55 bis 59
PRTM5	Trend participation rate, males, age group 60 to 64	Trend Erwerbsquote Männer im Alter von 60 bis 64
PRTM6	Trend participation rate, males, age group 65 and older	Trend Erwerbsquote Männer im Alter von 65+
QLD	Ratio of LE to LD	Umrechnungsfaktor zwischen (Aktiv)Beschäftigten u. Vollzeitäquivalente
QLENA	Ratio of LENA to POP0	Faktor Nicht-Aktiv-Beschäftigte an Kindern im Alter von 0 bis 14
QLST	Ratio of dependent labour supply to total trend labour supply	Anteil d. Unselbständigen an den gesamten Erwerbspersonen
QHSC	Share of private households in social contributions	Anteil der privaten Haushalte an den Sozialbeiträgen, Durchschnittssatz
QHTDIR	Share of private households in direct taxes	Anteil der privaten Haushalte an den direkten Steuern, Durchschnittssatz
QHTRM	Share of private households in monetary transfers	Anteil der privaten Haushalte an den Sozialtransfers, Durchschnittssatz
QHTRO	Share of private households in other transfers	Anteil der privaten Haushalte an den sonstigen Transfers, Durchschnittssatz
QHYI	Share of private household interest income in gross operating surplus	Anteil der Zinseinkommen privater Haushalte am Betriebüberschuss, Durchschnittssatz
QHYL	Share of private household labour income in compensation to employees	Anteil der privaten Haushalte am Lohneinkommen, Durchschnittssatz
QHYS	Share of private household entrepreneurial income in gross operating surplus	Anteil der Einkommen aus unternehmerischer Tätigkeit privater Haushalte am Betriebsüberschuss, Durchschnittssatz
QGCN	Ratio of government consumption to government expenditures less social security expenditures, subsidies and expenditures on interest	Verhältnis der Konsumausgaben des Staates zu den Staatsausgaben abzüglich der Sozialausgaben, der Subventionen und Zinsen für die Staatsschuld
QGDMV	Ratio of ex-budgetary transactions to government debt	Verhältnis der außerbudgetären Transaktionen zur Staatsschuld
QGEOC	Ratio of other government spending to nominal GDP, constant spending rule	Anteil der sonst. Staatsausgaben am BIP bei konstanter Regel Ausgabenquote
QGRO	Other government revenues, ratio	Restliche Staatseinnahmen, Quote
QSC	Ratio of social contributions according to ESA to social security contributions according to Federation of Austrian Social Security Institutions, average rate	Verhältnis von Sozialbeiträgen lt. VGR zu Sozialversicherungsbeiträgen, Durchschnittssatz
QSCL	Share of wage related contributions in total social security contributions	Anteil der lohnbezogenen Beiträge an den gesamten Sozialversicherungsbeiträgen
QSUB	Ratio of subsidies to tax revenues	Verhältnis von Subventionen zu Steuereinnahmen, Durchschnittssatz
RN	Nominal long term interest rate	Nominaler Zinssatz, Sekundärmarktrendite Bund
RSCO	Other social contributions, ratio	Restliche Sozialbeiträge, Quote
RTC	Corporation taxes, average tax rate	Unternehmenssteuer (Köst+Gewst), Durchschnittssatz

Table A1 / continued:

RTDIR	Other taxes on income and wealth, receivable, average tax rate	Restliche Einkommen u. Vermögensteuern, Durchschnittssatz
RTIND	Taxes on production and imports, average tax rate	Produktions- u. Importabgaben, Durchschnittssatz
RTW	Wage taxes, average tax rate	Lohnsteuer inkl. AK u. Land AK Umlage, Durchschnittssatz
MCBS	Minimum contribution basis of self employed	Mindestbeitragsgrundlage für Selbständige
QPEN	Adjustment factor pension insurance	Pensionsanpassungsfaktor
QRP	Ratio retirees to population, age group 0 to 54	Quote d. Pensionisten an d. Bevölkerung im Alter von 0 bis 54
QSCE	Adjustment factor, social contribution rates of employees to social security	Nettoanpassungsfaktor bei Löhnen
QSCP	Adjustment factor, social (health) contribution rate of pensioners	Nettoanpassungsfaktor bei Pensionen
RSA	Contribution rate, accident insurance	Beitragssatz, Unfallversicherung
RSH	Contribution rate, health insurance	Beitragssatz, Krankenversicherung
RSHR	Contribution rate, health insurance, for retirees	Beitragssatz, Krankenversicherung für Pensionisten
RSPC	Contribution rate, pension insurance, for employers	Beitragssatz, Pensionsversicherung, Arbeitgeber
RSPE	Contribution rate, pension insurance, for employees	Beitragssatz, Pensionsversicherung, Arbeitnehmer
RSPF	Contribution rates of the pension insurance funds	Beitragssatz, Krankenversicherung d. PV Träger
RSPS	Contribution rate, pension insurance, for self-employed	Beitragssatz, Pensionsversicherung, Selbständige
RSU	Contribution rate, unemployment insurance	Beitragssatz, Arbeitslosenversicherung
UTH	Upper threshold health insurance contributions, at current prices	Höchstbeitragsgrundlage d. Krankenversicherung
UTPA	Upper threshold pension and accident insurance contributions, at current prices	Höchstbeitragsgrundlage d. Pensions- u. Unfallversicherung
UTU	Upper threshold unemployment insurance contributions, at current prices	Höchstbeitragsgrundlage d. Arbeitslosenversicherung
PM	Deflator, imports	Deflator, Importe
POPW	Population, 25 OECD-countries, in million persons	Bevölkerung von 25 OECD-Länder*, Mrd. Personen
R	Real long term interest rate	Realer Zinssatz, Sekundärmarktrendite Bund
QSDIFF	Ratio of changes in inventory, acquisition less disposition of valuables, and statistical discrepancy to GDP	Verhältnis von Vorratsveränderungen, Nettozugang an Wertsachen und Statistischer Differenz zum BIP
YW	Gross domestic product, 25 OECD countries, in billion US dollars, at constant 1995 prices	Bruttoinlandsprodukt von 25 OECD-Länder*, Mrd. USD, zu Preisen von 1995
Endogenous Variables		
DPN	Consumption of fixed capital, at current prices	Abschreibungen, laufende Preise
I	Gross capital formation, at constant 1995 prices	Bruttoinvestitionen, zu Preisen von 1995
K	Physical capital stock, at constant 1995 prices	Nettokapitalstock, zu Preisen von 1995
MPL	Marginal product of labour	Grenzprodukt d. Arbeit
PVTD	Present value of the tax depreciation allowance	Steuerliche Abschreibung, Barwert
Q	Tobin's Q	Tobinsches Q
Y	Gross domestic product, at constant 1995 prices	Bruttoinlandsprodukt, zu Preisen von 1995
YN	Gross domestic product, at current prices	Bruttoinlandsprodukt, laufende Preise

Table A1 / continued:

CP	Private consumption, at constant 1995 prices	Privater Konsum, zu Preisen von 1995
HWF	Financial wealth of private households, at constant 1995 prices	Finanzvermögen d. priv. Haushalte, zu Preisen von 1995
HWH	Human wealth of private households, at constant 1995 prices	Humanvermögen d. priv. Haushalte, zu Preisen von 1995
LD	Economically active employees in full time equivalents, in million persons	Unselbständig (Aktiv)Beschäftigte in Vollzeitäquivalente, Mio. Personen
LE	Employees (incl. LENA), in million persons	Unselbständig Beschäftigte (inkl. KUG), Mio. Personen
LEA	Economically active employees (LE - LENA), in million persons	(Aktiv)Beschäftigte
LENA	Persons on maternity leave and persons in military services, in million persons	Kindergeldbezieher u. Präsenzdiener, Mio. Personen
LF	Economically active population (Labour force), in million persons	Realisierte Erwerbspersonen
LFF	Economically active population, females, in million persons	Erwerbspersonen, Frauen
LFM	Economically active population, males, in million persons	Erwerbspersonen, Männer
LFT	Labour force, trend, in million persons	Erwerbspersonen Trend
LS	Dependent labour supply, in million persons	Arbeitsangebot unselbständig, Mio. Personen
LSS	Self employeed, in million persons	Selbständig Beschäftigte, Mio. Personen
LST	Labour supply, trend, in million persons	Trend unselbständiges Arbeitsangebot, Mio. Personen
LU	Unemployed, in million persons	Arbeitslose, Mio. Personen
PR	Participation rate	Erwerbsquote
PR4_5	Participation rate, age group 50 to 64	Erwerbsquote im Alter von 50 bis 64
PR6	Participation rate, age group 65 and older	Erwerbsquote im Alter von 65+
PRF1	Participation rate, females, age group 15 to 24	Erwerbsquote Frauen im Alter von 15 bis 24
PRF2	Participation rate, females, age group 25 to 49	Erwerbsquote Frauen im Alter von 25 bis 49
PRF3	Participation rate, females, age group 50 to 55	Erwerbsquote Frauen im Alter von 50 bis 54
PRF4	Participation rate, females, age group 55 to 59	Erwerbsquote Frauen im Alter von 55 bis 59
PRF5	Participation rate, females, age group 60 to 64	Erwerbsquote Frauen im Alter von 60 bis 64
PRF6	Participation rate, females, age group 65 and older	Erwerbsquote Frauen im Alter von 65+
PRM1	Participation rate, males, age group 15 to 24	Erwerbsquote Männer im Alter von 15 bis 24
PRM2	Participation rate, males, age group 25 to 49	Erwerbsquote Männer im Alter von 25 bis 49
PRM3	Participation rate, males, age group 50 to 54	Erwerbsquote Männer im Alter von 50 bis 54
PRM4	Participation rate, males, age group 55 to 59	Erwerbsquote Männer im Alter von 55 bis 59
PRM5	Participation rate, males, age group 60 to 64	Erwerbsquote Männer im Alter von 60 bis 64
PRM6	Participation rate, males, age group 65 and older	Erwerbsquote Männer im Alter von 65+
TWED	Tax wedge	Lohnschere
U	unemployment rate	Arbeitslosenquote
W	Real wage per capita, in full time equivalents	Realer Lohn in Vollzeitäquivalenten
P	Deflator, GDP	Deflator, Bruttoinlandsprodukt
PC	Deflator, private consumption	Deflator, privater Konsum
PD	Deflator, domestic demand	Deflator, Inlandsnachfrage
PI	Deflator, Gross capital formation	Deflator, Bruttoinvestitionen
PX	Deflator, exports	Deflator, Exporte

Table A1 / continued:

GOS	Gross operating surplus and gross mixed income, at current prices	Bruttobetriebsüberschuss u. Selbständigeneinkommen, laufende Preise
HSC	Social contributions, payable, private households, at current prices	Sozialbeiträge, priv. Haushalte, gezahlt, laufende Preise
HTRM	Social benefits other than social transfers in kind, receivable, private households, at current prices	Monetäre Sozialleistungen, priv. Haushalte, erhalten, laufende Preise
HTRO	Balance of other current transfers, private households, at current prices	Sonstige laufende Transfers, Saldo, priv. Haushalte, laufende Preise
HYI	Balance of property income, private households, at current prices	Vermögenseinkommen, Saldo, priv. Haushalte, laufende Preise
HYNSI	Non-entrepreneurial disposable income of private households, at current prices	Verfügbares Einkommen d. priv. Haushalte ohne Selbständigeneinkommen, laufende Preise
HYL	Compensation of employees, receivable, private households, at current prices	Arbeitnehmerentgelt, priv. Haushalte, erhalten, laufende Preise
HYS	Mixed income, net, private households, at current prices	Selbständigeneinkommen, priv. Haushalte, erhalten, laufende Preise
YDN	Disposable income of private households, at current prices	Verfügbares Einkommen d. priv. Haushalte, laufende Preise
YL	Compensation to employees, at current prices	Arbeitnehmerentgelt, zu Preisen von 1995
GC	Government consumption, at current prices	Konsumausgaben des Staates, zu laufenden Preisen
GD	Government debt, at current prices	Staatsschuld, laufende Preise
GDMV	Government debt management and valuation changes, at current prices	Staatsschuldenverwaltung und Bewertungsänderungen, laufende Preise
GE	Government expenditures, at current prices	Staatsausgaben, laufende Preise
GEC	Government expenditures under constant spending ratio rule, at current prices	Staatsausgaben unter Regel konst. Staatsausgabenquote, laufende Preise
GEI	Government expenditures on interest, at current prices	Zinsen für die Staatsschuld, Staat konsolidiert, laufende Preise
GEIC	Gov. exp. on interest under constant spending ratio rule, at current prices	Zinsen für die Staatsschuld unter Regel konst. Staatsausgabenquote, laufende Preise
GEO	Other government expenditures, at current prices	Sonstige staatliche Ausgaben, laufende Preise
GEOC	Other government expenditures under constant spending ratio rule, at current prices	Sonst. Staatl. Ausg. unter Regel konst. Staatsausgabenquote, laufende Preise
GR	Government revenues, at current prices	Staatseinnahmen, laufende Preise
HTDIR	Current taxes on income and wealth, payable, private households, at current prices	Einkommen u. Vermögensteuern, priv. Haushalte, gezahlt, laufende Preise
RGD	Implicit average interest rate on government debt	Impliziter durchschnittlicher Zinssatz der Staatsschuld
SC	Social contributions, at current prices	Sozialbeiträge, laufende Preise
SUB	Subsidies, at current prices	Subventionen, laufende Preise
TDIR	Current taxes on income and wealth, receivable, at current prices	Einkommen u. Vermögensteuern, Aufkommen, laufende Preise
TIND	Taxes on production and imports, at current prices	Produktions- u. Importabgaben, laufende Preise
PEN	Number of pensions, in million	Anzahl d. Pensionsbezüge (Direktpensionen+Hinterbliebenenpensionen)
QPP4_5	Adjustment factor, share of pension insured persons at age 55 to 64	Normierungsfaktor für Versicherte in d. PV im Alter von 55 bis 64
SCA	Social security contributions - accident insurance, at current prices	Beitragseinnahmen d. Unfallversicherung, laufende Preise
SCH	Social security contributions - health insurance, at current prices	Beitragseinnahmen d. Krankenversicherung, laufende Preise
SCHE	Social security contributions - health insurance, employees, at current prices	Beitragseinnahmen d. Krankenversicherung, Arbeitnehmer, laufende Preise
SCHR	Social security contributions - health insurance, retirees, at current prices	Beitragseinnahmen d. Krankenversicherung, Beiträge für Pensionisten, laufende Preise

Table A1 / continued:

SCP	Social security contributions - pension insurance, at current prices	Beitragseinnahmen d. Pensionsversicherung, laufende Preise
SCPE	Social security contributions - pension insurance, employees, at current prices	Beitragseinnahmen d. Pensionsversicherung, Unselbständige, laufende Preise
SCPS	Social security contributions - pension insurance, self-employed, at current prices	Beitragseinnahmen d. Pensionsversicherung, Selbständige, laufende Preise
SCU	Social security contributions - unemployment insurance, at current prices	Beitragseinnahmen, Arbeitslosenversicherung
SE	Social security expenditures, at current prices	Sozialausgaben, laufende Preise
SEA	Total social security expenditures, accident insurance, at current prices	Gesamte Ausgaben, Unfallversicherung
SEAO	Other social security expenditures, accident insurance, at current prices	Sonstige Ausgaben, Unfallversicherung
SEH	Total social security expenditures, health insurance, at current prices	Gesamte Ausgaben, Krankenversicherung
SEHO	Other expenditures - health insurance, at current prices	Sonstige Ausgaben d. Krankenversicherung
SEP	Total social security expenditures, pension insurance, at current prices	Gesamte Ausgaben, Pensionsversicherung
SEPO	Other expenditures - pension insurance, at current prices	Sonstige Ausgaben d. Pensionsversicherung
STR	Social security transfers, at current prices	Transferausgaben Sozial u. Arbeitslosenversicherung, laufende Preise
TRA	Transfer expenditures, accident insurance, at current prices	Leistungsausgaben d. Unfallversicherung
TRH	Transfer expenditures, health insurance, at current prices	Leistungsausgaben d. Krankenversicherung
TRP	Transfer expenditures, pension insurance, at current prices	Leistungsausgaben d. Pensionsversicherung
TRU	Transfer expenditures, unemployment insurance, at current prices	Leistungsausgaben d. Arbeitslosenversicherung
DE	Gross domestic product, at constant 1995 prices	Bruttoinlandsprodukt, zu Preisen von 1995
M	Imports, at constant 1995 prices	Importe, zu Preisen von 1995
NFA	Net foreign assets, at current prices	Netto-Auslandsvermögensposition, laufende Preise, Saldo
SDIFF	Changes in inventory, acquisition less disposition of valuables, and statistical discrepancy	Vorratsveränderungen, Nettozugang an Wertsachen und Statistischer Differenz
X	Exports, at constant 1995 prices	Exporte, zu Preisen von 1995
YGAP	Output gap	Output-Lücke