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Model Documentation and Simulations

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Abstract:

In this paper we develop a long run macroeconomic model for Austria to simulate the effects of aging on employment, output growth, and the solvency of the social security system. By disaggregating the population into six age cohorts and modelling sex specific participation rates for each cohort, we are able to account for the future demographic trends. Apart from a baseline scenario, we perform six alternative simulations that highlight the effects of aging from different perspectives. These include two population projections with high life expectancy and with low fertility, a dynamic activity rate scenario, two scenarios with a stable fiscal balance of social security and an alternative pension indexation, and a scenario with higher productivity growth.

JEL classification: C6, E2, O4
Key words: Economic growth, aging, Austria

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1. Introduction and overview

A-LMM is a long-run macroeconomic model for the Austrian economy 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, to develop long-term scenarios, and to perform simulation studies. The current version of the model foresees a projection horizon until the year 2075. 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 in a flexible way and set up as simulation experiments contingent on exogenous and policy variables.

A-LMM is a model derived from neoclassical theory which replicates the well-known stylised facts about growing market economies summarised by Nicholas Kaldor (recit. *Solow*, 2000). These are: (i) the output to labour ratio has been rising at a constant rate, (ii) similarly, the capital stock per employee is rising at a constant rate, (iii) the capital output ratio and (iv) the marginal productivity of capital have been constant. Together, facts (iii) and (iv) imply constant shares of labour and capital income in output. An economy for which all of the above facts hold is said to be growing in steady state.

In A-LMM, the broad picture outlined by Kaldor emerges as a result of optimizing behaviour of 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. As the third major actor we consider the general government. We assume a constant legal and institutional framework for the whole projection period. The government is constrained by the balanced budget requirement of the Stability and Growth Pact. The structure of A-LMM is shown in figure 1.1.

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[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.,* 1996, *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).

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. It is well known that a constant return to scale production technology under Harrod-neutral technical progress is one of the few specifications consistent with Kaldor's facts. We therefore assume a Cobb-Douglas production function with exogenous Harrod-neutral technical progress. Factor demand is derived under the assumption of profit maximisation subject to resource constraints and the production technology. 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 net of business taxes. Labour demand is derived directly from the first order condition of the firms' profit maximisation problem.

Private households' behaviour is derived from intertemporal utility maximisation according to an intertemporal budget constraint. Within this set-up, decisions about consumption and savings (financial wealth accumulation) are formed in a forward looking manner. Consumption depends on discounted expected future disposable income (human wealth) and financial wealth but also on current disposable income since liquidity constraints are binding for some households.

To afford consumption goods, household supply their labour and receive income in return. A special characteristic of A-LMM is the focus 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 rate. In the model we implement highly disaggregated (by sex and age groups) participation rates. This gives us the opportunity to account for the different behaviour of males and females (where part-time work is a major difference) and young and elderly employees (here early retirement comes into consideration).

Another special characteristic of A-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 the pension, health and accident, and unemployment insurance, respectively. Additionally, expenditures on long term care are modelled. Demographic developments are important explanatory variables in the social security model. Although, individual branches of the public sector may run permanent deficits, for the public sector as a whole, the long-run balanced-budget condition is forced to hold.

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

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[2] See, for example, *Allen – Hall* (1997).

A-LMM as a long run model is supply side driven. The demand side adjusts in each period to secure equilibrium in the goods market. The adjustment mechanism runs via disequilibria in the trade balance. The labour market equilibrium is characterised by a time varying natural rate of unemployment. Prices and financial markets are not modelled explicitly; rather we view Austria as a small open economy. Consequently, the real interest and inflation rates coincide with their foreign counterparts. We impose that the domestic excess savings correspond to the income balance in the current account.

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 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]. A-LMM is developed and implemented in EViews©.

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 consumption and savings decisions of private households. In sections 4 and 5 we consider the labour market, and income determination, respectively. The public sector in general and the social security system in particular are dealt with in sections 6 and 7. How the model is closed is the focus of section 8. In section 9 we conclude with a discussion of several projections based on different assumptions for key exogenous variables. These scenarios concern changes in population growth and labour market participation rates, a reduction of the fiscal deficit of the social security system, an alternative rule for indexing pensions and an increase in total factor productivity growth.

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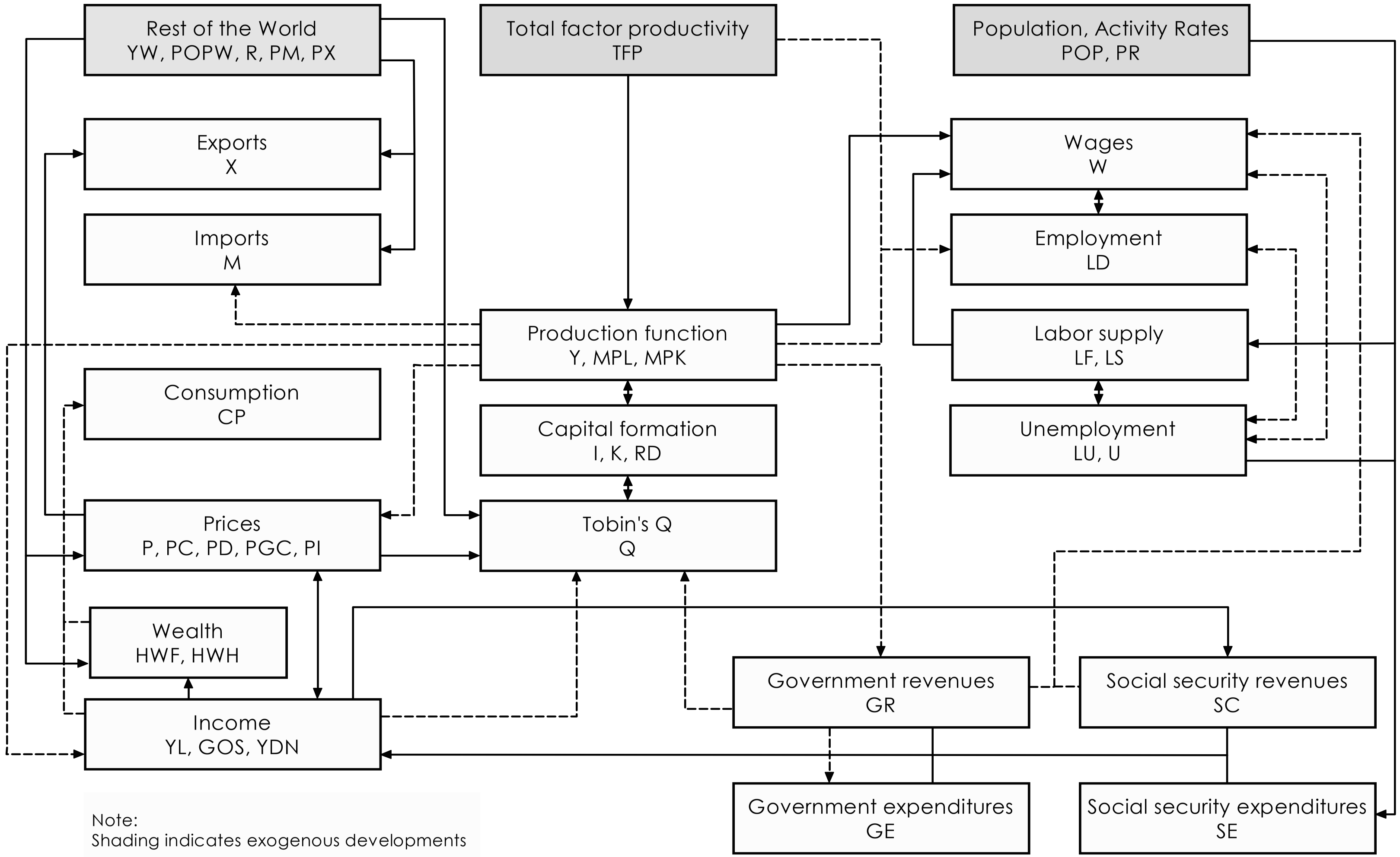
[3] For consistency A-LMM relies on the system of national accounts. On the basis of the current European System of National Accounts framework (*ESA,* 1995), official data are available from 1976, in part only from 1995, onwards. The projection outreaches the estimation period by a factor of three.

[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 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).

Figure 1.1: A-LMM Structure



Note:
Shading indicates exogenous developments

2. Firm behaviour

2.1 The modified neoclassical investment function

In A-LMM, the investment function closely follows the neoclassical theory modified by the inclusion of costs of installation for new capital goods. This approach ensures smoothness of the investment path over time and offers sufficient scope for simulations.

Lucas – Prescott (1971) were the first to note that adding the costs of installing new investment goods to the neoclassical theory of investment by *Jorgenson* (1963) reconciles the latter 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.

Jorgenson (1963) postulates a representative firm with perfect foresight of future cash flows. The firm chooses the rate of investment so as to maximise the present discounted value of future net cash flows subject to the technological constraints and market prices. *Lucas* (1967) and others have noted several deficiencies in the early versions of that theory. Among them are the indeterminacy of the rate of investment and the exogeneity of output. The former can be remedied by including a distributed lag function for investment. If installing a new capital good incurs a cost, then this cost can be thought of as the cost of adjusting the capital stock.

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 profit maximisation 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. A typical installation function is strictly monotone increasing and concave in investment. In addition, the function takes the value of zero when no investment is taking place, is increasing because for a given stock of capital the cost of installation per unit of investment is greater, the greater the rate of investment, and concave due to diminishing marginal costs of installation. The installation function is commonly defined by its inverse.

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

$$\frac{I_t}{K_{t-1}} = F(Q_t). \tag{2.1}$$

The left hand side of *(2.1)* is approximately the rate of change of K_t.

Since the marginal Tobin's Q is unobservable, the usual practice is to turn to the average Q_t:

$$Q_t = CONQ + \frac{1}{P_t K_t} \sum_{i=0}^{T} \frac{(1 - RTC_t - RTDIR_t) NOS_{t+i} + DPN_{t+i}}{(1 + RN_{t+i} + RD_t)^i}, \tag{2.2}$$

where *i* = 0,1,...,*T*. Hayashi shows that the average and marginal Q are essentially the same for a price-taking firm subject to linearly homogenous production and installation functions. Tobin's Q introduces a forward looking element into our model. In 2.2, the theoretically infinite sum is approximated by the first 11 terms, or *T* = 10, plus a constant *CONQ*. The numerator in Q_t is a proxy for the market value of new investment computed as the present value of future cash flows of the firm. The cash flow is given by the net operating surplus NOS_t, net of business taxes plus the current depreciation DPN_t. RTC_t denotes the average rate of corporation tax and $RTDIR_t$ the average rate of all other direct taxes paid by the business sector. The replacement costs of capital are approximated 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 nominal rate of interest, RN_t, and the rate of physical depreciation of capital RD_t. The fiscal policy variables RTC_t, $RTDIR_t$, and the rate of physical depreciation of capital, RD_t, are exogenous and are held constant in the baseline.

For a particular inverse installation function

$$\psi(I_t, K_{t-1}) = I_t \left(1 + \frac{PHI}{2} \frac{I_t}{K_{t-1}}\right) \frac{PI_t}{P_t}, \tag{2.3}$$

the investment function becomes

$$\frac{I_t}{K_{t-1}} = \frac{1}{PHI} \left(\frac{Q_t P_t}{PI_t} - 1\right), \tag{2.4}$$

where PI_t the investment deflator and the constant parameter $PHI \geq 0$ reflects adjustment costs of capital. In the model $PHI = 7.18$.

2.2 Capital stock and depreciation

For a comprehensive discussion of the methodology for measuring the capital stock in Austria see *Böhm et al.* (2001) and *Statistics Austria* (2002). In the model, the capital stock at constant 1995 prices is accumulated according to the perpetual inventory method:

$$K_t = (1 - RD_t)^{0.5} I_t + (1 - RD_t) K_{t-1}, \tag{2.5}$$

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 $(1-RD_t)^{0.5}$ 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 thereafter. Physical depreciation at current prices is thus given by the sum of depreciation on current investment and on the existing capital stock:

$$DPN_t = \left(\left(1-(1-RD_t)^{0.5}\right)I_t + RD_t K_{t-1}\right) PI_t \,. \qquad (2.6)$$

2.3 The neoclassical production function

Output is produced with a Cobb-Douglas technology by combining labour and physical capital under constant returns to scale. After taking the natural logarithm, the Cobb-Douglas production function is given by:

$$\log(Y_t) = CONY + TFP \cdot t + ALPHA \log(K_t) + (1-ALPHA)\log(LD_t)\,, \qquad (2.7)$$

where Y_t denotes GDP at constant 1995 prices. *CONY* denotes the constant in the production function, *TFP* is the growth rate of total factor productivity, *t* is a time trend, LD_t the number of full-time equivalent employees[5], and K_t the stock of capital. The parameter *ALPHA* = 0.491 is the output elasticity of capital. The value of (*1 = ALPHA*) corresponds to share of labour income in nominal GDP in 2002. The labour income share in Austria is lower than in most other developed countries. This can be partially explained by Austria's practice of including incomes of self-employed into the gross operating surplus, i.e., profits. This makes our specification closer in spirit to the augmented neoclassical growth model along the lines of *Mankiw – Romer – Weil* (1992). By augmenting the production function by the stock of human capital, these authors obtain an estimate the labour coefficient of 0.39.

The Cobb-Douglas production function implies a unit elasticity of substitution between the factor inputs. 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 profit maximisation (or 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 relative factor prices. In our case, factor prices are the real wage per full-time equivalent and the user costs of capital. Thus, other things being equal, an increase of the ratio of real wage to the user costs will lower the ratio of the number of employees to capital by the same magnitude.

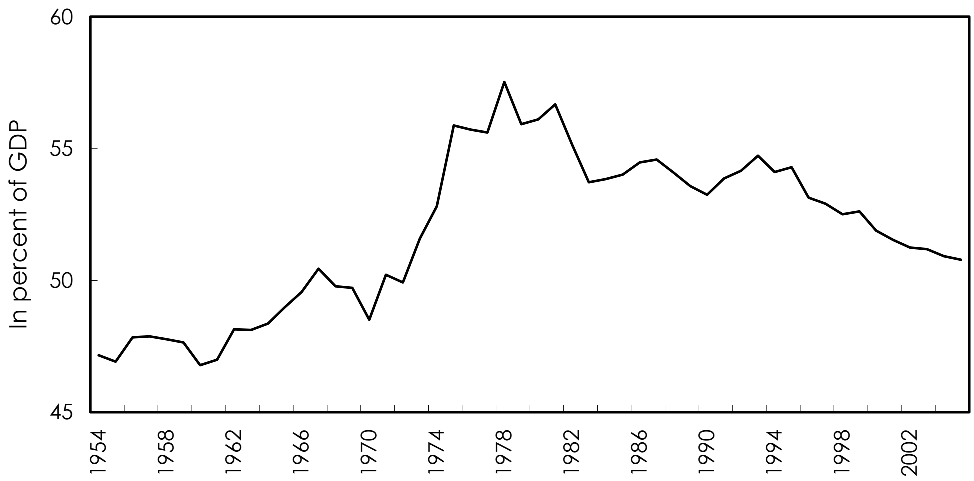
A Cobb-Douglas production function implies constancy of the income shares of factor inputs in the total value added. These are given by the ratios of the gross operating surplus and

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

wages to GDP at constant prices. Although the labour income share in Austria has been falling since the late seventies, in the longer term it has varied in a narrow range (figure 2.1). For this reason the assumption of long term constancy of the labour income share over a long run seems appropriate. One of the plausible reasons for time a varying income share is structural change in the economy. For example, a shift towards capital intensive sectors leads to a decrease in the aggregate labour income share even if sector specific production functions imply constant income shares. Since we abstract from modelling structural change by assuming a representative firm producing a homogenous good, a constant labour income share is adequate.

Another feature of Cobb-Douglas technology is that the marginal and the average products of input factors grow at identical rates, their levels differing by the respective factor shares. In the baseline, we assume a constant annual rate of change of labour productivity of 1.7 percent. The corresponding annual rate of change of total factor productivity TFP_t is 1.7 (1-ALPHA) = 0.85 percent.

Figure 2.1: Labour share in percent of GDP in Austria



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[6]. This insurance scheme is sustainable 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

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

which describes expected utility as the discounted sum of instantaneous utilities from current and future consumption (cp_{t+i}) for $i = 0,\ldots,\infty$ 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

[6] 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 is:

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

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)*. Instead, different concepts for financial and human wealth must be used. The optimal level of aggregate consumption CP_t is:

$$CP_t = (RTP + PRD)(HWF_t + HWH_t), \qquad (3.8)$$

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:

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

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 disposable income of private households net of profits and interest income, $HYNSI_t$:

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

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). Many empirical studies on the behaviour of consumption 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 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 are the so 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 aggregate consumption function:

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

where *CONCP* is a constant. 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.

Savings of private households in period *t* result from the difference between disposable income and private consumption ($YDN_t - CP_tPC_t$).

Human capital is computed as the discounted sum of future disposable non-entrepreneurial income, $HYNSI_t$, plus distributed profits of the business sector from the current period. 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., $\varphi = 0$. 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 2075 and we have to rely on a simple extrapolation of the population beyond that date.

Financial wealth is computed as the sum of three components: the initial net foreign asset position of Austria at current prices at the beginning of period t, NFA_t, and the present value of future gross operating surplus, GOS_t, as well as the future current account balances, CA_t, is the forward looking component of aggregate financial wealth HWF_t:

$$HWF_t = \frac{(1-QHYS_t)GOS_t}{P_t} + \sum_{i=1}^{30}\left(\frac{GOS_{t+i}+CA_{t+i}}{P_{t+i}}\right)\frac{1}{(1+R_{t+i}+PRD)^i} + \frac{NFA_t}{P_t}. \qquad (3.14)$$

In order to avoid double counting we only put retained earnings from the current period into the computation of financial wealth for period t. For all future periods we use the discounted sum of future total gross operating surplus. This formulation 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 do not distinguish between equity and bonds. Bonds will be regarded as 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.

4. The labour market

The labour market block of the model consists of three parts (labour supply; labour demand; wage setting, and unemployment). In the first part aggregate labour supply is projected until 2075. Total labour supply is determined by activity rates of disaggregated sex-age cohorts and the respective population shares. Labour demand is derived from the first order conditions of the cost minimisation problem. 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 (tax burden on wages and the income replacement rate from unemployment benefits).

For the projections of labour supply and the wage equation we use elements of the neo-classical labour supply hypothesis (*Borjas,* 1999). There labour supply 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.

We use the following data with respect to labour. Total labour supply, LF_t, comprises the dependent employed, LE_t, the self-employed, LSS_t, and the unemployed, LU_t. We take our data from administrative sources (Federation of Austrian Social Security Institutions[7] for LE_t, AMS for LU_t, WIFO for LSS_t)[8] and not from the labour force survey. Only this database provides consistent long-run time series for the calculation of labour force participation rates. Note that the reported activity rates are below the values from the labour force survey. Dependent labour supply (employees and unemployed), LS_t, and the unemployed are calculated as:

$$LS_t = QLS_t \, LF_t \,. \tag{4.1}$$

$$LU_t = LS_t - LE_t \,. \tag{4.2}$$

In the projections we set $QLS = 0.9$, the value for the year 2002. Therefore LSS_t amounts to 10 percent of LF_t. In our projections we differentiate between self-employed persons in agriculture, $LSSA_t$, and in other industries, $LSSNA_t$. $LSSA_t$ is calculated as:

$$LSSA_t = QLSSA_t \, LSS_t \,. \tag{4.3}$$

$QLSSA_t$ denotes the share of $LLSA_t$ in LSS_t. We project a continuously falling $QLSSA_t$, which assumes an ongoing structural decline in agriculture[9].

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[7] Hauptverband der österreichischen Sozialversicherungsträger.

[8] For a description of the respective data series see *Biffl* (1988).

[9] We thank Franz Sinabell (WIFO) for providing information about the future development of $QLSSA_t$.

In LE_t persons on maternity leave and persons in military service (Karenzgeld- bzw. Kindergeldbezieher und Kindergeldbezieherinnen und Präsenzdiener mit aufrechtem Beschäftigungsverhältnis – $LENA_t$) are included due to administrative reasons. In the projection of $LENA_t$ we assume a constant relationship, $QLENA_t$, between $LENA_t$ and the population aged 0 to 4 years, $POPC_t$, which serves as proxy for maternity leave. We use the number of dependent employed in full-time equivalents, LD_t, as labour input in the production function. The data source for employment in full-time equivalents is Statistics Austria. Employment (in persons) is converted into employment in full-time equivalents through the factor QLD_t. For the past, QLD_t is calculated as $LD_t/(LE_t\text{-}LENA_t)$. QLD_t is kept constant over the whole forecasting period at 0.98, the value for 2002).

QWT_t denotes an average working time-index, which takes the development of future working hours into account. QTW_t is calculated in the following way: the share of females in the total labour force times females average working hours plus the share of males in the labour force times the average working hours of males. The average working time for males and females is 38.7 hours per week and 32.8 hours per week, respectively. These values are taken from the Microcensus 2002. QWT_t is standardised to 1 in 2002. In general we could simulate the impact of growing part-time work on production by changing average working time of males and females, respectively. In our scenarios we assume constant working hours for males and females, respectively, over time. An increasing share of females in the labour force implies that total average working time will fall. The relationship between LE_t and LD_t is as follows:

$$LE_t = \frac{LD_t}{QLD_t\, QWT_t} + LENA_t\,. \tag{4.4}$$

4.1 Labour supply

In this section we present two scenarios for labour supply in Austria covering the period 2003 to 2075. The development of the Austrian labour force depends on the future activity rates and the population scenario. In our model population dynamics is exogenous. We use three different scenarios of the most recent population projections 2000 to 2075 (medium variant; high life expectancy; low fertility) by Statistics Austria[10] (*Statistics Austria,* 2003, *Hanika et al.,* 2004).

We project the activity rates for 6 male (PRM_{1t} to PRM_{6t}) and 6 female (PRF_{1t} to PRF_{6t}) age cohorts separately. The following age groups are used (PRM_{it} and PRF_{it}: 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). $POPM_{1t}$ to

[10] We received extended population projections from Statistics Austria until the year 2125. Therefore we are able to solve the model until 2100.

$POPM_{6t}$ and $POPF_{1t}$ to $POPF_{6t}$ denote the corresponding population groups. Total labour supply, LF_t, is given by

$$LF_t = \sum_{i=1}^{6} PRM_{it} POPM_{it} + PRF_{it} POPF_{it} \,. \tag{4.5}$$

In order to consider economic repercussions on future labour supply we model future activity rates as trend activity rates, PRT_t, which are exogenous in A-LMM, and a second part, depending on the development of wages and unemployment:

$$PRM_{it} = PRTM_{it} + ELS \cdot WA_t \,; \tag{4.6a}$$

$$PRF_{it} = PRTF_{it} + ELS \cdot WA_t \,. \tag{4.6b}$$

ELS denotes the uniform participation elasticity with respect to WA_t, and WA_t is given by

$$WA_t = \log\left(\frac{w_t(1-u_t)}{w_{2002}(1+g_{wa})^t (1-u_{wa})} \right). \tag{4.7}$$

WA_t is a proxy for the development of the ratio of the actual wage to the reservation wage. It measures the (log) percentage difference between the actual wage at time *t*, weighted by the employment probability $(1 - u_t)$, and an alternative wage[11]. For the path of the alternative wage (see the denominator in 4.7) we assume for the future a constant employment probability $(1 - u_{wa})$ and that wages grow at a constant rate g_{wa}. In our simulations we set g_{wa} to 1.8 percent and u_{wa} to 5.4 percent. These values are taken from the simulation of our base scenario with the assumption $ELS = 0$ (see section 9.1.1). Setting g_{wa} and u_{wa} to these values implies (on average) the same values for the labour force in the base scenario with and without endogenous participation. With other words, our trend activity rate scenario implicitly assumes an average wage growth of 1.8 percent and an average unemployment rate of 5.4 percent.

Since no actual estimate for the Austrian participation elasticity is available we use an estimate for Germany with respect to gross wages and set $ELS = 0.066$ (*Steiner,* 2000). This estimate implies that a 10 percent increase in the (weighted) wage leads to a 0.66 percentage point increase in the participation rate.

In the following we explain the construction of the two activity rate scenarios. First we present stylised facts about labour force participation in Austria and actual reforms in the old-age pension system. Similar to most other industrialised 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

[11] We use lagged WA_t instead of current WA_t to avoid convergence problems in EViews©.

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 was 60 for women and 65 for men until 2000. 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 legislation. Given the relatively high pension expenditures and the aging of the population, the government introduced reforms with the aim to rise the actual retirement age and to curb the 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 2017. Starting from the second half of 2004, the early retirement age will be raised by one month every quarter.

4.1.1 Baseline trend labour supply scenario

In the following we explain the construction of the baseline trend labour supply scenario. We model the trend participation rates outside the macro-model because empirical evidence shows that the retirement decision is determined by non-monetary considerations and low pension reservation levels (*Bütler et al.,* 2004). The Austrian pension reform 2003 increased the statutory minimum age for retirement and leaves only small room for individual decisions on the retirement date.

Projections of aggregate activity rates are often based on the assumption that participation rates by age groups remain unchanged in the future (static scenario). Another 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 use trend extrapolation 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 29, 30 to 39, and 40 to 49 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 due to one additional year of schooling 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 25 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 years we project stable rates for males and a slight reduction for females, where the apprenticeship system is less important.

Austria is characterised by a very low participation rate of older workers. In the past, incentives to retire early inherent in the Austrian pension system 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 (see *Burniaux et al.,* 2003 for international evidence).

We project the following scenario for the different age cohorts (figure 4.2). 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 reverts 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 2050 the participation rate of females amounts to 70 percent.

We extend our projections up to 2075 by assuming constant participation rates for all sex-age groups as of 2050. 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 an important factor for economic growth in A-LMM, we have developed a second labour force scenario.

The static approach is one alternative for constructing the second scenario. However, due to problems with this method (see below) we use a dynamic approach (see *Burniaux et al.*, 2003). Additionally, we add more pessimistic assumptions concerning the impact of the pension reform. We follow the OECD in calling this method dynamic approach, because it extends the static approach by using information about the rate of change of labour force participation rates over time. To avoid misunderstandings, the baseline trend labour supply scenario is not based on a static approach. In the following we describe the methodology and the results of the alternative activity rate scenario.

4.1.2 Dynamic activity rate scenario

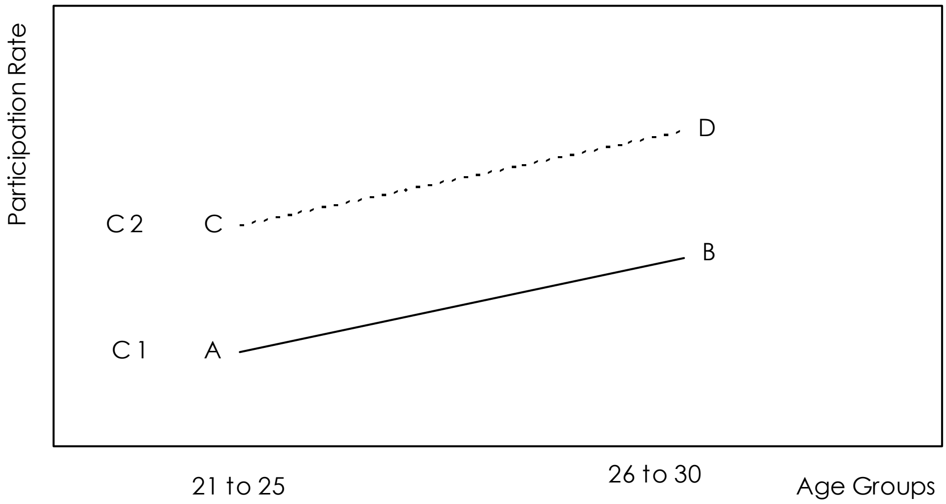
Projections of aggregate activity rates are often based on the assumption that activity rates by age groups remain at the current level (i.e., the "static approach"). These projections are static in the sense that they do not incorporate the dynamics resulting from the gradual replacement over time of older cohorts by new ones with different characteristics. The static model runs into problems if cohort specific differences in the level of participation rates exist, e.g., a stronger attachment of females to the labour market. For that reason we use the dynamic model of *Scherer* (2002), considering cross-cohort shifts of activity. This projection method is based on an assumption that keeps lifetime participation profiles in the future parallel to those observed in the past (see *Burniaux et al.* 2003, pp. 40ff.).

Figure 4.1 gives a simplified example of the difference between the static and dynamic approach to model the evolution of participation rates over time. Assume two female cohorts (C1 and C2) in 2002: C1 is aged 26-30 and C2 is aged 21-25. Figure 4.1 shows how the activity rate for C2 in the year 2007 is projected. Note that A and B are the observed activity rates for C1 at age 21-25 (in the year 1997) and age 26-30 (in the year 2002), respectively. For C2 we observe C, the activity rate at the age 21-25 in 2002, and we have to project the activity rate of C2 at the age of 26-30 in the year 2007. In the static approach the activity rate of C1 at the age of 26-30 (B) is used as estimate for the activity rate of C2 at age 26-30.

The dynamic approach takes account of the difference in the activity rates of the two cohorts at the age 21-25. The dynamic approach uses information about the change in the activity rate of C1 between age 21-25 and age 26-30. The activity rate of C2 is projected to grow at the same rate as the activity rate of C1 did between 1997 and 2002 (illustrated by the parallel lines in figure 4.1). Therefore, in the dynamic approach, the activity rate of C2 at the age of 26-30 is projected to be D in 2007.

Note that the assumption of an unchanged (age specific) participation rate has been replaced by the assumption of an unchanged (age specific) slope of the lifetime participation profile. In other words, the (age specific) probabilities of entry and exit in and out of the labour market are assumed constant in the dynamic approach.

Figure 4.1: The dynamic projection approach. Dynamic vs. static participation rates



Formally, the dynamic projection method is based on the observed distribution of entry and retirement probabilities by age. Let $PR^{t}_{x,x+4}$ be the activity rate of age group *x* to *x + 4* in period *t* (e.g., the activity rate of the age group 20 to 24 in 2002). Then the probability $WX^{t}_{x,x+4}$ of persons aged *x* to *x + 4* to retire before period *t* and *t + 5*, respectively, is

$$WX^{t}_{x,x+4} = 1 - \frac{PR^{t}_{x+5,x+9}}{PR^{t-5}_{x,x+4}} \geq 0 , \qquad (4.8)$$

the probability WN^{t}_{x} to enter into the job market is

$$WN^{t}_{x,x+4} = 1 - \frac{\overline{PR} - PR^{t}_{x+5,x+9}}{\overline{PR} - PR^{t-5}_{x,x+4}} \geq 0 , \qquad (4.9)$$

where $\overline{PR}$ is an upper limit on activity rates (we assume 99 percent for men and 95 percent for women).

We use the male and female activity rates in 5-year age-groups (15 to 19, 20 to 24, ... , 60 to 64 and 65 plus) for the years 1997 and 2002, respectively, to calculate the entry and retirement probabilities for the year 2002 for men and women separately (4.8 and 4.9). Based on the assumption that these probabilities will not change during the projection period 2003 to 2075, the projected activity rates for this period are given by (*t* = 2003,...,2075):

$$\begin{aligned} PR^{t}_{x+5,x+9} &= PR^{t-5}_{x,x+4}\left(1-WX^{2002}_{x,x+4}\right), && \text{if } WX^{2002}_{x,x+4} > 0, \\ PR^{t}_{x+5,x+9} &= \overline{PR}\cdot WN^{2002}_{x,x+4} + PR^{t-5}_{x,x+4}\left(1-WN^{2002}_{x,x+4}\right) && \text{if } WN^{2002}_{x} > 0, \\ PR^{t}_{x+5,x+9} &= PR^{t-5}_{x,x+4}, && \text{otherwise.} \end{aligned} \quad (4.10a)$$

We assume constant activity rates for the age groups 15 to 19 and 20 to 24:

$$PR^{t}_{15,19} = PR^{2002}_{15,19}, \qquad t = 2003,\ldots,2075. \quad (4.10b)$$

$$PR^{t}_{20,24} = PR^{2002}_{20,24}, \qquad t = 2003,\ldots,2075. \quad (4.10c)$$

Women today are more active than decades ago. This catching-up process vis-à-vis men is currently still in progress, but this may not be the case for the entire future. For this reason the non-critical application of this model (which comprehend this current catching-up process) would lead to implausible results for female activity rates. Therefore, we make the following four assumptions:

1) The activity rates of women aged 35 to 39 is not higher than the activity rates of women aged 30 to 34:

$$PR^{female,t}_{35,39} \le PR^{female,t}_{30,34}. \quad (4.11a)$$

2) The activity rates of women aged 45 to 49 is not higher than the activity rates of women aged 40 to 44:

$$PR^{female,t}_{45,49} \le PR^{female,t}_{40,44}, \quad (4.11b)$$

3) The activity rates of females in the age group 50-54 increased considerably over the last five years. Using the resulting exit probabilities would lead to unreasonably high activity rates in the future. Therefore we use the average of the male and female exit probability:

$$WX^{female,new,t}_{50,54} = \frac{WX^{female,t}_{50,54} + WX^{male,t}_{50,54}}{2}, \quad (4.11c)$$

4) The activity rate of the age group 65+ does not exceed 5 percent:

$$PR^{male,t}_{65+} \le 0.05,\; PR^{female,t}_{65+} \le 0.05. \quad (4.11d)$$

All modifications replace the original values in the calculations thus they lead to changes in the successive age groups of the same cohorts indirectly.

We make the following assumptions with respect to the effects of the pension reform of 2003. We calculated the activity rates for males and females under the assumption that $^2/_3$ of all persons currently in early retirement due to long-term insurance coverage and $^4/_5$ of all persons in early retirement due to unemployment would be in the labour force. Note that this seems to be a rather conservative assumption about the effects of the pension reform. This exercise yields an increase in the participation rate of females in the age group of 55 to 60 of 17 percentage points, and 21 percentage points for males aged 60 to 64, respectively. We consider the transition period until 2017 by assuming a linear increase of the activity rate. With respect to the impact of the increasing statutory retirement age for females, we assume an increase in the participation rate in the age group 60 to 64 by 21 percentage points until 2033.

The projection method yields the following results with respect to PRT_1 to PRT_6 (see figure 4.3). The participation rate of the young age-cohort is assumed to remain constant. The activity rate of males aged 25-49 will fall from 88.2 percent to 86.3 percent. For the age cohorts 50-54 (55-59) we project a 3 (4.5) percentage point decrease in the participation rate to 77.4 percent (62.5 percent). Due to the effects of the pension reform 2003, we project an increase of 21.3 percentage points in the age cohort 60-64. Overall the male activity rate is almost unchanged and amounts to 75.5 percent. For females we project a significant increase in all age cohorts but the first. This is caused by the catching up of females and is further augmented by the pension reform. According to the projections the activity rate of females aged 25-49 will increase by 4.3 percentage points to 79.3 percent. For the age group 50-54 we expect an increase from 64.7 percent to 77.5 percent. The cohort effect and the pension reform will cause a strong increase in the participation rate of females aged 55-59 from 33.4 percent to 60 percent. For the age cohort 60-64 the activity rate will increase from 5.1 percent to 34.4 percent. In total the female activity rate will increase from 60 percent to 71.6 percent.

Biffl – Hanika (2003) provide also a long-term labour force projection for Austria. According to their main variant the Austrian labour force will increase by 4.4 percent between 2002 and 2031. Hence labour force growth from *Biffl – Hanika* is stronger as in our baseline scenario (1.8 percent). The main difference is caused by the assumptions concerning the development of the female labour force. In our scenarios we make relative conservative assumptions about future female activity rates. In contrast, *Biffl – Hanika* project that the increasing trend in female activity rates will continue until the Austrian rates are similar to the rates of the Nordic countries. Extending the projection period to the year 2050 considerably narrows the gap between our baseline scenario and that of *Biffl – Hanika*. In our baseline scenario labour force declines by 3.2 percent between 2002 and 2050; in *Biffl – Hanika* the decline amounts to 2.6 percent. One should further note that *Biffl – Hanika* expect that working time will be reduced for both sexes. Overall both projections are relatively similar, given the uncertainty and the long projection period, and more optimistic than the forecasts in *Burniaux et al.* (2003).

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 Cobb-Douglas production function. Labour input, LD_t, is measured as the number of dependent employed persons in full-time equivalents. Consistent with the production technology, optimal labour demand, LD^*_t, can be derived from the first order conditions of the cost minimisation problem as follows

$$\log(LD_t^*) = \log(1 - ALPHA) - \log(W_t) + \log(Y_t)\,. \tag{4.12}$$

Labour demand rises with output, Y_t, and is negatively related to real wages, W_t. As it takes time for firms to adjust to their optimal workforce (*Hamermesh,* 1993), we assume the following partial adjustment process for employment. The partial adjustment parameter *ALD* denotes the speed of adjustment:

$$\left(\frac{LD_t}{LD_{t-1}}\right) = \left(\frac{LD_t^*}{LD_{t-1}}\right)^{ALD}, \tag{4.13}$$

with 0 < *ALD* < 1. Actual labour demand is then given by

$$\log(LD_t) = ALD\big(\log(1 - ALPHA) - \log(W_t) + \log(Y_t)\big) + (1 - ALD)\log(LD_{t-1})\,. \tag{4.14}$$

The speed of adjustment parameter *ALD* is set to 0.5.

4.3 Wage setting and unemployment

We follow the simple theoretical framework of *Blanchard – Katz* (1999) to motivate the wage equation in our model. Wage setting models imply that, given the workers' reservation wage, the tighter the labour market, the higher will be the real wage. Bargaining and efficiency wage models deliver a wage relation that can be represented as

$$\log\left(\frac{wn_t}{p_t}\right) = \mu \log(b_t) + (1 - \mu)\log(prod_t) - \gamma_1 U_t\,, \tag{4.15}$$

where wn_t and p_t (the actual instead of the expected value as in *Blanchard – Katz,* 1999) are, respectively, the nominal wage and the price level, b_t denotes the reservation wage and $prod_t$ labour productivity. The parameter μ ranges from 0 and 1. The replacement rate of unemployment benefits is one important 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 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

$$\log(b_t) = \alpha + \lambda \log\left(\frac{wn_{t-1}}{p_{t-1}}\right) + (1-\lambda)\log(prod_t)\,. \tag{4.16}$$

Substituting b_t into the wage equation (4.15) and rearranging we receive the following equation:

$$\Delta\log(wn_t) = \mu\alpha + \Delta\log(p_t) - (1-\mu\lambda)\log\left(\frac{wn_{t-1}}{p_{t-1}prod_{t-1}}\right)$$
$$+ (1-\mu\lambda)\Delta\log(prod_t) - \gamma_1 U_t\,. \tag{4.17}$$

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.

Whether μ and λ are close to 1 or smaller has important consequences for the determination of equilibrium unemployment. Empirical evidence indicates that $\mu\lambda = 1$ is a reasonable approximation for the USA, whereas in Europe $(1-\mu\lambda)$ is on average around 0.25 (*Blanchard – Katz,* 1999). 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:

$$\log\left(\frac{wn_t}{p_t}\right) = \log(prod_t) - z_t\,. \tag{4.18}$$

For constant z and *prod* the equilibrium unemployment rate, u^*, is:

$$u^* = \left(\frac{1}{\gamma_1}\right)\left[\mu\alpha + (1-\mu\lambda)z\right]. \tag{4.19}$$

If $\mu\lambda$ is less than unity, the higher the level of z, the higher will be the natural rate of 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. Note, however, that wage growth is lagging behind productivity since the second half of the 1990s. 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).

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, W_t. W_t is determined in a bargaining framework and depends in the long run on the level of (marginal) labour productivity, MPL_t, the unemployment rate, U_t, and several wage push factors, such as the tax wedge on labour taxes, $TWED_t$, and the gross replacement rate, GRR_t, (i.e., the relation of unemployment benefits to gross wages) and $CONW_t$. $CONW_t$ is an exogenous variable used to calibrate the rate of structural unemployment. We postulate the following wage equation:

$$\log(W_t) = CONW_t + \alpha_1 MPL_t - \alpha_2 UR_t + \alpha_3 TWED_t + \alpha_4 GRR \,. \qquad (4.20)$$

MPL_t is derived from the Cobb-Douglas production function:

$$\log(MPL_t) = \log(1 - ALPHA) + \log(Y_t) - \log(LD_t)\,. \qquad (4.21)$$

Following our theoretical considerations and empirical estimates for Austria (e.g., *Hofer – Pichelmann – Schuh,* 2001) we set $\alpha_1 = 1$. We estimate α_2 the coefficient of the dampening influence of unemployment on wages to be around 2. Note that a higher coefficient implies a lower equilibrium unemployment rate. $TWED_t$ 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. The tax wedge is calculated as

$$TWED_t = \log\left[\frac{YL_t}{(1 - RTW_t)(YL_t - QSCL_t SC_t)}\right], \qquad (4.22)$$

where YL_t is the labour compensation, RTW_t wage tax rate, and $QSCL_t$ corrects for statistical discrepancy in the national accounts in security contributions, SC_t.

For α_3 we adopt a coefficient of 0.4[12]. This is in accordance with *Pichelmann – Hofer* (1996) and slightly below the values of *Sendlhofer* (2001). 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_t on wages (see also *Sendlhofer,* 2001). This could be caused by measurement errors. Due to theoretical reasons, we include GRR_t in our wage equation and calibrate $\alpha_4 = 0.3$ such that we receive a smaller effect of changes in GRR_t on unemployment as compared to the tax wedge. The ratio α_4/α_3 corresponds to the coefficients measuring the

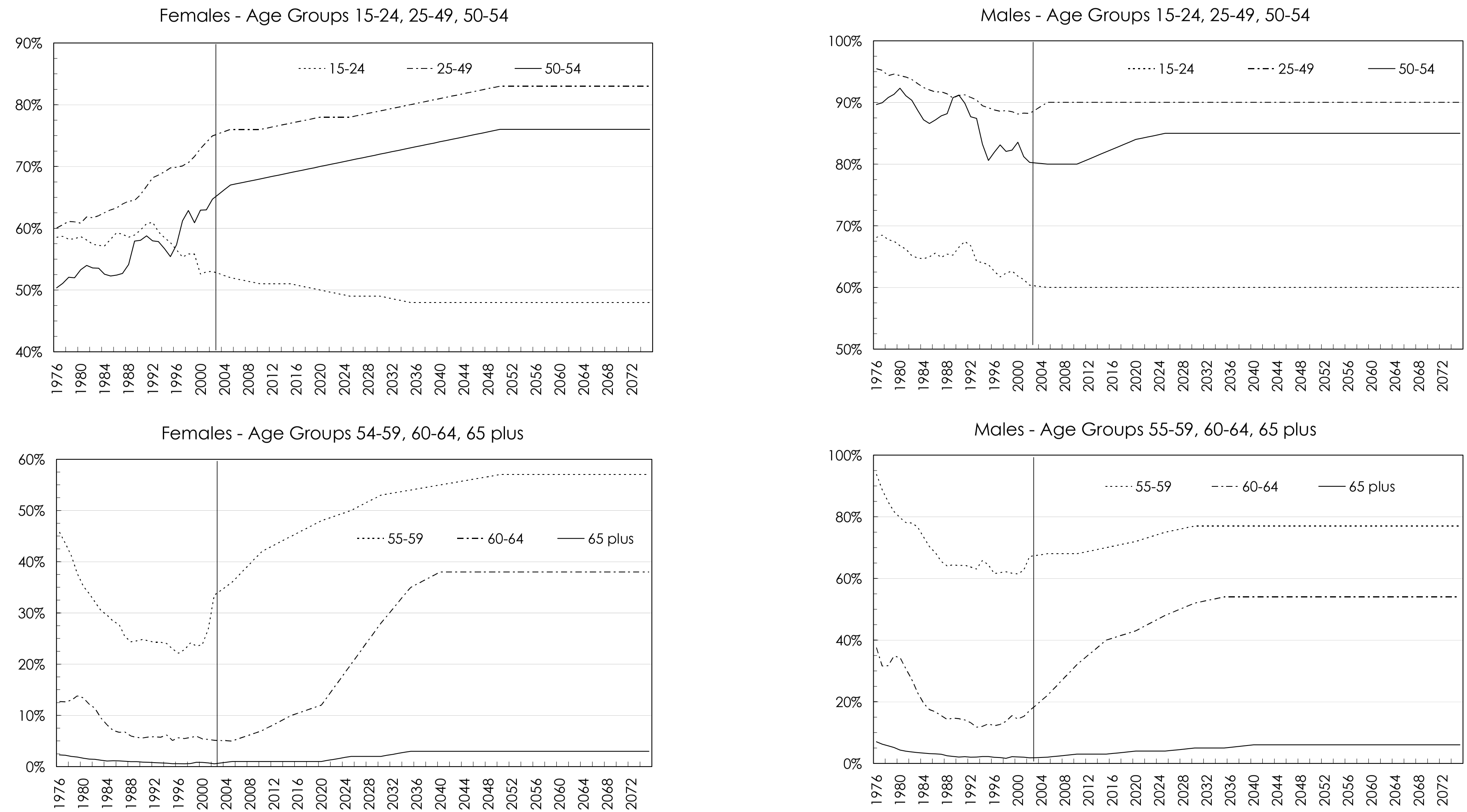
[12] To avoid convergence problems in EViews©, we use the lagged value of $TWED_t$.

impact of the tax wedge, and the gross replacement rate, respectively, on the unemployment rate reported in *Nickell et al.* (2002).

Note that for an economy consistent with Cobb-Douglas technology equilibrium real wages are in steady state equal to (log) labour productivity plus 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, the unique equilibrium rate of unemployment, U^*_t, is given by

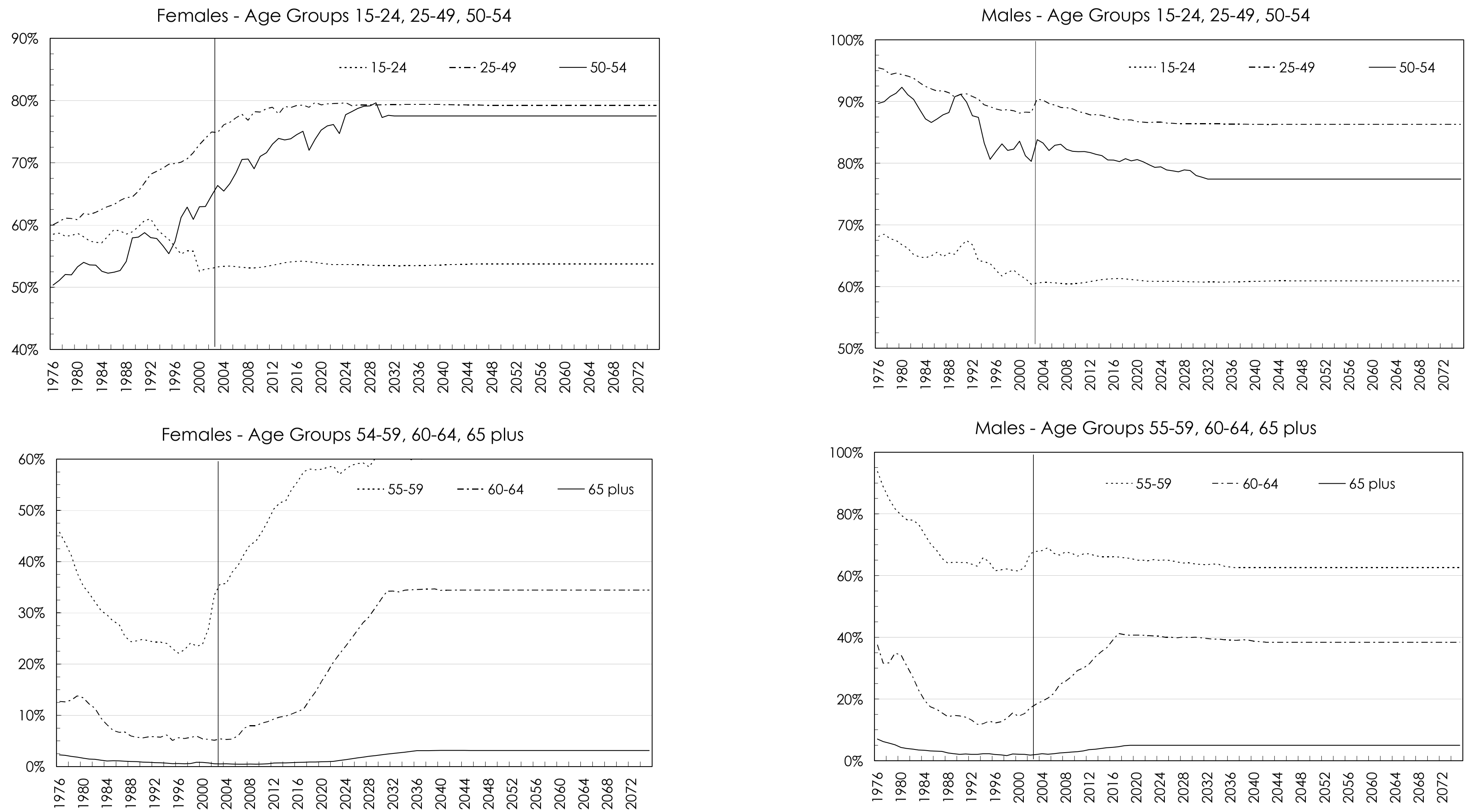
$$U_t^* = \frac{CONW_t + \alpha_3 TWED_t + \alpha_4 GRR}{\alpha_2} . \qquad (4.23)$$

Figure 4.2: Activity rates of different sex and age groups on the Austrian labour market (1976-2075)



Source: 1976-2002 WIFO; 2003-2075 projections

Figure 4.3: Dynamic activity rates of different sex and age groups on the Austrian labour market (1976-2075)



Source: 1976-2002 WIFO; 2003-2075 projections

5. Income determination and domestic financial balance

In this section we show how disposable income is related to gross domestic product. 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 of employees:

$$YL_t = W_t \; LD_t \; P_t \,. \tag{5.1}$$

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 national income accounting. Starting from GDP at current prices, we subtract indirect taxes, $TIND_t$, and add subsidies SUB_t (cf. section 6). The Cobb-Douglas production function guarantees that factor shares will remain constant in the steady state. The gross operating surplus is

$$GOS_t = Y_t P_t - YL_t - (TIND_t \; - SUB_t) \,, \tag{5.2}$$

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 of private households from the nominal compensations of labour and capital. Labour income is supposed to be fully attributable to private households:

$$HYL_t = QHYL_t \; YL_t \,, \tag{5.3}$$

thus $QHYL_t$ is set to 1 for simulations. This assumption is fully backed by column one in table 5.1.

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 $QHYS$ = 0.33 from table 5.1:

$$HYS_t = QHYS_t \; GOS_t \,. \tag{5.4}$$

Table 5.1: 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	0.174	1.198	1.110	0.858	0.014
1996	1.007	0.331	0.208	1.184	1.110	0.829	0.016
1997	1.006	0.329	0.217	1.164	1.112	0.836	0.011
1998	1.006	0.331	0.222	1.146	1.111	0.828	0.014
1999	1.005	0.335	0.225	1.146	1.111	0.851	0.012
2000	1.006	0.327	0.229	1.150	1.116	0.833	0.011
2001	1.006	0.327	0.223	1.140	1.128	0.782	0.023
2002	1.003	0.330	0.222	1.141	1.128	0.828	0.020
Mean	1.006	0.330	0.215	1.159	1.116	0.831	0.015
Standard dev.	0.001	0.003	0.018	0.022	0.008	0.022	0.004
Minimum	1.003	0.327	0.174	1.140	1.110	0.782	0.011
Maximum	1.007	0.335	0.229	1.198	1.128	0.858	0.023

Thereby, we assume that investment plans are not credit constrained. Again, this assumption results in a constant legal environment for simulations.

We differentiate between interest earned on foreign and domestic assets. The former is earned on the stock of net foreign assets accumulated in the past, NFA_{t-1}. Interest earned on domestic assets is modelled as the share of interest income in the gross operating surplus, $QHYI_t$, going to private households:

$$HYI_t = NFA_{t-1}RN_t + QHYI_t\ GOS_t\ . \tag{5.5}$$

This ratio varied between 0.17 and 0.23 (cf. table 5.1). The average value is biased from years with a lower tax rate (1995 and 1996). Therefore, we set $QHYI_t$ equal to 0.23 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 7) and adjust the sum of monetary payments by the health, pension, accident, and unemployment insurance system, and the long term care expenditures, STR_t, by a factor, $QHTRM_t$, to the level given by the national accounts:

$$HTRM_t = QHTRM_t\ STR_t\ . \tag{5.6}$$

This factor slowly decreased from 1995 through 2002 (table 5.1). In simulations of future scenarios we will set the factor equal to 1.141.

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, $TDIR_t$, respectively, according to the national accounts definition:

$$HSC_t = QHSC_t \; SC_t \,, \tag{5.7}$$

$$HTDIR_t = QHTDIR_t \; TDIR_t \,, \tag{5.8}$$

where $QHSC_t$ and $QHTDIR_t$ are those ratios. Table 5.1 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:

$$HTRO_t = QHTRO_t \; GR_t \,. \tag{5.9}$$

As can be seen from table 5.1 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:

$$YDN_t = HYS_t + HYL_t + HYI_t + HTRM_t - HSC_t - HTDIR_t + HTRO_t \,. \tag{5.10}$$

6. The public sector

This section describes the modelling of the public sector. The details of the social security system are dealt with in section 7. 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 set equal to unity. We close the government sector by a simple policy target:

$$GE_t = GR_t , \tag{6.1}$$

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, although constant, 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 than 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:

$$GR_t = \frac{TIND_t + TDIR_t + SC_t}{1 - QGRO_t} , \tag{6.2}$$

where SC_t are social contributions according to the national accounts. The ratio $QGRO_t$ decreased substantially from 1995 onwards. Table 6.1 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:

$$TIND_t = RTIND_t \; Y_t \; P_t , \tag{6.4}$$

where the average tax rate, $RTIND_t$, varies in a narrow band between 14.2 and 16.3 percent (table 6.2). We choose 14.9 percent in all simulations to reflect the fact that observations from the last few years are below the mean value. The effect of variations in the average tax rate depends on the assumption of pass through mechanism, i.e. the degree to which a change in the tax rate is borne by consumers. Since all prices in the model are exogenous, we implicitly assume a zero pass through (cf. chapter 8). For example, an increase in the average tax rate lowers producer prices and, therefore, reduces the gross operating surplus, GOS_t, by the full amount of additional tax revenues. Forward looking firms and households react to lower current and future incomes by cutting their spending on investment and consumption. This corresponds to the income effect of an increase in the tax rate. By neglecting a partial pass through we overestimate the total outcome of adjustments in indirect taxes.

Direct taxes, $TDIR_t$, depend on the two main tax bases: labour income net of social security contributions and capital income net of depreciation:

$$TDIR_t = RTW_t(YL_t - QSCL_t SC_t) + (RTC_t + RTDIR_t)(GOS_{t-1} - DPN_{t-1}), \tag{6.5}$$

where RTW_t represents the average tax rate on wages, $QSCL_t$ corrects for statistical discrepancy in the national accounts. For the simulation we assume that $QSCL_t = 1.067$ (cf. table 6.1). 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 realisation 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 6.5 reflects the fact that depreciation is 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 an accrual basis.

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

$$SUB_t = QSUB_t\left(GR_t - SC_t\right). \tag{6.6}$$

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 6.1). 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 insurance, SEP_t, the health insurance, SEH_t, the accident insurance, SEA_t, the unemployment insurance system, TRU_t, and expenditures on long term care, $GELTC_t$. (cf. section 8):

$$SE_t = SEP_t + SEH_t + SEA_t + TRU_t + GELTC_t. \tag{6.7}$$

Monetary transfers comprise only cash payments and are included in STR_t:

$$STR_t = TRP_t + TRH_t + TRA_t + TRU_t + GELTC_t. \tag{6.8}$$

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:

$$SC_t = QSC_t(SCH_t + SCP_t + SCA_t + SCU_t). \tag{6.9}$$

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:

$$RGD_t = \frac{1}{2}\left(\frac{1}{6}\sum_{i=0}^{5} RN_{t-i} + RGD_{t-1}\right), \tag{6.10}$$

which is an average of lagged nominal interest rates RN_t and the previous implicit rate of interest. This combination reproduces the effect of government debt maturity on the level of the implicit interest rate.

This equation recognises 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, RN_t, 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:

$$GEI_t = RGD_t GD_{t-1}. \tag{6.11}$$

where GD_t represents the level of public debt.

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

$$GE_t = SE_t + SUB_t + HTRO_t + GEI_t + GEO_t. \tag{6.12}$$

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

$$GEO_t = GR_t - (SE_t + SUB_t + HTRO_t + GEI_t), \tag{6.1'}$$

such that equation 6.1 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), 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. Furthermore, we assume that a change in government consumption leaves the output level unchanged. This is true for example, when labour employed in private and public sectors are perfect substitutes, which is a reasonable assumption in the long run.

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 is due to 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:

$$GD_t = GD_{t-1} + (GR_t - GE_t) + GDMV_t \, , \tag{6.13}$$

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 $GDMV_t$ follows:

$$GDMV_t = QGDMV_t GD_t \, , \tag{6.14}$$

where $QGDMV_t$ is the ratio of the value of ex-budgetary transactions to government debt. In the baseline we fix $QGDMV_t$ at zero (cf. table 6.1). Thus government debt is fixed at the level of 2002, as the public sector net savings are also zero by our policy rule.

One can also simulate an alternative scenario where other government expenditures, $GEOC_t$, are held constant as a share of nominal GDP:

$$GEOC_t = QGEOC_t YN_t \, , \tag{6.15}$$

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 a deficit. Other policy rules, for example, pre-funding for an expected increase in old-age related expenditures can be easily implemented.

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:

$$GC_t = QGCN_t \frac{GE_t - SE_t - SUB_t - GEI_t}{PGC_t} \, , \tag{6.16}$$

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 6.1). We fix $QGCN_t$ at the last observed value. Because all items of government expenditures are measured at current prices we use the deflator of government consumption PGC_t to compute real values.

Table 6.1: 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 according 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 6.2: Average tax rates, 1976-2002

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

7. Social security and long term care

The social security sector in Austria comprises the publicly provided pension, health and accident Insurance. In the European System of National Accounts (ESA95) 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. Expenditures on long term care form another important social expenditure item, which is also included in this section.

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, we use 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.

7.1 Social expenditures

As mentioned above the model contains four components of social expenditures (pensions, health, accidents, unemployment). Total social expenditures, SE_t, are the sum of expenditures of the pensions insurance, SEP_t, health insurance, SEH_t, accident insurance, SEA_t, the transfer expenditures of unemployment insurance, TRU_t, and expenditures on long term care, $GELTC_t$:

$$SE_t = SEP_t + SEH_t + SEA_t + TRU_t + GELTC_t . \qquad (7.1)$$

Total expenditures of pension insurance, SEP_t, contain transfer expenditures, TRP_t, and other expenditures of the pension insurance, $SEPO_t$:

$$SEP_t = TRP_t + SEPO_t . \qquad (7.2)$$

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_t, 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:

$$PEN_t = QRP_t(POP_t^0 + POP_t^{1to3}) + (QPP_t^{4to5} - PR_t^{4to5})POP_t^{4to5} + \left(POP_t^6 - \alpha_t PR_t^6 POP_t^6\right). \qquad (7.3)$$

The equation implies that the number of pensions is a fraction, QRP_t, of the number of persons 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 α_t above the age of 65. The parameter α_t which is strictly smaller than one (0.5 for simulations) reflects the fact that for the age group older than 65 it is possible for employees to receive direct pension payments.

The labour force and the number of pensions do not necessarily add up to total population within the relevant age group for a number of reasons:

- the model depicts the development of pensions rather than the number of retirees;
- persons may receive multiple pensions;
- pensions of civil servants are not included;
- persons living abroad can receive pension payments;
- persons may temporarily be out of labour force.

The parameter QPP^{4to5} 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 proportionally to the average net wage. In the model it is assumed that the government will continue to apply this form of indexation of average pension benefits:

$$\Delta \log\left(QSCP_t \frac{TRP_t}{PEN_t}\right) = QPEN_t \, \Delta \log(QSCE_t W_t P_t) . \qquad (7.4)$$

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_tP_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 solely 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[13]. Another implication of this form of pension indexation is that any modifications in the generosity of pension benefits are ineffective with respect to the total public pension expenditures: any reduction or increases in pension benefits for new pensioners are automatically completely offset by corresponding adjustments of the benefits of existing pensioners.

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):

$$\log(SEPO_t) = \alpha_1 \log(TRP_t) + \alpha_2 \log(SEPO_{t-1}) \,. \qquad (7.5)$$

Total expenditures of health insurance funds, SEH_t, consist of transfer expenditures, TRH_t, and other expenditures, $SEHO_t$:

$$SEH_t = TRH_t + SEHO_t \,. \qquad (7.6)$$

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, and 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:

$$\Delta \log\left(\frac{TRH_t}{P_t}\right) = \alpha_0 + \Delta \log(POP_t) + \alpha_1 \Delta \log\left(\frac{POPM^6{}_t + POPF^6{}_t}{POP_t}\right) + \alpha_2 \log\left(\frac{TRH_{t-1}}{YN_{t-1}}\right). \qquad (7.7)$$

The estimated parameters of this equation imply that the growth of real transfer expenditures, TRH_t/P_t, is increasing with the (log) change in 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

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[13] Note that in the model the wage share is constant in the long run and that wages correspond to the marginal product of labour.

share of total health expenditures will decline over time (reflected by the estimated negative coefficient for α_2):

$$\log(SEHO_t) = \alpha_0 + \alpha_1 \log(TRH_t) + \alpha_2 \log(SEHO_{t-1}) . \qquad (7.8)$$

Long term care (LTC) forms an important component of age related public expenditures. Expenditures for long term care are not part of social insurance, but are financed out of the budgets of federal (Bund) and state governments (Länder). The provision of LTC is under the responsibility of the regional governments; however, the federal and regional governments have established an agreement that ensures nationwide uniform criteria for the provision of LTC transfers.

In Austria LTC expenditures comprise the federal nursing scheme (Bundespflegegeld) and local nursing schemes of the Länder. As coherent data for LTC expenditures of the states is unavailable, we only include the federal nursing scheme into the model.

The Bundespflegeld amounts to about 84 percent of total public expenditures on LTC. In modelling the expenditures for the Bundespflegeld we follow the methodology used in *Riedel – Hofmarcher* (2001). Age specific expenditures for the federal nursing scheme of the year 2000 are used to project the future developments of expenditures. Data have been kindly provided by the IHS Health-Econ group for the age groups 0-15 years, age 15 to 65, 65-80 and persons aged above 80.

Federal nursing scheme expenditures are a function of age specific costs, which are revalued every year by the growth rate of nominal GDP per capita. This specification corresponds to the one used in *Riedel – Hofmarcher* (2001). Inspection of the results obtained in the base scenario confirms that the model very well reproduces the results of the study mentioned above:

$$GELTC = \alpha_0 POP_t^0 + \alpha_1 POP_t^{15to64} + \alpha_2 POP_t^{65to80} + \alpha_3 POP_t^{80+} . \qquad (7.9)$$

Expenditures for accident insurance, SEA_t, consist of transfer expenditures, TRA_t, and other expenditures, $SEAO_t$:

$$SEA_t = TRA_t + SEAO_t . \qquad (7.10)$$

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, YL_t:

$$\Delta \log(TRA_t) = \Delta \log(YL_t) . \qquad (7.11)$$

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):

$$\log(SEAO_t) = \alpha_0 + \alpha_1 \log(TRA_t) + \alpha_2 TREND_t \,. \qquad (7.12)$$

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 LU_t and nominal wages, W_tP_t:

$$\Delta \log(TRU_t) = \Delta \log(LU_t) + \Delta \log(W_t P_t) \,. \qquad (7.13)$$

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

7.2 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:

$$SC_t = QSC_t (SCP_t + SCH_t + SCA_t + SCU_t) \,. \qquad (7.14)$$

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:

$$SCP_t = SCPE_t + SCPS_t \,. \qquad (7.15)$$

The change in pension insurance contributions of employees, $SCPE_t$, depends on the change in contribution rates ($RSPE_t$ and $RSPC_t$ for the rates of employees and employers respectively), the change in the wage bill, YL_t, and the change in the ratio of the upper earnings threshold, $UTPA_t$, 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:

$$\Delta \log(SCPE_t) = \alpha_1 \Delta \log(RSPE_t + RSPC_t) + \Delta \log(YL_t) + \alpha_2 \Delta \log\left(\frac{UTPA_t}{YL_t / LE_t}\right). \qquad (7.16)$$

The change in contributions of self employed to pension insurance, $SCPS_t$, depends with unit elasticity ($\alpha_1 = 1$) on the change of the respective contribution rate, $RSPS_t$. It furthermore depends on the current and lagged change in net operating surplus, NOS_t, which is used as a proxy for the income of the self employed, where α_2 and α_3, sum to 0.9. Finally, it depends, with an elasticity of 0.65, on the change of the minimum contribution basis of self employed, $MCBS_t$, relative to the upper earnings threshold, $UTPA_t$:

$$\Delta \log(SCPS_t) = \alpha_1 \Delta \log(RSPS_t) + \alpha_2 \Delta \log(NOS_t) + \alpha_3 \Delta \log(NOS_{t-1}) + \alpha_4 \Delta \log\left(\frac{MCBS_t}{UTPA_t}\right). \tag{7.17}$$

Contributions to health insurance funds, SCH_t, originate from two sources: contributions of employees, $SCHE_t$, and contributions of pensioners, $SCHR_t$. Total contributions to pension insurance are the sum of these two aggregates:

$$SCH_t = SCHE_t + SCHR_t. \tag{7.18}$$

The change in the contributions of employees, $SCHE_t$, 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:

$$\Delta \log(SCHE_t) = \alpha_1 \Delta \log(RSH_t) + \Delta \log(YL_t) + \alpha_2 \Delta \log\left(\frac{UTH_t}{YL_t / LE_t}\right). \tag{7.19}$$

The change of the contributions of 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:

$$\Delta \log(SCHR_t) = \alpha_1 \Delta \log(RSPF_t + RSHR_t) + \Delta \log(TRP_t). \tag{7.20}$$

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:

$$\Delta \log(SCA_t) = \alpha_1 \Delta \log(RSA_t) + \Delta \log(YL_t) + \alpha_2 \Delta \log\left(\frac{UTH_t}{YL_t / LE_t}\right). \tag{7.21}$$

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, UTU_t:

$$\Delta \log(SCU_t) = \alpha_1 \Delta \log(RSU_t) + \Delta \log(YL_t) + \alpha_2 \Delta \log\left(\frac{UTU_t}{YL_t / LE_t}\right). \tag{7.22}$$

8. Closing the model

For simplicity, and in view of our focus on the long run, we assume homogeneity of output in goods and services across countries and perfect competition. For Austria, as a small open economy, the world market price thus completely determines domestic prices. In particular, this implies the absence of terms of trade fluctuations. Otherwise, with heterogeneous output, any growth differential between Austria and the rest of the world would cause terms of trade effects due to excess demand or supply in one region relative to the other.

To ensure price homogeneity on the demand side of the national accounts, we set inflation rates of all components of domestic demand: private consumption, PC_t, government consumption PGC_t, investment, PI_t, exports, PX_t, and the GDP, P_t, to the inflation rate of import (world) prices PW_t. Since Austria's closest trading relationships will continue to be those with EU member states, the import price is assumed to increase at an annual rate of 2 percent, which is in line with the implicit inflation target of the ECB.

To ensure dynamic efficiency, we assume that the domestic real rate of interest, R_t, follows the foreign rate, which is a function of the real rate of growth of the world economy, YW_t,

$$R_t = \frac{1}{5}\sum_{i=0}^{4} \Delta \log(YW_{t-i}), \qquad (8.1)$$

Here YW_t is the aggregate GDP of 25 OECD countries[14] measured in US-Dollars at constant 1995 prices and exchange rates. In the baseline, aggregate real GDP of the 25 OECD countries grows on average by 2.5 percent per annum between 2002 and 2075. The nominal rate of interest, RN_t, is

$$RN_t = R_t + \Delta \log(PI_t), \qquad (8.2)$$

where PI_t is the deflator for total investment.

We use the current account to achieve a balance between savings and investment and at the same time equilibrium in the goods market. The current account, CA_t, is disaggregated into three components: (i) the balance in trade of goods and services, $CAXM_t$, (ii) the balance of income flows, CAY_t, (iii) and the balance of transfer payments, CAT_t:

$$CA_t = CAXM_t + CAY_t + CAT_t . \qquad (8.3)$$

The balance of trade at current prices is computed as the difference between aggregate output and the three demand components modelled separately. Those are private and

[14] 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.

public consumption and investment. This can be motivated by our homogeneous good assumption. The balance of trade follows:

$$CAXM_t = P_tY_t - PC_tCP_t - PGC_tGC_t - PI_tI_t - SDIFFN_t \,, \qquad (8.4)$$

where the statistical difference at current prices, $SDIFFN_t$, is set to zero for the future. Identity (8.4) is an equilibrium condition that ensures that any difference between aggregate demand and supply, as determined by the production function, will be eliminated by a corresponding imbalance in goods and services trade. The balance of trade, $CAXM_t$, is further disaggregated into exports and imports of goods and services. Assuming unit elasticity of exports with respect to income and constant terms of trade, exports at constant 1995 prices, X_t, grow with real aggregate income of the rest of the world:

$$\Delta \log(X_t) = \Delta \log(YW_t) \,. \qquad (8.5)$$

Imports at constant 1995 prices, M_t, are then recovered as:

$$M_t = (PX_tX_t - CAXM_t) / PW_t \,, \qquad (8.6)$$

The balance of income flows, CAY_t, is proportional to the interest earned on the stock of net foreign assets, NFA_{t-1}, accumulated in the past:

$$CAY_t = QCAY_tNFA_{t-1}RN_t \,, \qquad (8.7)$$

where the factor $QCAY_t$ is equal to 1.5.

Domestic savings of the economy, S_t, is the sum of private household savings, government savings and savings by the business sector:

$$S_t = (YDN_t - PC_tCP_t) + (GR_t - GE_t) + QSB_tPI_tI_t \,. \qquad (8.8)$$

Business sector saving is determined as a constant ratio to investment at current prices. The ratio is fixed at $QSB_t = 0.168$ as of 2002. This formulation implies that a constant share of investment is financed with cash flow. The cash flow financed amount of investment corresponds to business sector savings.

Excess savings of the total economy corresponds to the right hand side in the following equation:

$$CAT_t = S_t - (PI_tI_t - DPN_t) - CAXM_t - CAY_t - SDIFFN_t \,. \qquad (8.9)$$

The left hand side is the balance of transfer payments. Equating excess saving to the balance of transfer payments closes the savings investment identity for an open economy.

Current account imbalances will cumulatively change the net foreign asset position, NFA_t, which evolves according to

$$NFA_t = NFA_{t-1} + CA_t \,, \tag{8.10}$$

where every year the current account balance is added to the previous year stock of assets. This characterisation 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 provides a feedback mechanism that brings about a zero current account balance in the long run. 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. This feedback mechanism is illustrated in figure 8.1.

Disaggregating current account into trade, income and transfer flows allows us to distinguish between the gross domestic product and the gross national product, *YNPN*$_t$:

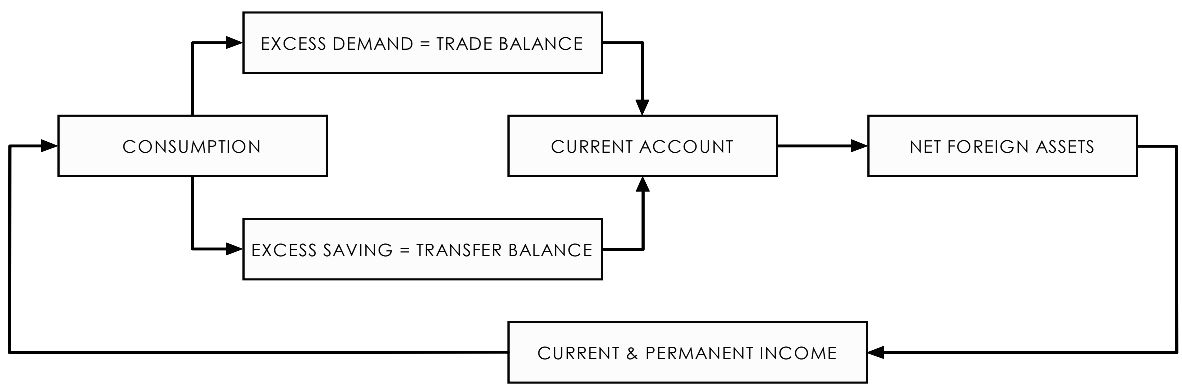
$$YNPN_t = YN_t + CAY_t \,. \tag{8.11}$$

The difference between the two income concepts reveals the amount by which domestic consumption may deviate from domestic production. A positive income balance allows for levels of demand in excess of supply of domestic goods and services, because of interest earnings received from the rest of the world. With a net foreign liability position, servicing the debt will reduce consumption possibilities below domestic output.

Finally, we compute the disposable income of the total economy, *YDEN*$_t$:

$$YDEN_t = YNPN_t - DPN_t + CAT_t \,. \tag{8.12}$$

Figure 8.1: Closing A-LMM



9. Simulations with A-LMM

A good insight into the properties of a model can be gained by simulating shocks to exogenous variables. Such an exercise highlights the workings and the stability properties of the model. Stability is studied with constant employment with steady state solutions up to the year 2500. In the following we first discuss a scenario using the main variant of the latest Austrian population forecast (*Hanika et al.,* 2004). The baseline scenario has been created for the purpose of comparisons. The other six scenarios will be presented not as deviations from the baseline, but in full detail.

The population forecast by Statistics Austria extends to 2075 and is exogenous to the model. Since the model is intended for projections up to 2075, the population forecast horizon is too short for computing the forward looking part of A-LMM. Therefore, we use an extended population forecast going up to 2150 by assuming constant fertility and mortality rates. The extension is provided by Statistics Austria and enables us to obtain a forward looking solution until 2075. Forward looking terms appear in private consumption and investment functions.

The following section 9.1.1 presents the baseline scenario based on the main variant of the population projection by Statistics Austria. In the section 9.1.2 we discuss the effects of higher life expectancy. The consequences of lower fertility rates can be seen in the scenario documented in section 9.1.3. Since participation rates have a major effect on the fiscal balance of the social security system, we also include a scenario with dynamic participation rates. This is studied in section 9.2. Another point of interest is studying the macroeconomic effects of a balanced fiscal position of the social security system. Here the balance is brought about by an increase in contribution rates such that the share of government transfers to the social security system in relation to GDP is constant. Section 9.3.1 shows the results of this simulation. Following that we discuss the effects of an alternative indexation of the pensions in section 9.3.2. Finally, section 9.4 studies an increase in total factor productivity growth by 0.5 percentage points.

9.1 Base scenario with different population projections

9.1.1 Baseline scenario with main variant of the population projection (scenario 1A)

The base scenario documents the simulation with the main variant of the population forecast for Austria (*Hanika et al.,* 2004). In this variant the working age population (15-64) increases until 2012 reaching a peak value of 5.61 million persons. Afterwards, the working age population abates with a slightly negative rate of change between 2002 and 2070 (table 9.1A). The old age dependency ratio (population aged 65+ over labour force) soars from the current value of 23 to the peak value of 52.5 percent in 2062. This development is accompanied by a substantial decline in the number of pensions per person aged 65+.

Despite the starting decline in the size of the working age population in 2012, the labour force keeps rising until 2015 and shows a weak downward trend until 2070. This pattern is due to the increase in the overall participation rate throughout the simulation period by 8 percentage points. Labour market participation rates of women increase in all age cohorts, whereas for males only those of the elderly rise. Despite higher activity rates, the number of economically active persons in full time equivalents decreases on average by 0.1 percent per year, amounting to a cumulated reduction of 200,000 persons until 2070. The gradual decline of unemployment built into the model keeps the number of unemployed rising until 2011. After 2020 unemployment shrinks rapidly towards the natural rate level of 4.5 percent, as implied by the wage equation.

The investment to GDP ratio converges rapidly towards its long run value of 21.5 percent. This results in a modest increase in the capital to output ratio, which is associated with a gradual decline in the marginal product of capital. We assume a constant rate of growth of total factor productivity of 0.85 percent per year. In the case of a Cobb-Douglas production function with $\alpha = 0.5$ this is equivalent to a labour augmenting technical progress at a rate of 1.7 percent per year. With only a modest degree of capital deepening and lower employment due to the decelerating size of the working age population, the model predicts an average annual growth rate of real GDP of 1.6 percent.

The rate of inflation is set exogenously to the long run implicit target of the European Central Bank of 2 percent. This results in an average annual growth rate of nominal GDP of 3.7 percent. Since the Cobb-Douglas technology implies constant factor shares, the long run annual growth rates of real and nominal labour compensation amount to 1.7 and 3.7 percent, respectively. Per capita real wages grow in tandem with real GDP.

Because the parameters in the revenue equations of the social security block remain unchanged, social contributions in relation to nominal GDP remain almost constant throughout the simulation horizon. Social expenditures, on the other hand, increase by 0.4 percent per year on average, reaching a maximum of 24.2 percent of nominal GDP in 2054. The government transfers to the pension insurance system rise from 2.2 percent of nominal GDP in 2002 to a maximum of 6.3 percent in the year 2057.

As we impose the balanced budget on the public sector, any increase in social expenditures has to be matched by a reduction in other components of government spending. This fiscal policy rule keeps government spending in line with GDP-growth. Consequently, the government debt declines rapidly relative to nominal GDP.

Table 9.1A: Baseline (scenario 1A)

	2002	2010	2020	2030	2040	2050	2060	2070	Avg. change (in %) 2002/2070	Cum. change (in % points) 2002/2070
				1,000 persons						
Working Age Population (15-64)	5,464.7	5,577.6	5,562.9	5,237.2	4,944.1	4,759.1	4,551.2	4,423.9	-0.3	
Economically active population (Labour force)	3,765.3	3,895.8	3,931.1	3,838.6	3,750.8	3,638.3	3,490.9	3,390.3	-0.2	
Economically active employees in full time equivalents	3,006.8	3,108.3	3,148.9	3,125.4	3,083.2	2,990.9	2,870.2	2,787.6	-0.1	
Number of pensions	1,999.0	2,142.8	2,407.4	2,682.3	2,827.9	2,884.3	2,830.0	2,717.5	0.5	
				In percent						
Participation rate, total	68.9	69.8	70.7	73.3	75.9	76.4	76.7	76.6	0.2	7.7
Women	61.1	61.7	62.3	65.6	69.4	70.6	70.9	70.8	0.2	9.7
Men	76.7	77.9	79.0	80.9	82.2	82.2	82.4	82.3	0.1	5.6
Unemployment rate	6.9	7.2	6.9	5.4	4.5	4.4	4.4	4.4	-0.6	-2.4
Old age dependency ratio	22.8	26.2	30.2	39.6	47.5	50.6	52.4	51.8	1.2	28.9
Pensions relative to insured persons	62.4	64.5	71.7	82.0	88.7	93.5	96.1	95.3	0.6	32.8
Pensions relative to population aged 65+	1.60	1.46	1.43	1.29	1.20	1.20	1.19	1.19	-0.4	
				Bill. €						
Gross domestic product at constant 1995 prices	201.2	237.5	286.0	338.5	397.2	459.2	525.7	605.0	1.6	
Gross domestic product at current prices	218.3	302.0	443.3	639.7	915.0	1,289.3	1,799.3	2,524.1	3.7	
				1,000 €						
Real GDP per capita	25.0	28.8	34.0	40.2	47.7	56.3	66.5	79.1	1.7	
				2002 = 100						
Real wage per capita, in full time equivalents (MPL)	100.0	113.7	136.0	162.1	192.9	230.3	274.8	325.2	1.7	
				Percentage change against previous year						
Gross domestic product at constant 1995 prices	1.4	2.1	1.7	1.7	1.6	1.4	1.4	1.4	1.6	
Compensation to employees, at current prices	2.2	4.2	3.8	3.7	3.6	3.4	3.4	3.5	3.7	
Real wage per employee	1.3	1.6	1.9	1.7	1.7	1.8	1.7	1.7	1.7	
GDP deflator	1.4	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	
				Ratio						
Marginal product of capital	0.14	0.14	0.13	0.13	0.13	0.13	0.13	0.13	-0.1	
Capital-output-ratio	3.62	3.62	3.64	3.67	3.70	3.73	3.77	3.78	0.1	0.2

Table 9.1A/continued: Baseline (scenario 1A)

	2002	2010	2020	2030	2040	2050	2060	2070	Avg. change (in %) 2002/2070	Cum. change (in % points) 2002/2070
	In percent of GDP, at current prices									
Social security contributions pension insurance	7.6	7.5	7.5	7.4	7.4	7.4	7.4	7.4	0.0	-0.2
Contributions to pension insurance by employees	7.0	6.9	7.0	7.0	7.0	7.0	7.0	7.0	0.0	0.0
Contributions to pension insurance by self-employed	0.6	0.5	0.5	0.5	0.5	0.5	0.4	0.4	-0.4	-0.2
Contributions to pension insurance by others	1.3	1.2	1.2	1.2	1.2	1.2	1.2	1.2	-0.1	-0.1
Total social security expenditures pension insurance	11.0	11.2	12.3	13.6	14.3	14.8	14.8	14.4	0.4	3.4
Government transfers to pensions insurance system	2.2	2.5	3.6	4.9	5.6	6.1	6.2	5.8	1.5	3.6
Social security contributions health insurance	4.0	3.9	4.1	4.2	4.2	4.3	4.3	4.2	0.1	0.3
Total social security expenditures health insurance	5.0	6.0	6.3	6.6	6.7	6.5	6.4	6.2	0.3	1.3
Social security contributions accident insurance	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.0	0.0
Total social security expenditures accident insurance	0.5	0.5	0.5	0.4	0.4	0.4	0.4	0.4	-0.2	-0.1
Social contributions	16.6	16.4	16.6	16.7	16.7	16.8	16.8	16.7	0.0	0.1
Transfer expenditures - pensions, health and long term care	16.0	16.7	18.2	20.0	20.9	21.6	21.6	21.1	0.4	5.0
Social expenditures	17.7	19.9	21.3	22.7	23.5	24.1	24.0	23.4	0.4	5.7
	2002=100									
Average real pension per year [1])	100.0	112.0	131.5	153.9	179.8	210.6	246.7	286.7	1.6	
	In percent of GDP, at current prices									
Government expenditures	51.3	50.6	50.8	50.8	50.8	50.8	50.7	50.6		-0.8
Other government expenditures	25.5	25.3	24.6	23.6	23.2	22.8	22.9	23.5		-1.9

1) Average transfer expenditures deflated by GDP-deflator to facilitate comparison with real wage.

9.1.2 A population projection with high life expectancy (scenario 1B)

Scenario 1B and 1C demonstrate the impact of different population projections on the model results of A-LMM (see figures 9.1.1 and 9.1.2). Scenario 1B uses the main population projection of Statistics Austria adjusted for higher life expectancy (see *Hanika et al.,* 2004). In this projection life expectancy of new born males will increase between 2002 and 2050 from 75.8 years to 87 years (main scenario 83 years). Female life expectancy increases from 81.7 years to 91 years (88 years). In this scenario the population in the year 2050 amounts to 8.5 million persons (8.2 millions). The increase in life expectancy affects mainly the age group 65 and older (2.7 millions to 2.4 millions). The working age population decreases in this scenario from 5.5 million persons in 2002 to 4.8 millions in 2050. This is almost the same amount as in scenario 1A.

Table 9.1B presents the results for scenario 1B. Between 2002 and 2010 the average economic growth of the Austrian Economy is slightly above 2 percent. In the following decades the declining labour force leads to slower growth. In the year 2050 the growth rate of the Austrian economy is 1.4 percent and remains at this value until the end of the projection horizon. Over the whole simulation period average growth is 1.6 percent. The levels and patterns of economic growth are almost identical with scenario 1A. This is caused by the almost identical development of the working age population and therefore labour supply. The assumed 2.5 percentage points decline in the structural unemployment rate between 2020 and 2035 contributes to economic growth in this time period. Labour productivity and real wages will grow on average with 1.7 percent between 2002 and 2070.

Whereas the economic development is similar to scenario 1A, the increased life expectancy implies significant consequences for the social security system. The old age dependency ratio increases from 22.8 percent to 31.3 in 2020. After 2020 the speed accelerates considerably and the old-age dependency ratio reaches its maximum of 61 percent in 2062. In accordance with this development the number of pensions increases from currently 2 millions to 3.1 millions in 2070. In scenario 1A the number of pensions in 2070 is 2.7 millions only.

Whereas social security contributions are of similar magnitude as in scenario 1A, social security expenditures are significantly higher after 2020 due to the higher life expectancy. Between 2020 and 2060 the pension insurance expenditures increase from 12.6 percent of GDP to 16.7 percent (figure 9.1.3). The government transfers to the pension insurance system will increase from 3.9 percent of GDP to 8.1 percent in this time period. At the end of the forecasting period the government transfers are almost 2 percentage points higher as in scenario 1A (figure 9.1.4). The gap between social contributions and social expenditures will increase during the forecasting period and amounts to 9.1 percentage points in 2060 (7.2 percentage points in scenario 1A).

Table 9.1B: Population projection with high life expectancy (scenario 1B)

	2002	2010	2020	2030	2040	2050	2060	2070	Avg. change (in %) 2002/2070	Cum. change (in % points) 2002/2070
				1,000 persons						
Working Age Population (15-64)	5,464.7	5,580.5	5,574.2	5,255.3	4,965.8	4,784.0	4,576.9	4,450.4	-0.3	
Economically active population (Labour force)	3,765.3	3,897.8	3,939.1	3,854.4	3,774.9	3,669.1	3,525.2	3,425.2	-0.1	
Economically active employees in full time equivalents	3,006.8	3,109.7	3,154.7	3,137.3	3,101.4	3,013.9	2,895.7	2,813.7	-0.1	
Number of pensions	1,999.0	2,158.5	2,472.0	2,817.4	3,050.8	3,209.6	3,222.0	3,110.4	0.7	
				In percent						
Participation rate, total	68.9	69.8	70.7	73.3	76.0	76.7	77.0	77.0	0.2	8.1
Women	61.1	61.7	62.2	65.6	69.4	70.7	71.0	71.0	0.2	9.9
Men	76.7	77.9	79.0	81.0	82.5	82.5	82.8	82.8	0.1	6.1
Unemployment rate	6.9	7.2	6.9	5.5	4.6	4.6	4.6	4.6	-0.6	-2.3
Old age dependency ratio	22.8	26.5	31.3	41.9	51.8	57.2	60.8	60.4	1.4	37.5
Pensions relative to insured persons	62.4	65.0	73.7	86.2	95.7	104.1	109.4	109.0	0.8	46.6
Pensions relative to population aged 65+	1.60	1.46	1.42	1.28	1.19	1.17	1.16	1.16	-0.5	
				Bill. €						
Gross domestic product at constant 1995 prices	201.2	237.6	286.4	339.6	399.2	462.3	529.8	610.2	1.6	
Gross domestic product at current prices	218.3	302.1	444.0	641.7	919.5	1,297.9	1,813.4	2,545.7	3.7	
				1,000 €						
Real GDP per capita	25.0	28.7	33.8	39.6	46.6	54.3	63.6	75.6	1.6	
				2002 = 100						
Real wage per capita, in full time equivalents (MPL)	100.0	113.6	135.9	161.9	192.7	230.0	274.5	325.0	1.7	
				Percentage change against previous year						
Gross domestic product at constant 1995 prices	1.4	2.1	1.7	1.7	1.6	1.4	1.4	1.4	1.6	
Compensation to employees, at current prices	2.2	4.2	3.8	3.7	3.6	3.5	3.4	3.5	3.7	
Real wage per employee	1.3	1.6	1.9	1.7	1.7	1.8	1.7	1.7	1.7	
GDP deflator	1.4	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	
				Ratio						
Marginal product of capital	0.14	0.14	0.13	0.13	0.13	0.13	0.13	0.13	-0.1	
Capital-output-ratio	3.62	3.62	3.64	3.67	3.69	3.73	3.76	3.77	0.1	0.2

Table 9.1B/continued: Population projection with high life expectancy (scenario 1B)

	2002	2010	2020	2030	2040	2050	2060	2070	Avg. change (in %) 2002/2070	Cum. change (in % points) 2002/2070
	In percent of GDP, at current prices									
Social security contributions pension insurance	7.6	7.5	7.5	7.4	7.4	7.4	7.4	7.4	0.0	-0.2
Contributions to pension insurance by employees	7.0	6.9	7.0	7.0	7.0	7.0	7.0	7.0	0.0	0.0
Contributions to pension insurance by self-employed	0.6	0.5	0.5	0.5	0.5	0.5	0.4	0.4	-0.5	-0.2
Contributions to pension insurance by others	1.3	1.2	1.2	1.2	1.2	1.2	1.2	1.2	-0.1	-0.1
Total social security expenditures pension insurance	11.0	11.3	12.6	14.2	15.3	16.2	16.7	16.3	0.6	5.3
Government transfers to pensions insurance system	2.2	2.6	3.9	5.5	6.6	7.6	8.1	7.7	1.9	5.5
Social security contributions health insurance	4.0	3.9	4.1	4.2	4.3	4.4	4.5	4.4	0.2	0.5
Total social security expenditures health insurance	5.0	6.1	6.4	6.7	6.8	6.7	6.6	6.3	0.4	1.4
Social security contributions accident insurance	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.0	0.0
Total social security expenditures accident insurance	0.5	0.5	0.5	0.4	0.4	0.4	0.4	0.4	-0.2	-0.1
Social contributions	16.6	16.4	16.6	16.7	16.8	17.0	17.0	16.9	0.0	0.3
Transfer expenditures - pensions, health and long term care	16.0	16.8	18.6	20.7	22.1	23.3	23.6	23.0	0.5	7.0
Social expenditures	17.7	19.9	21.6	23.4	24.6	25.8	26.0	25.4	0.5	7.7
	2002=100									
Average real pension per year [1])	100.0	112.0	131.5	153.7	179.6	210.4	246.4	286.4	1.6	
	In percent of GDP, at current prices									
Government expenditures	51.3	50.6	50.8	50.8	50.9	50.9	50.9	50.8		-0.6
Other government expenditures	25.5	25.2	24.2	23.0	22.1	21.2	21.1	21.7		-3.7

1) Average transfer expenditures deflated by GDP-deflator to facilitate comparison with real wage.

Figure 9.1.1: Population 65 and older (Main variant and high life expectancy))

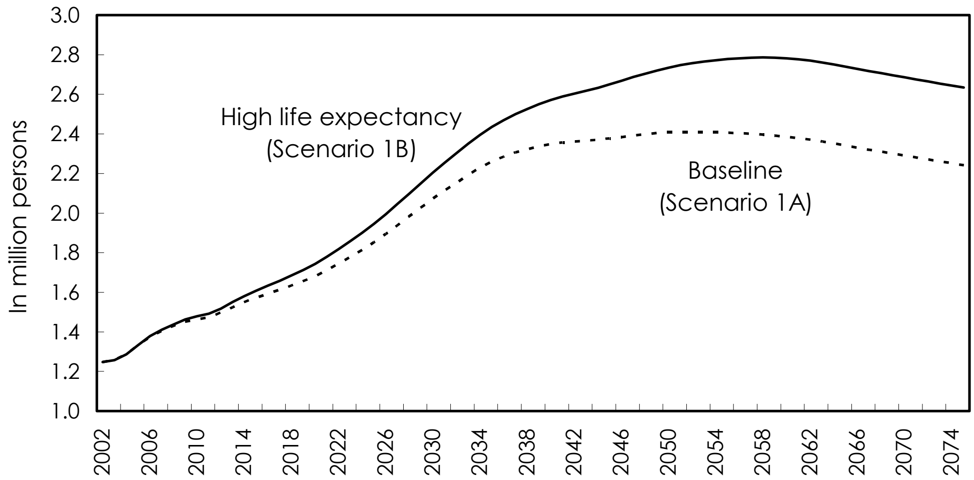


Figure 9.1.2: Labour force for different population projections

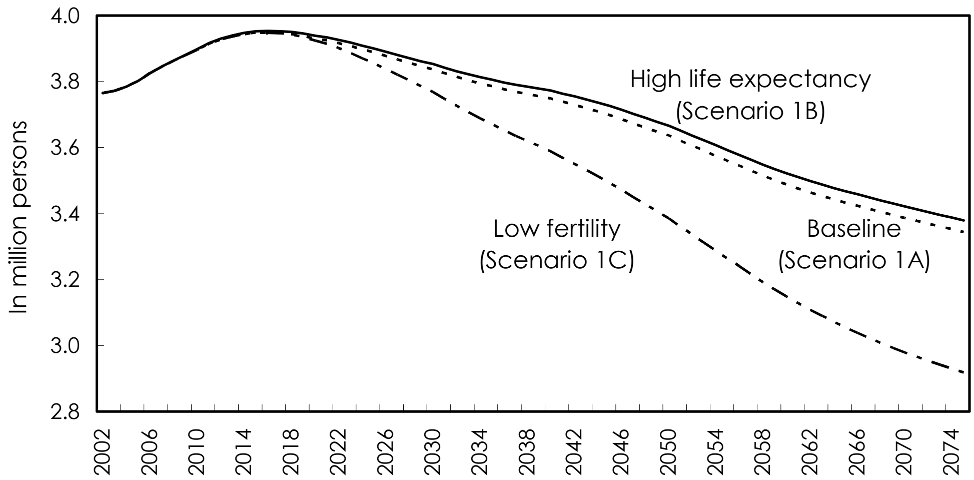


Figure 9.1.3: Social security expenditures of pension insurance (baseline and high life expectancy)

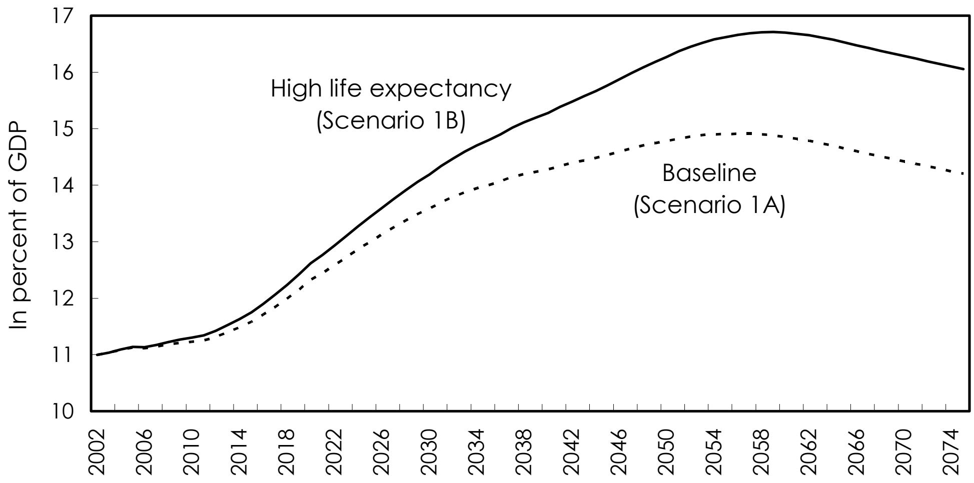
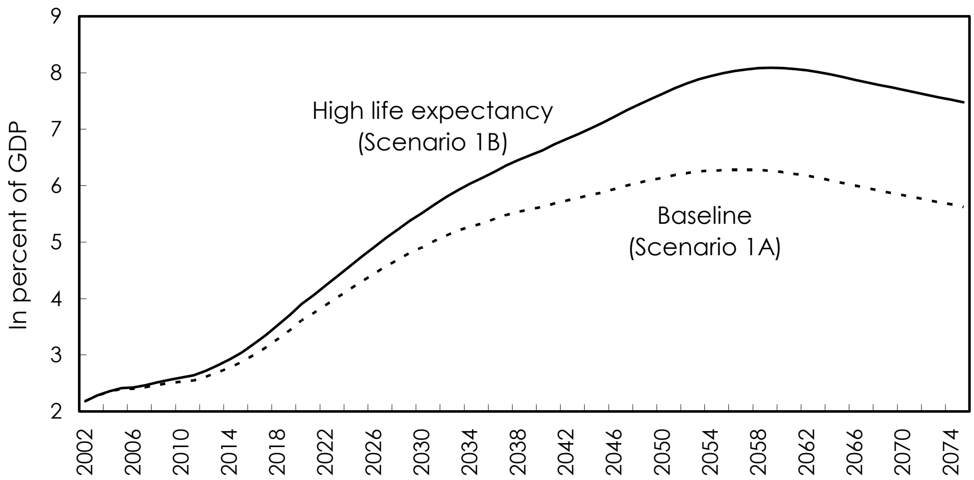


Figure 9.1.4: Government transfers to pension insurance system (baseline and high life expectancy)



9.1.3 A population projection with low fertility (scenario 1C)

Scenario 1C uses the base population projections but with a lower fertility rate. In the main variant of Statistics Austria the fertility level is kept constant at 1.4 children per female. In this projection the fertility level is reduced to 1.1 children per female after 2015. According to this projection the population decreases from currently 8 million persons to 7.8 millions in 2050. In 2075 the population is further reduced to 6.9 million people.

The working age population decreases in this scenario from 5.5 million persons in 2002 to 3.9 millions in 2070. The working age population in 2070 is reduced by 570.000 persons in comparison with scenario 1A. The lower population growth affects labour supply (see figure 9.1.1). Until the year 2020 no big differences to scenario 1A emerge. Due to the measures of the pension reform labour supply in 2020 is higher by 160.000 persons as in 2002. In the following decades labour supply falls, due to the smaller size of the cohorts entering the labour force. In 2070, labour supply merely amounts to 3 million persons (3.4 millions in scenario 1A).

Table 9.1C presents the result for scenario 1C. Between 2002 and 2010 the average economic growth of the Austrian economy is slightly above 2 percent. In the following decades the decrease in the labour force leads to slower growth. In 2070 the growth rate of the Austrian economy is 1.2 percent. Over the whole simulation period average annual growth is 1.5 percent. After 2020, economic growth is on average 0.25 percentage points slower as in scenario 1A. In 2070 the GDP is 11 percent lower than in scenario 1A. This lower growth is only caused by the population differences, as age specific participation rates are kept constant. Labour productivity and real wages will grow on average with 1.8 percent per year between 2002 and 2070 and therefore almost at the same pace as in scenario 1A.

The lower fertility rate has severe consequences for the old age dependency ratio. This ratio increases from 22.8 to 30.3 percent in 2020. After 2020 the speed accelerates and the old-age dependency ratio rises up to 59.2 percent in the year 2070. In contrast to scenario 1B this increase is caused by the lower working age population and not by a strong increase of persons with age above 65. The number of pensions increases in line with scenario 1A from currently 2 millions to 2.7 millions in 2070.

Social contributions amount to 16.6 percent of nominal GDP in 2020. In the following decades the share of social security contributions in GDP will increase slightly up to 17 percent in 2070. In contrast social expenditures (as share of GDP) grow considerably faster. Between 2020 and 2060 the pension insurance expenditures increase from 12.3 percent of GDP to 16.4 percent (figure 9.1.5). The government transfers to the pension insurance system will increase from 3.6 percent of GDP to 7.8 percent in this time period (figure 9.1.6). At the end of the forecasting period the government transfers are 1.7 percentage points higher than in scenario 1A. Between 2002 and 2030, the share of social expenditures in GDP will increase by 5.3 percentage points. In the year 2059, the share of social expenditures in GDP reaches its maximal value of 25.8 percent. In this year the gap between contributions and expenditures amounts to 8.8 percentage points.

The aim of scenario 1B and 1C was to present the impacts of different assumptions about population development on economic growth and on the fiscal balance of the social security system. In these scenarios age-specific participation rates and technical progress have been kept constant to isolate the population impact. We have shown that a population scenario with higher life expectancy leads to similar economic growth as in scenario 1A, but the strengthened aging has consequences for social expenditures as the number of pensions is considerably increased. The scenario with lower fertility implies weaker growth in the future and puts also pressure on the solvency of the social security system.

Table 9.1C: Population projection with low fertility (scenario 1C)

	2002	2010	2020	2030	2040	2050	2060	2070	Avg. change (in %) 2002/2070	Cum. change (in % points) 2002/2070
				1,000 persons						
Working Age Population (15-64)	5,464.7	5,577.6	5,552.3	5,110.7	4,700.7	4,411.4	4,089.2	3,855.2	-0.5	
Economically active population (Labour force)	3,765.3	3,895.8	3,925.1	3,769.3	3,590.3	3,388.0	3,152.1	2,982.8	-0.3	
Economically active employees in full time equivalents	3,006.8	3,108.3	3,145.0	3,070.8	2,951.4	2,783.1	2,587.5	2,445.1	-0.3	
Number of pensions	1,999.0	2,142.8	2,407.2	2,678.5	2,820.5	2,873.8	2,814.6	2,669.5	0.4	
				In percent						
Participation rate, total	68.9	69.8	70.7	73.8	76.4	76.8	77.1	77.4	0.2	8.5
Women	61.1	61.7	62.3	66.0	69.8	70.8	71.1	71.4	0.2	10.3
Men	76.7	77.9	79.0	81.4	82.8	82.7	82.9	83.1	0.1	6.5
Unemployment rate	6.9	7.2	6.9	5.3	4.4	4.4	4.4	4.4	-0.6	-2.4
Old age dependency ratio	22.8	26.2	30.3	40.5	49.9	54.6	58.4	59.2	1.4	36.4
Pensions relative to insured persons	62.4	64.5	71.8	83.6	92.8	100.8	107.0	107.9	0.8	45.5
Pensions relative to population aged 65+	1.60	1.46	1.43	1.29	1.20	1.19	1.18	1.17	-0.5	
				Bill. €						
Gross domestic product at constant 1995 prices	201.2	237.5	285.4	333.5	383.2	432.2	481.2	539.9	1.5	
Gross domestic product at current prices	218.3	301.9	442.4	630.1	882.6	1,213.6	1,647.0	2,252.6	3.5	
				1,000 €						
Real GDP per capita	25.0	28.8	34.0	40.2	47.4	55.3	64.6	76.3	1.7	
				2002 = 100						
Real wage per capita, in full time equivalents (MPL)	100.0	113.7	136.0	162.8	194.9	233.7	279.9	331.6	1.8	
				Percentage change against previous year						
Gross domestic product at constant 1995 prices	1.4	2.1	1.6	1.5	1.3	1.1	1.1	1.2	1.5	
Compensation to employees, at current prices	2.2	4.2	3.8	3.5	3.4	3.2	3.1	3.2	3.5	
Real wage per employee	1.3	1.6	2.0	1.8	1.8	1.8	1.8	1.7	1.8	
GDP deflator	1.4	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	
				Ratio						
Marginal product of capital	0.14	0.14	0.14	0.13	0.13	0.13	0.13	0.13	-0.1	
Capital-output-ratio	3.62	3.62	3.64	3.68	3.73	3.78	3.83	3.85	0.1	0.2

Table 9.1C/continued: Population projection with low fertility (scenario 1C)

	2002	2010	2020	2030	2040	2050	2060	2070	Avg. change (in %) 2002/2070	Cum. change (in % points) 2002/2070
	In percent of GDP, at current prices									
Social security contributions pension insurance	7.6	7.5	7.5	7.5	7.4	7.4	7.4	7.4	0.0	-0.2
Contributions to pension insurance by employees	7.0	6.9	7.0	7.0	7.0	7.0	7.0	7.0	0.0	0.0
Contributions to pension insurance by self-employed	0.6	0.5	0.5	0.5	0.5	0.4	0.4	0.4	-0.5	-0.2
Contributions to pension insurance by others	1.3	1.2	1.2	1.2	1.2	1.2	1.2	1.2	-0.1	0.0
Total social security expenditures pension insurance	11.0	11.2	12.3	13.8	14.9	15.8	16.4	16.1	0.6	5.1
Government transfers to pensions insurance system	2.2	2.5	3.6	5.1	6.2	7.2	7.8	7.5	1.8	5.4
Social security contributions health insurance	4.0	3.9	4.1	4.2	4.3	4.4	4.4	4.4	0.2	0.4
Total social security expenditures health insurance	5.0	6.0	6.3	6.7	6.7	6.7	6.6	6.4	0.4	1.4
Social security contributions accident insurance	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.0	0.0
Total social security expenditures accident insurance	0.5	0.5	0.5	0.4	0.4	0.4	0.4	0.4	-0.2	-0.1
Social contributions	16.6	16.4	16.6	16.7	16.8	16.9	17.0	16.9	0.0	0.3
Transfer expenditures - pensions, health and long term care	16.0	16.7	18.2	20.2	21.6	22.8	23.3	23.0	0.5	7.0
Social expenditures	17.7	19.9	21.3	23.0	24.2	25.3	25.8	25.4	0.5	7.7
	2002=100									
Average real pension per year [1])	100.0	112.0	131.5	153.9	179.8	210.6	246.7	286.7	1.6	
	In percent of GDP, at current prices									
Government expenditures	51.3	50.6	50.8	50.8	50.8	50.8	50.7	50.6		-0.7
Other government expenditures	25.5	25.3	24.6	23.4	22.5	21.5	21.1	21.5		-3.9

1) Average transfer expenditures deflated by GDP-deflator to facilitate comparison with real wage.

Figure 9.1.5: Social security expenditure of pension insurance (baseline and low fertility)

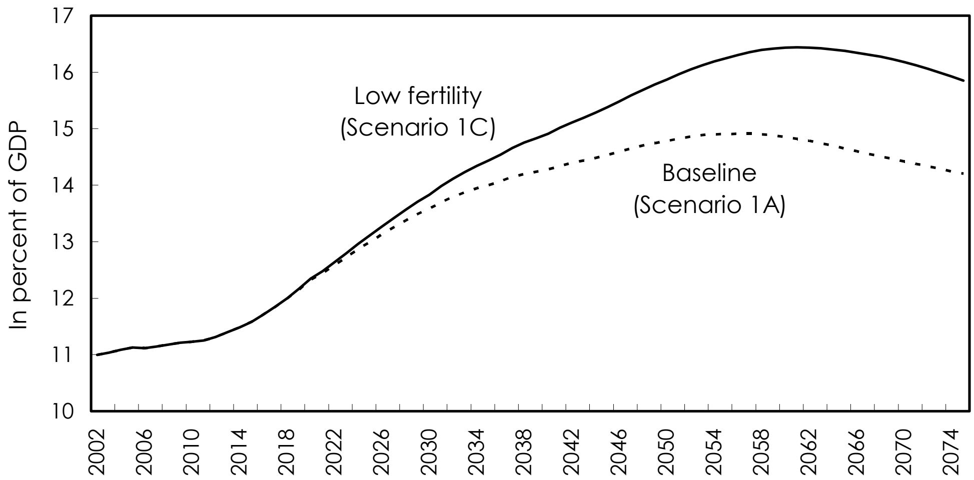
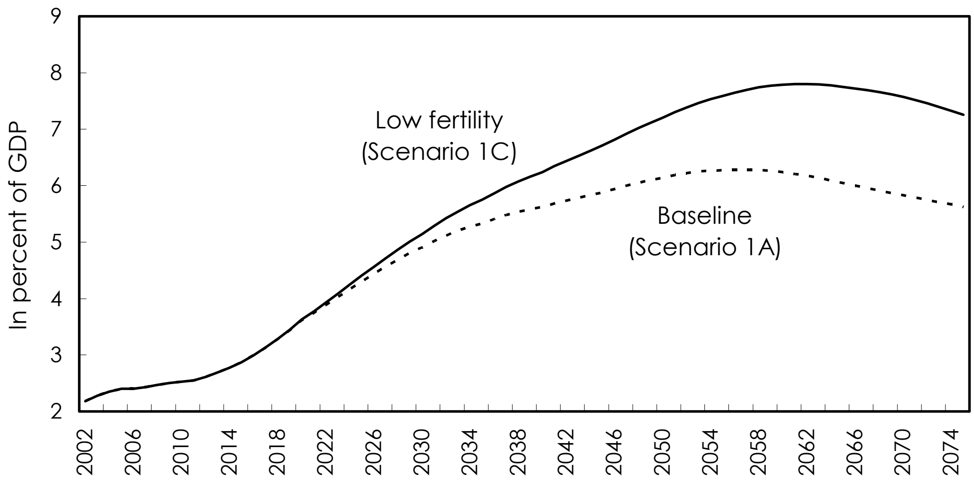


Figure 9.1.6: Government transfers to pension insurance (baseline and low fertility)



9.2 A dynamic activity rate scenario (scenario 2)

The development of labour supply is one important determinant of economic growth. In this scenario we discuss the impact of an alternative activity rate scenario. The baseline activity rate scenario is relatively optimistic. Therefore, we simulate the impact of an alternative activity rate scenario. We use the dynamic approach augmented with more pessimistic assumptions concerning the impact of the pension reform on labour market participation to derive the activity rates for scenario 2 (see section 4.1.2). The participation rate of the young age cohort is assumed to be constant. We expect a slight decrease in the activity rates of males between 25 and 59. Due to the effects of the pension reform we project an increase of around 20 percentage points in the age cohort 60-64. For females we project a significant increase in all age cohorts but the first. This is caused by the catching up of females and is further augmented by the pension reform.

Table 9.2 demonstrates the results for scenario 2. The aggregate participation rate of females will slightly increase because of cohort effects and the pension reform. Over the forecasting period we expect an increase of 10.6 percentage points. The aggregate male activity rate stays almost constant over the simulation period. This implies an increase for the total participation rate from currently 68.9 percent to 73.7 percent in 2070. In this year the activity rate is 3 percentage points below the value in scenario 1A.

Population development and the activity rates determine labour supply. Labour supply will increase between 2002 and 2020 by 97.000 persons, mainly because of the pension reform. In the following decades labour supply falls. In 2070, labour supply amounts to 3.3 million persons (130.000 less than in scenario 1A; figure 9.2.1). Due to the rising labour supply, employment will grow until 2020. In the following years employment growth will become negative. However, the assumed 2.3 percentage points decline in the structural unemployment rate between 2020 and 2037 cushions the fall in employment. Over the whole forecasting period employment will shrink by an annual average rate of 0.2 percent.

Between 2002 and 2010 the average economic growth rate of the Austrian economy is close to 2 percent. In the following decades the decrease in the labour force leads to slower growth. The Austrian economy will grow with 1.5 percent per year in the period 2010 to 2040 and with 1.4 percent afterwards. Over the whole simulation period average annual growth is 1.6 percent. In 2070 the level of GDP is 4.2 percentage points lower as in scenario 1A. Labour productivity and real wages will grow on average with 1.7 percent between 2002 and 2070 and therefore at the same pace as in scenario 1A.

The share of social contributions in GDP of 16.4 percent in 2010 will increase slightly to 16.8 percent in 2070. Due to aging, social expenditures (as a share of GDP) will grow considerably faster. Between 2002 and 2020 the share of social expenditures in GDP will increase by 3 percentage points. In the year 2050 the share of social expenditure in GDP is

25.3 percent and it is slightly reduced until the 2070. In this year the gap between contributions and expenditures amounts to 7.7 percentage points. The pension insurance expenditures increase continuously from 11 percent of GDP in 2002 to 15.9 percent in 2060. As a consequence the government transfers to the pension insurance system will also rise and will reach their maximum at 7.3 percent in 2060. After 2060 the pressure on the fiscal stance of the pension system is slightly reduced (6.9 percent in 2070). At the end of the forecasting period the government transfers are 1.1 percentage points higher as in scenario 1A.

Figure 9.2.1: Labour force with different participation rates

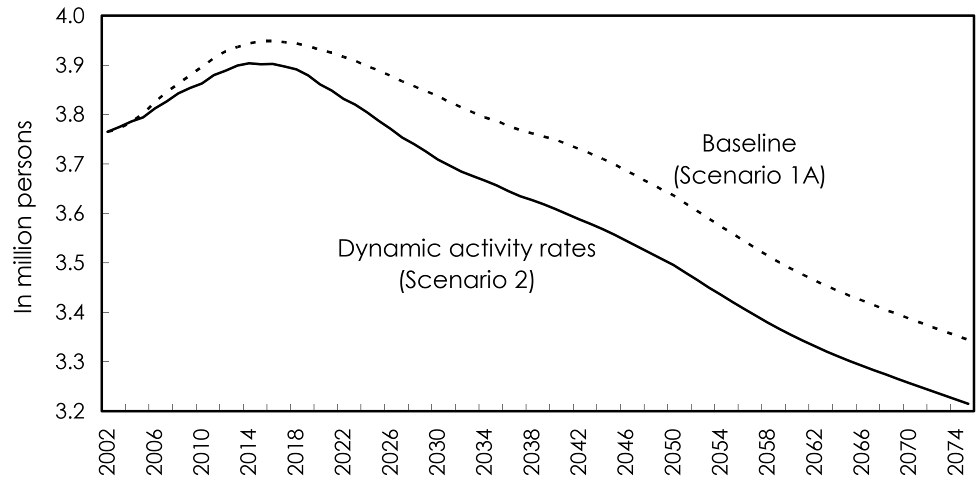


Figure 9.2.2: Real gross domestic product

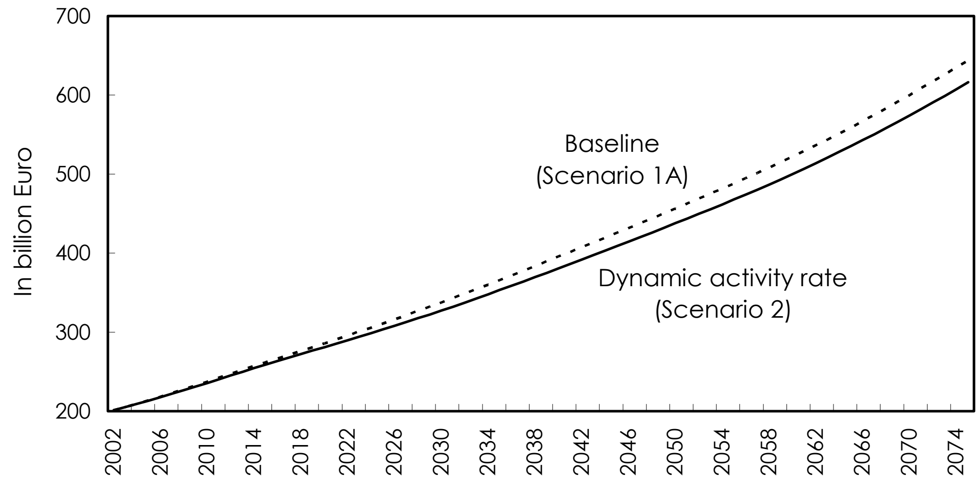


Table 9.2: Dynamic activity rate scenario (scenario 2)

	2002	2010	2020	2030	2040	2050	2060	2070	Avg. change (in %) 2002/2070	Cum. change (in % points) 2002/2070
					1,000 persons					
Working Age Population (15-64)	5,464.7	5,577.6	5,562.9	5,237.2	4,944.1	4,759.1	4,551.2	4,423.9	-0.3	
Economically active population (Labour force)	3,765.3	3,863.1	3,862.0	3,710.6	3,611.0	3,498.7	3,357.2	3,260.2	-0.2	
Economically active employees in full time equivalents	3,006.8	3,081.2	3,089.5	3,010.0	2,953.4	2,859.9	2,744.6	2,665.7	-0.2	
Number of pensions	1,999.0	2,155.6	2,433.8	2,754.8	2,910.4	2,969.2	2,909.6	2,794.5	0.5	
					In percent					
Participation rate, total	68.9	69.3	69.4	70.9	73.0	73.5	73.8	73.7	0.1	4.8
Women	61.1	62.1	62.9	66.4	70.3	71.5	71.8	71.7	0.2	10.6
Men	76.7	76.3	75.9	75.2	75.7	75.5	75.7	75.6	0.0	-1.1
Unemployment rate	6.9	7.1	6.8	5.4	4.5	4.5	4.5	4.5	-0.6	-2.4
Old age dependency ratio	22.8	26.2	30.2	39.6	47.5	50.6	52.4	51.8	1.2	28.9
Pensions relative to insured persons	62.4	65.5	73.9	87.4	95.2	100.5	103.1	102.3	0.7	39.9
Pensions relative to population aged 65+	1.60	1.47	1.45	1.33	1.24	1.23	1.22	1.22	-0.4	
					Bill. €					
Gross domestic product at constant 1995 prices	201.2	235.9	281.4	328.4	382.8	441.0	504.1	579.5	1.6	
Gross domestic product at current prices	218.3	300.0	436.3	620.5	881.8	1,238.3	1,725.3	2,417.9	3.6	
					1,000 €					
Real GDP per capita	25.0	28.6	33.5	39.0	46.0	54.0	63.8	75.7	1.6	
					2002 = 100					
Real wage per capita, in full time equivalents (MPL)	100.0	114.1	136.7	163.6	194.3	231.3	275.6	325.8	1.8	
					Percentage change against previous year					
Gross domestic product at constant 1995 prices	1.4	2.0	1.5	1.5	1.5	1.4	1.4	1.4	1.6	
Compensation to employees, at current prices	2.2	4.1	3.7	3.6	3.5	3.4	3.4	3.4	3.6	
Real wage per employee	1.3	1.7	2.1	1.8	1.8	1.7	1.7	1.7	1.7	
GDP deflator	1.4	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	
					Ratio					
Marginal product of capital	0.14	0.14	0.13	0.13	0.13	0.13	0.13	0.13	-0.1	
Capital-output-ratio	3.62	3.62	3.65	3.70	3.72	3.75	3.78	3.78	0.1	0.2

Table 9.2/continued: Dynamic activity rate scenario (scenario 2)

	2002	2010	2020	2030	2040	2050	2060	2070	Avg. change (in %) 2002/2070	Cum. change (in % points) 2002/2070
	In percent of GDP, at current prices									
Social security contributions pension insurance	7.6	7.5	7.5	7.5	7.4	7.4	7.4	7.4	0.0	-0.2
Contributions to pension insurance by employees	7.0	6.9	7.0	7.0	7.0	7.0	7.0	7.0	0.0	0.0
Contributions to pension insurance by self-employed	0.6	0.5	0.5	0.5	0.5	0.5	0.4	0.4	-0.4	-0.1
Contributions to pension insurance by others	1.3	1.2	1.2	1.2	1.2	1.2	1.2	1.2	-0.1	-0.1
Total social security expenditures pension insurance	11.0	11.4	12.7	14.5	15.3	15.9	15.9	15.5	0.5	4.5
Government transfers to pensions insurance system	2.2	2.7	4.0	5.8	6.7	7.2	7.3	6.9	1.7	4.7
Social security contributions health insurance	4.0	4.0	4.1	4.3	4.3	4.4	4.4	4.3	0.1	0.4
Total social security expenditures health insurance	5.0	6.1	6.4	6.8	6.8	6.6	6.5	6.3	0.3	1.3
Social security contributions accident insurance	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.0	0.0
Total social security expenditures accident insurance	0.5	0.5	0.5	0.4	0.4	0.4	0.4	0.4	-0.2	-0.1
Social contributions	16.6	16.4	16.6	16.8	16.8	16.9	16.9	16.8	0.0	0.2
Transfer expenditures - pensions, health and long term care	16.0	17.0	18.7	21.0	22.1	22.8	22.7	22.1	0.5	6.1
Social expenditures	17.7	20.1	21.7	23.7	24.6	25.3	25.2	24.5	0.5	6.8
	2002=100									
Average real pension per year [1])	100.0	112.0	131.5	153.9	179.8	210.6	246.7	286.7	1.6	
	In percent of GDP, at current prices									
Government expenditures	51.3	50.7	50.8	50.8	50.8	50.8	50.7	50.7		-0.7
Other government expenditures	25.5	25.1	24.2	22.6	22.1	21.6	21.8	22.5		-3.0

1) Average transfer expenditures deflated by GDP-deflator to facilitate comparison with real wage.

9.3. Alternative contribution rates and pension indexation in the social security system

9.3.1 A scenario with a stable fiscal balance of social security (scenario 3A)

In A-LMM the evolution of expenditures of the social security sector is driven to a large extent by demographic developments. The increase in the number of pensions due to the aging of the Austrian population brings about a significant increase in spending relative to GDP. Additionally, demographic trends affect the development of health expenditures. The impact of demography on pensions and health expenditures results in a significant increase in total social security spending relative to nominal GDP.

Revenues of the social security funds depend on the growth rate of the wage bill and the contribution rates. The baseline scenario (scenario 1A) is based on the assumption of no policy change such that contribution rates remain unaltered at their 2002 level. Therefore revenues of the social security funds grow proportional to the wage bill. As the labour share remains constant in A-LMM this implies that the ratio of social security revenues to GDP stays constant over the whole simulation horizon.

Scenario 1A leads to an increasing gap between revenues and expenditures of the social security funds. Consequently, the government transfer to the pension insurance system would climb from 2.2 percent of GDP to 6.2 percent in 2060, with a moderate decline afterwards (figure 9.1.4).

In scenario 3A we assume that contribution rates are continuously adjusted in a way that the balance of the social security sector (as a percentage of GDP) remains at the level of the year 2002. This scenario leads to a significant increase in contribution rates. As depicted in figure 9.3.1 contribution rates in the ASVG pension system (the sum of employee and employers rates) would have to be increased from 22.8 percent of wages up to a maximum rate of 34 percent in 2055. In order to stabilise the fiscal balance of the social security funds, social contributions as a percentage of nominal GDP have to rise by a maximum amount of about 6.4 percentage points in the year 2050. In A-LMM the adjustment of contribution rates has direct effects on the annual pension adjustment, and the tax wedge (figure 9.3.2).

The increase in contribution rates has a direct effect on pension expenditures. According to current law the indexation of net pensions is linked to the growth in net wages. This implies that the growth rate of average pension benefits is dampened, whenever contributions rates rise. As a result, total expenditures of the pension insurance as a percentage of GDP are slightly below the corresponding values of scenario 1A in the period from 2040 to 2070.

Finally, social security contributions affect the outcome of the wage bargaining process via the tax wedge. In A-LMM part of the increase of social contributions is shifted into higher wage claims, which in turn lead to a decline in labour demand and higher unemployment.

Rising contribution rates have a very significant indirect effect on unemployment. The increase in the tax wedge leads to an upward shift of the structural unemployment rate. Consequently, the average unemployment rate would be 8.5 percent over the simulation period, which is about 3 percentage points above the value obtained in scenario 1A. Figure 9.3.3 describes the evolution of unemployment in this scenario compared to the baseline scenario. Employment and GDP growth are reduced on average by around 0.1 percentage point per year. For the year 2070 this implies that the levels of employment, nominal and real GDP are 4.6 percent lower as compared to scenario 1A.

Figure 9.3.1: Contribution rates in pension insurance (ASVG) - Stabilising government transfers

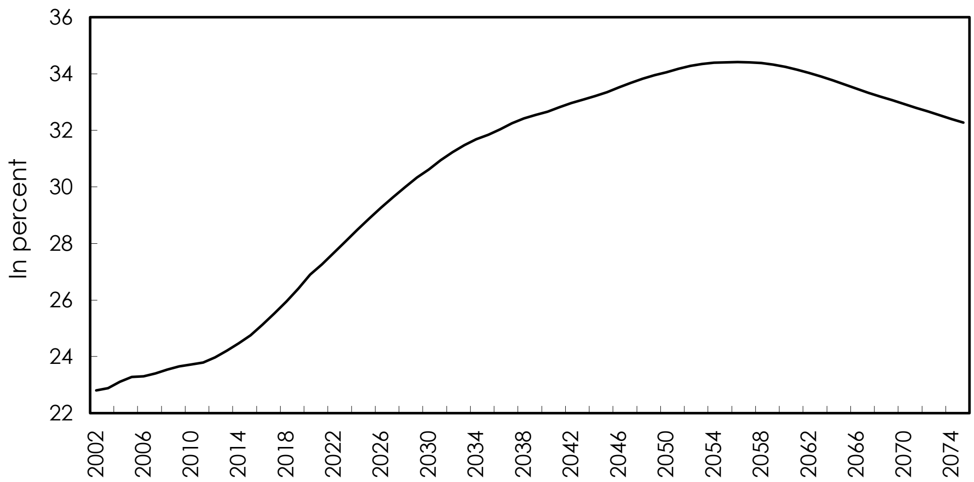


Table 9.3A: Stable fiscal balance of social security (scenario 3A)

	2002	2010	2020	2030	2040	2050	2060	2070	Avg. change (in %) 2002/2070	Cum. change (in % points) 2002/2070
				1,000 persons						
Working Age Population (15-64)	5,464.7	5,577.6	5,562.9	5,237.2	4,944.1	4,759.1	4,551.2	4,423.9	-0.3	
Economically active population (Labour force)	3,765.3	3,893.2	3,924.5	3,825.8	3,733.3	3,618.7	3,470.6	3,371.7	-0.2	
Economically active employees in full time equivalents	3,006.8	3,073.2	3,078.1	3,002.8	2,933.7	2,834.1	2,718.6	2,658.4	-0.2	
Number of pensions	1,999.0	2,143.5	2,409.3	2,686.2	2,833.2	2,890.6	2,836.4	2,723.3	0.5	
				In percent						
Participation rate, total	68.9	69.8	70.5	73.1	75.5	76.0	76.3	76.2	0.1	7.3
Women	61.1	61.7	62.1	65.4	69.0	70.1	70.4	70.3	0.2	9.3
Men	76.7	77.9	78.9	80.6	81.9	81.8	82.0	81.9	0.1	5.2
Unemployment rate	6.9	8.2	8.8	8.7	8.6	8.8	8.8	8.3	0.3	1.4
Old age dependency ratio	22.8	26.2	30.2	39.6	47.5	50.6	52.4	51.8	1.2	28.9
Pensions relative to insured persons	62.4	64.5	71.9	82.4	89.3	94.3	96.9	96.1	0.6	33.6
Pensions relative to population aged 65+	1.60	1.46	1.43	1.30	1.21	1.20	1.19	1.19	-0.4	
				Bill. €						
Gross domestic product at constant 1995 prices	201.2	235.5	280.6	327.4	380.4	437.2	499.6	577.0	1.6	
Gross domestic product at current prices	218.3	299.4	434.9	618.6	876.2	1,227.7	1,709.8	2,407.3	3.6	
				1,000 €						
Real GDP per capita	25.0	28.5	33.4	38.9	45.7	53.6	63.2	75.4	1.6	
				2002 = 100						
Real wage per capita, in full time equivalents (MPL)	100.0	114.1	136.7	163.4	194.2	231.5	275.6	325.0	1.7	
				Percentage change against previous year						
Gross domestic product at constant 1995 prices	1.4	2.0	1.5	1.5	1.5	1.4	1.4	1.5	1.6	
Compensation to employees, at current prices	2.2	4.0	3.6	3.5	3.5	3.4	3.4	3.5	3.6	
Real wage per employee	1.3	1.6	2.0	1.7	1.7	1.7	1.7	1.7	1.7	
GDP deflator	1.4	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	
				Ratio						
Marginal product of capital	0.14	0.14	0.13	0.13	0.13	0.13	0.13	0.13	-0.1	
Capital-output-ratio	3.62	3.63	3.65	3.70	3.72	3.75	3.78	3.78	0.1	0.2

Table 9.3A/continued: Stable fiscal balance of social security (scenario 3A)

	2002	2010	2020	2030	2040	2050	2060	2070	Avg. change (in %) 2002/2070	Cum. change (in % points) 2002/2070
	In percent of GDP, at current prices									
Social security contributions pension insurance	7.6	7.8	8.8	10.0	10.6	11.1	11.1	10.6	0.5	3.1
Contributions to pension insurance by employees	7.0	7.2	8.2	9.3	10.0	10.4	10.4	10.0	0.5	3.0
Contributions to pension insurance by self-employed	0.6	0.6	0.6	0.7	0.7	0.7	0.7	0.6	0.1	0.0
Contributions to pension insurance by others	1.3	1.2	1.2	1.2	1.2	1.2	1.2	1.2	-0.1	-0.1
Total social security expenditures pension insurance	11.0	11.3	12.3	13.6	14.2	14.7	14.7	14.3	0.4	3.3
Government transfers to pensions insurance system	2.2	2.3	2.3	2.3	2.4	2.4	2.4	2.5	0.2	0.3
Social security contributions health insurance	4.0	5.0	5.4	5.9	5.9	5.9	5.7	5.5	0.5	1.5
Total social security expenditures health insurance	5.0	6.1	6.4	6.8	6.8	6.7	6.5	6.3	0.3	1.3
Social security contributions accident insurance	0.5	0.5	0.5	0.5	0.4	0.4	0.4	0.4	-0.2	-0.1
Total social security expenditures accident insurance	0.5	0.5	0.5	0.4	0.4	0.4	0.4	0.4	-0.2	-0.1
Social contributions	16.6	18.0	19.8	21.7	22.6	23.0	22.8	22.0	0.4	5.4
Transfer expenditures - pensions, health and long term care	16.0	16.9	18.3	20.0	21.0	21.6	21.5	21.0	0.4	4.9
Social expenditures	17.7	20.2	21.8	23.5	24.4	25.0	24.9	24.1	0.5	6.4
	2002=100									
Average real pension per year [1])	100.0	112.0	131.5	153.9	179.8	210.6	246.7	286.7	1.6	
	In percent of GDP, at current prices									
Government expenditures	51.3	52.1	53.6	55.2	56.0	56.3	56.1	55.4		4.0
Other government expenditures	25.5	26.3	26.9	27.2	27.4	27.3	27.4	27.5		2.1

1) Average transfer expenditures deflated by GDP-deflator to facilitate comparison with real wage.

Figure 9.3.2: Tax wedge

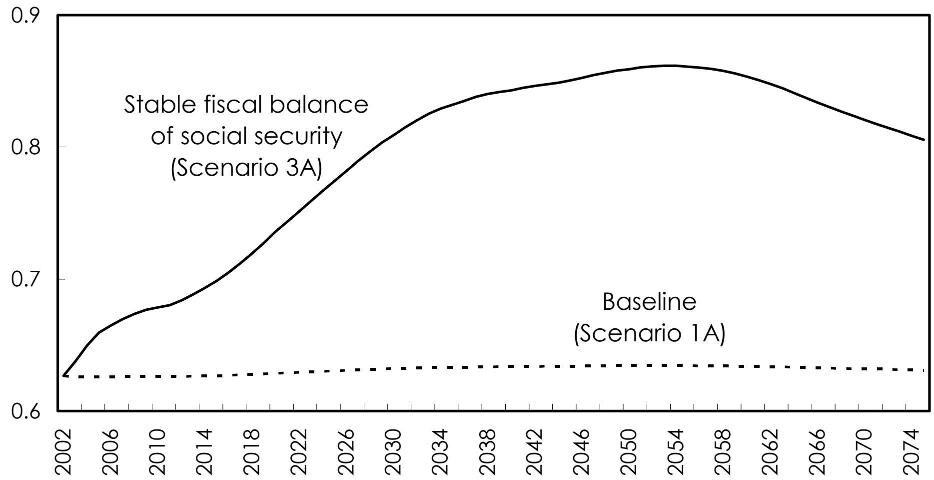
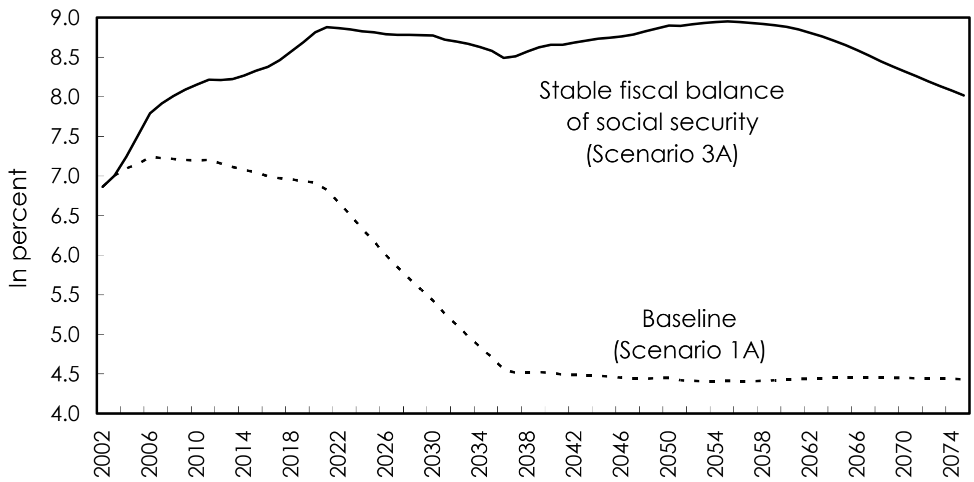


Figure 9.3.3: Unemployment rate



9.3.2 A scenario with alternative pension adjustment (scenario 3B)

As mentioned in section 7.1 the current system of pension indexation implies, that the growth rate of the average pension (which is the sum of average new and existing pension benefits) net of social contributions corresponds to the growth of net wages. This rule makes any measures that modify the generosity of pension benefits ineffective with respect to total transfer expenditures of the pension insurance. Therefore the very recently enacted pension reform in Austria, which causes a continuous decline in pension benefits for new pensioners by 10 percent until 2009, would lead to no reductions in overall spending, as this effect would be completely compensated by automatically higher growth of existing pension benefits.

In scenario 3B we assume an alternative rule for indexing existing pensions. Specifically we assume that benefits of existing pensioners rise in line with the inflation rate (refer to appendix 1 for details). The growth rate of average pension benefits (the sum of new and average pension benefits) that follows from this rule will be different from the inflation rate because of two effects:

- pension benefits of new pensioners are in general higher than existing benefits, and
- pensioners that die have on average lower pension benefits than those who survive.

The size of both effects depends on changes in the generosity of the pension system, the difference in growth rates of new pension benefits (which will be in the long term the growth rate of wages) versus the growth rate of existing benefits (the pension indexation), the average duration of receiving a pension, the average duration of receiving a pension of those pensioners who die and the relative size of the three groups of pensioners. In the year 2000 the first effect amounted to about 1 percentage point and the second effect caused an increase of the average pension of about 0.5 percent.

In scenario 3B this alternative rule of pension indexation implies that the growth rate of average pension benefits will fall significantly below the corresponding growth rates under current legislation until 2030. This is a consequence of the decline in pension benefits for new pensioners in the period from 2004 to 2009 implied by the most recent pension reform. Over time, however, the dampening effect of lower pension benefits for new pensioners vanishes and growth rates of average pensions climb to levels comparable to those obtained under current legislation after 2030.

The moderate growth in average pensions leads to a significant reduction in total transfer expenditures of pension insurance. Over the whole projection period transfer expenditures and similarly the government transfer to the pension system decline on average by about 1.3 percentage point of GDP (see figure 9.3.4). Alternative pension indexation has practically no effect on other variables in the A-LMM model. Employment, wages, investment and GDP growth are nearly identical to the baseline scenario.

Table 9.3B: Alternative pension adjustment (scenario 3B)

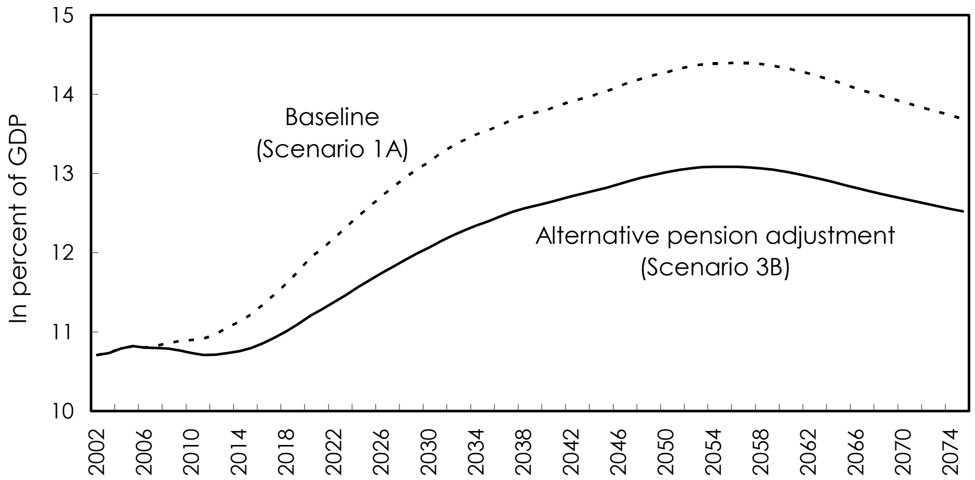
	2002	2010	2020	2030	2040	2050	2060	2070	Avg. change (in %) 2002/2070	Cum. change (in % points) 2002/2070
				1,000 persons						
Working Age Population (15-64)	5,464.7	5,577.6	5,562.9	5,237.2	4,944.1	4,759.1	4,551.2	4,423.9	-0.3	
Economically active population (Labour force)	3,765.3	3,895.9	3,931.2	3,838.9	3,751.1	3,638.7	3,491.3	3,390.7	-0.2	
Economically active employees in full time equivalents	3,006.8	3,108.6	3,150.6	3,128.2	3,086.4	2,994.2	2,873.6	2,790.8	-0.1	
Number of pensions	1,999.0	2,142.8	2,407.3	2,682.2	2,827.8	2,884.2	2,829.8	2,717.3	0.5	
				In percent						
Participation rate, total	68.9	69.8	70.7	73.3	75.9	76.5	76.7	76.6	0.2	7.7
Women	61.1	61.7	62.3	65.6	69.4	70.6	70.9	70.8	0.2	9.7
Men	76.7	77.9	79.0	80.9	82.2	82.2	82.4	82.3	0.1	5.6
Unemployment rate	6.9	7.2	6.9	5.4	4.4	4.4	4.3	4.4	-0.7	-2.5
Old age dependency ratio	22.8	26.2	30.2	39.6	47.5	50.6	52.4	51.8	1.2	28.9
Pensions relative to insured persons	62.4	64.5	71.7	82.0	88.7	93.5	96.0	95.2	0.6	32.8
Pensions relative to population aged 65+	1.60	1.46	1.43	1.29	1.20	1.20	1.19	1.19	-0.4	
				Bill. €						
Gross domestic product at constant 1995 prices	201.2	237.5	286.1	338.8	397.6	459.7	526.3	605.7	1.6	
Gross domestic product at current prices	218.3	302.0	443.5	640.2	915.8	1,290.7	1,801.3	2,526.9	3.7	
				1,000 €						
Real GDP per capita	25.0	28.8	34.1	40.2	47.7	56.3	66.6	79.2	1.7	
				2002 = 100						
Real wage per capita, in full time equivalents (MPL)	100.0	113.7	136.0	162.0	192.9	230.3	274.8	325.2	1.7	
				Percentage change against previous year						
Gross domestic product at constant 1995 prices	1.4	2.1	1.7	1.7	1.6	1.4	1.4	1.4	1.6	
Compensation to employees, at current prices	2.2	4.2	3.8	3.7	3.6	3.4	3.4	3.5	3.7	
Real wage per employee	1.3	1.6	1.9	1.7	1.7	1.8	1.7	1.7	1.7	
GDP deflator	1.4	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	
				Ratio						
Marginal product of capital	0.14	0.14	0.13	0.13	0.13	0.13	0.13	0.13	-0.1	
Capital-output-ratio	3.62	3.62	3.64	3.67	3.70	3.73	3.77	3.78	0.1	0.2

Table 9.3B/continued: Alternative pension adjustment (scenario 3B)

	2002	2010	2020	2030	2040	2050	2060	2070	Avg. change (in %) 2002/2070	Cum. change (in % points) 2002/2070
	In percent of GDP, at current prices									
Social security contributions pension insurance	7.6	7.5	7.5	7.4	7.4	7.4	7.4	7.4	0.0	-0.2
Contributions to pension insurance by employees	7.0	6.9	7.0	7.0	7.0	7.0	7.0	7.0	0.0	0.0
Contributions to pension insurance by self-employed	0.6	0.5	0.5	0.5	0.5	0.5	0.4	0.4	-0.4	-0.2
Contributions to pension insurance by others	1.3	1.2	1.2	1.2	1.2	1.2	1.2	1.2	-0.1	-0.1
Total social security expenditures pension insurance	11.0	11.1	11.6	12.5	13.0	13.4	13.4	13.1	0.3	2.1
Government transfers to pensions insurance system	2.2	2.4	2.9	3.8	4.4	4.8	4.8	4.5	1.1	2.3
Social security contributions health insurance	4.0	3.9	4.0	4.1	4.1	4.2	4.2	4.1	0.1	0.2
Total social security expenditures health insurance	5.0	6.0	6.3	6.6	6.7	6.5	6.4	6.2	0.3	1.3
Social security contributions accident insurance	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.0	0.0
Total social security expenditures accident insurance	0.5	0.5	0.5	0.4	0.4	0.4	0.4	0.4	-0.2	-0.1
Social contributions	16.6	16.4	16.5	16.6	16.6	16.6	16.6	16.5	0.0	0.0
Transfer expenditures - pensions, health and long term care	16.0	16.6	17.5	18.9	19.7	20.3	20.2	19.7	0.3	3.7
Social expenditures	17.7	19.7	20.5	21.6	22.2	22.7	22.6	22.1	0.3	4.3
	2002=100									
Average real pension per year [1])	100.0	112.0	131.5	153.9	179.8	210.6	246.7	286.7	1.6	
	In percent of GDP, at current prices									
Government expenditures	51.3	50.6	50.7	50.7	50.7	50.6	50.5	50.5		-0.9
Other government expenditures	25.5	25.4	25.3	24.6	24.3	24.0	24.2	24.8		-0.7

1) Average transfer expenditures deflated by GDP-deflator to facilitate comparison with real wage.

Figure 9.3.4: Transfer expenditures of pension insurance



9.4 A scenario with higher productivity growth (scenario 4)

The average growth rate of the economy is determined by the growth rates of employment, the capital stock, and total factor productivity. Out of these three factors we already showed the implication of a change in the participation rate on employment and GDP-growth. In this section we will discuss the effects of a higher growth rate in total factor productivity. In the base scenario the growth rate of total factor productivity is set constant at an annual rate of 0.85 percent. Under the assumption of constant employment and a constant capital-output ratio this implies a constant annual rate of growth of GDP of 1.6 percent. The alternative scenario assumes a growth rate of total factor productivity of 1.15 percent.

The underlying population projection corresponds to the main variant of *Hanika et al.* (2004). The higher growth rate provides a moderate stimulus to the labour supply. For this reason all variables relating labour market to population or the number of pensions change as well. For example, the ratio of pensions to the number of insured persons falls by 6.3 percentage points by 2070 compared to baseline. In the model a higher total factor productivity growth feeds through to higher real wages. The average growth of real wages per capita rises by 0.6 percentage point relative to the baseline.

The resulting GDP growth is higher than in the baseline case, although less than to be expected from a TFP-shock of this size. As has been mentioned in section 2, a 0.5 percent growth rate in total factor productivity corresponds to an increase in labour augmented technical progress by 1 percent. Thus we would expect a long run GDP-growth of around 2.3 percent. However, the constraint imposed by demography slows down the economy. Investment adjusts such that the marginal productivity of capital remains optimal and the capital output ratio drops towards a level of 3.6. Since inflation is assumed constant at 2 percent, the nominal GDP grows by 2 percentage points in excess of real GDP.

By design of the social security block, we do not expect major changes in the key figures as the result of a change in the average growth rate of the economy. Contribution rates are proportional up to the upper earnings threshold, and the upper earnings threshold itself grows in line with nominal wages. The simulation results live up to these expectations. Revenues from contributions by each of the four branches do not deviate by more then 0.1 percentage point of nominal GDP from the baseline. The expenditure side, on the other hand, shows a more pronounced reaction to a high-growth environment. Social expenditures increase less steeply and reach a lower peak value of 24.2 percent of GDP in 2054. The savings occur mainly in the health insurance system. The size of savings in pension expenditures is about half as large as in the health insurance branch. The other two branches do not react visibly. Consequently, public transfers to the social security system are lower in a high growth scenario, although the decrease of transfers to the pension system is less pronounced.

The higher growth rate in GDP is associated with higher tax revenues as a share of GDP. Since we require full balance of the public budget in each year of the simulation this allows for higher government spending as well.

Table 9.4: Higher productivity growth (scenario 4)

	2002	2010	2020	2030	2040	2050	2060	2070	Avg. change (in %) 2002/2070	Cum. change (in % points) 2002/2070
				1,000 persons						
Working Age Population (15-64)	5,464.7	5,577.6	5,562.9	5,237.2	4,944.1	4,759.1	4,551.2	4,423.9	-0.3	
Economically active population (Labour force)	3,765.3	3,908.9	3,966.8	3,899.2	3,837.0	3,749.3	3,624.1	3,544.8	-0.1	
Economically active employees in full time equivalents	3,006.8	3,118.1	3,177.1	3,174.9	3,155.1	3,083.8	2,982.2	2,917.7	0.0	
Number of pensions	1,999.0	2,139.7	2,397.3	2,663.8	2,801.4	2,849.0	2,787.9	2,669.1	0.4	
				In percent						
Participation rate, total	68.9	70.1	71.3	74.5	77.6	78.8	79.6	80.1	0.2	11.2
Women	61.1	62.0	62.9	66.8	71.2	73.0	73.9	74.4	0.3	13.3
Men	76.7	78.1	79.6	82.0	83.9	84.4	85.2	85.7	0.2	9.0
Unemployment rate	6.9	7.2	6.9	5.4	4.5	4.4	4.4	4.4	-0.6	-2.5
Old age dependency ratio	22.8	26.2	30.2	39.6	47.5	50.6	52.4	51.8	1.2	28.9
Pensions relative to insured persons	62.4	64.2	70.7	80.1	85.7	89.4	90.8	89.1	0.5	26.6
Pensions relative to population aged 65+	1.60	1.46	1.43	1.29	1.19	1.18	1.17	1.17	-0.5	
				Bill. €						
Gross domestic product at constant 1995 prices	201.2	246.3	312.7	392.3	489.3	602.4	735.3	902.8	2.2	
Gross domestic product at current prices	218.3	302.0	443.3	639.7	915.0	1,289.3	1,799.3	2,524.1	3.7	
				1,000 €						
Real GDP per capita	25.0	29.8	37.2	46.6	58.7	73.8	93.0	118.0	2.3	
				2002 = 100						
Real wage per capita, in full time equivalents (MPL)	100.0	117.4	147.3	184.7	232.1	292.8	369.6	463.4	2.3	
				Percentage change against previous year						
Gross domestic product at constant 1995 prices	1.4	2.6	2.3	2.3	2.2	2.1	2.0	2.1	2.2	
Compensation to employees, at current prices	2.2	4.7	4.4	4.3	4.2	4.1	4.0	4.1	4.3	
Real wage per employee	1.3	2.1	2.4	2.3	2.3	2.3	2.3	2.3	2.3	
GDP deflator	1.4	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	
				Ratio						
Marginal product of capital	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.0	
Capital-output-ratio	3.62	3.56	3.54	3.55	3.55	3.57	3.60	3.60	0.0	0.0

Table 9.4/continued: Higher productivity growth (scenario 4)

	2002	2010	2020	2030	2040	2050	2060	2070	Avg. change (in %) 2002/2070	Cum. change (in % points) 2002/2070
	In percent of GDP, at current prices									
Social security contributions pension insurance	7.6	7.5	7.5	7.4	7.4	7.4	7.4	7.4	0.0	-0.2
Contributions to pension insurance by employees	7.0	6.9	7.0	7.0	7.0	7.0	7.0	7.0	0.0	0.0
Contributions to pension insurance by self-employed	0.6	0.5	0.5	0.5	0.5	0.5	0.4	0.4	-0.5	-0.2
Contributions to pension insurance by others	1.3	1.2	1.2	1.2	1.2	1.2	1.2	1.2	-0.1	-0.1
Total social security expenditures pension insurance	11.0	11.1	12.1	13.1	13.6	13.9	13.7	13.1	0.3	2.1
Government transfers to pensions insurance system	2.2	2.4	3.4	4.5	5.0	5.3	5.1	4.6	1.1	2.4
Social security contributions health insurance	4.0	3.9	4.0	4.1	4.2	4.2	4.2	4.1	0.1	0.2
Total social security expenditures health insurance	5.0	5.9	5.9	6.1	6.0	5.8	5.6	5.4	0.1	0.5
Social security contributions accident insurance	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.0	0.0
Total social security expenditures accident insurance	0.5	0.5	0.5	0.5	0.4	0.4	0.4	0.4	-0.2	-0.1
Social contributions	16.6	16.4	16.6	16.6	16.7	16.7	16.7	16.6	0.0	0.0
Transfer expenditures - pensions, health and long term care	16.0	16.5	17.7	19.1	19.8	20.2	20.0	19.3	0.3	3.3
Social expenditures	17.7	19.6	20.7	21.7	22.1	22.5	22.2	21.4	0.3	3.7
	2002=100									
Average real pension per year [1])	100.0	112.0	131.5	153.9	179.8	210.6	246.7	286.7	1.6	
	In percent of GDP, at current prices									
Government expenditures	51.3	50.7	50.9	50.9	50.9	50.9	50.8	50.7		-0.6
Other government expenditures	25.5	25.6	25.4	24.9	24.8	24.6	25.0	25.8		0.3

1) Average transfer expenditures deflated by GDP-deflator to facilitate comparison with real wage.

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Appendix 1: Modelling alternative adjustment of pension benefits

A-LMM describes the development of the average pension benefit. Average pension benefits comprise the benefits for new pensions as well as benefits of already existing pensioners. According to current legislation, average net pension benefits grow in line with net wages. The corresponding equation in A-LMM has been described in section 7. If an alternative rule for the revaluation of pension benefits would be introduced the task of modelling pension benefits would be more complicated. This section explains how pension benefits are modelled in A-LMM, if an alternative adjustment of pension benefits, as in scenario 3b, is assumed.

Modelling pension benefits may be described in a number of steps:

Step 1: If existing pension benefits remain unaltered between two periods, the average pension benefit of existing pensioners will rise by a factor *d*. This is due to the fact, that benefits of dying pensioners are usually lower than benefits of surviving pensioners.

$$B_{t-1} = \theta\, BB + (1-\theta) BD \,.$$

$$B_t = BB \,.$$

$$d = \frac{B_t}{B_{t-1}} - 1 = \frac{1}{\theta + (1-\theta)\dfrac{BD}{BB}} - 1 \,.$$

Here B_t average pension benefit;

BB average pension benefit of those who survive;

BD average pension benefit of those who die;

θ the share of pensioners that survive.

The parameter *d* is determined by the difference between benefit levels of surviving to dead pensioners and the share of surviving pensioners. In the year 2000 the growth of average pensions that is attributable to this effect amounted to 0.5 percent.

Step 2: If existing pension benefits remain unaltered the average pension benefit (new pension benefits plus existing pension benefits) will rise by a factor *n*. This is due to the fact, that benefits of new pensioners are usually higher than benefits of existing pensioners.

$$B_t = \psi\, BN + (1-\psi) BB \,.$$

$$B_{t-1} = BB \,.$$

$$n = \frac{B_t}{B_{t-1}} - 1 = \psi\left(\frac{BN}{BB} - 1\right).$$

Here BN average pension benefit of new pensioners;

ψ the share of new pensioners.

The reasoning is the same as in step 1. In the year 2000 the growth of average pension benefits attributable to this effect amounted to about 1.0 percent.

Step 3: The total increase in average pension benefits consists of the sum of the effects *n + d* and the adjustment of existing pension benefits. In order to project the increase in average pensions assumptions about the differences in benefit levels of the different groups and the corresponding shares have to be made.

The determinants of differences in benefit levels are:

- changes in the generosity of the pension system;
- differences in labour market histories;
- differences in the growth of new pensions vs. existing pensions.

In our approach we only consider the latter effect.

We assume that new pensions rise with the average wage, whereas existing pensions are indexed by the rate of inflation. In this case differences in the benefit levels between new, existing pensions and benefits of dying pensioners are determined by the difference between growth rates of new and existing pension benefits.

If a person retires in *t*, in *t + 1* she will receive a pension benefit that has grown by the adjustment factor (inflation rate, *Δlog(P)*). A person that retires in *t + 1* with the same replacement rate as the former person will have a pension benefit which is higher by the factor *(1 + Δlog(W))*:

$$\frac{BN}{BB} = D_{BB}^{\;1+\Delta\log(W)-\Delta\log(P)}.$$

Here D_{BB} denotes the duration of the average pension benefit claim.

The above equation implies, that existing pension benefits fall compared to new pension benefits, if the pension adjustment factor *Δlog(P)*, is below the average wage growth, *Δlog(W)*. The same will be true for the difference between benefits of dying and surviving pensioners.

$$\frac{BB}{BD} = (D_{BB} - D_{BD})^{1+\Delta\log(W)-\Delta\log(P)},$$

where D_{BD} is the duration of the average pension claim of dead pensioners.

In scenario 3b we use this methodology to model the growth of average pension benefits. Equation 7.4 (see section 7) is replaced by the following one:

$$\Delta \log\left(\frac{TRP_t}{PEN_t}\right) = NPS_t(NPB_t - 1) + d_t + \Delta \log(P_t).$$

Following the approach described above, the growth of average pension benefits, TRP_t/PEN_t, consists of three components. The first one comprises the effect of new pension benefits described by the relative share of the number of new benefits in total benefits, NPS_t, and the relationship between new pension benefits and the benefits of existing pensioners (NPB_t corresponds to *BN*/*BB* as defined above). The effect of dying pensioners is captured by the parameter d_t. Finally, it is assumed that existing pension benefits are indexed to inflation.

We expect a rather stable development of the relevant parameters. In the A-LMM model we assume that the effect due to dying pensioners, d_t, amounts to 0.5 percent and remains constant over time. The share of new pensions, NPS_t, is set to 4.5 percent. Finally, it is assumed that in the steady state the new pension will be 23 percent above the average pension benefit of existing pension benefits, i.e. $NPB_t = 1.23$. As the pension reform of 2003 implies that pension benefits for new pensioners fall by 10 percent until 2009 we gradually decrease NPB_t by 10 percent. In the period 2009 to 2030 NPB_t reverts gradually to its steady state value.

Appendix 2:List of variables

Table A2: List of Variables

Exogenous Variables

New	English	German	Type	Sec.
QSB	Ratio of business savings to investment	Verhältnis von Sparen im Unternehmenssektor zu den Investitionen	exo	2
RD	Rate of physical depreciation	Ökonomische Abschreibung, Durchschnittssatz	exo	2
RTD	Rate of tax depreciation allowance	Steuerliche Abschreibung, Durchschnittssatz	exo	2
TFP	Total factor productivity, rate of change	Veränderungsrate d. Gesamtfaktorproduktivität	exo	2
PRD	Probability of death (Inverse of life - expectancy), private households	Sterbewahrscheinlichkeit (Kehrwert d. Lebenserwartung) d. priv. Haushalts	exo	3
RTP	Rate of time preference	Zeitpräferenzrate	exo	3
GRR	Gross replacement rate	Ersatzrate d. Arbeitslosenversicherung	exo	4
POP	Population, Austria, in million persons	Bevölkerung von Österreich, Mio. Personen	exo	4
POP0	Population, age group 0 to 14, in million persons	Bevölkerung im Alter von 0 bis 14	exo	4
POP1_3	Population, age group15 to 55, in million persons	Bevölkerung im Alter von 15 bis 55	exo	4
POP4_5	Population, age group 55 to 65, in million persons	Bevölkerung im Alter von 55 bis 65	exo	4
POP6	Population, age group 65 and older, in million persons	Bevölkerung im Alter von 65+	exo	4
POPC	Population, age group 0 to 4, in million persons	Bevölkerung im Alter von 0 bis 4	exo	4
POPE	Population, age group 15 to 65, in million persons	Erwerbsfähige Wohnbevölkerung im Alter von 15 bis 65	exo	4
POPF	Population, Austria, females, in million persons	Gesamtbevölkerung von Österreich, Frauen	exo	4
POPF0	Population, females, age group 0 to 14, in million persons	Bevölkerung Frauen im Alter von 0 bis 14	exo	4
POPF1	Population, females, age group 15 to 24, in million persons	Bevölkerung Frauen im Alter von 15 bis 24	exo	4
POPF2	Population, females, age group 25 to 49, in million persons	Bevölkerung Frauen im Alter von 25 bis 49	exo	4
POPF3	Population, females, age group 50 to 54, in million persons	Bevölkerung Frauen im Alter von 50 bis 54	exo	4
POPF4	Population, females, age group 55 to 59, in million persons	Bevölkerung Frauen im Alter von 55 bis 59	exo	4
POPF5	Population, females, age group 60 to 64, in million persons	Bevölkerung Frauen im Alter von 60 bis 64	exo	4
POPF6	Population, females, age group 65 and older, in million persons	Bevölkerung Frauen im Alter von 65+	exo	4
POPM	Population, Austria, males, in million persons	Gesamtbevölkerung von Österreich, Männer	exo	4
POPM0	Population, males, age group 0 to 14, in million persons	Bevölkerung Männer im Alter von 0 bis 14	exo	4
POPM1	Population, males, age group 15 to 24, in million persons	Bevölkerung Männer im Alter von 15 bis 24	exo	4
POPM2	Population, males, age group 25 to 49, in million persons	Bevölkerung Männer im Alter von 25 bis 49	exo	4
POPM3	Population, males, age group 50 to 54, in million persons	Bevölkerung Männer im Alter von 50 bis 54	exo	4
POPM4	Population, males, age group 55 to 59, in million persons	Bevölkerung Männer im Alter von 55 bis 59	exo	4
POPM5	Population, males, age group 60 to 64, in million persons	Bevölkerung Männer im Alter von 60 bis 64	exo	4
POPM6	Population, males, age group 65 and older, in million persons	Bevölkerung Männer im Alter von 65+	exo	4
ELS	Labour supply elasticity	Arbeitsangebotselastizität	exo	4
PRT	Trend-participation rate	Trend Erwerbsquote	exo	4
PRTF1	Trend participation rate, females, age group 15 to 24	Trend Erwerbsquote Frauen im Alter von 15 bis 24	exo	4
PRTF2	Trend participation rate, females, age group 25 to 49	Trend Erwerbsquote Frauen im Alter von 25 bis 49	exo	4
PRTF3	Trend participation rate, females, age group 50 to 55	Trend Erwerbsquote Frauen im Alter von 50 bis 54	exo	4
PRTF4	Trend participation rate, females, age group 55 to 59	Trend Erwerbsquote Frauen im Alter von 55 bis 59	exo	4
PRTF5	Trend participation rate, females, age group 60 to 64	Trend Erwerbsquote Frauen im Alter von 60 bis 64	exo	4
PRTF6	Trend participation rate, females, age group 65 and older	Trend Erwerbsquote Frauen im Alter von 65+	exo	4

Table A2 / continued:

PRTM1	Trend participation rate, males, age group 15 to 24	Trend Erwerbsquote Männer im Alter von 15 bis 24	exo	4
PRTM2	Trend participation rate, males, age group 25 to 49	Trend Erwerbsquote Männer im Alter von 25 bis 49	exo	4
PRTM3	Trend participation rate, males, age group 50 to 54	Trend Erwerbsquote Männer im Alter von 50 bis 54	exo	4
PRTM4	Trend participation rate, males, age group 55 to 59	Trend Erwerbsquote Männer im Alter von 55 bis 59	exo	4
PRTM5	Trend participation rate, males, age group 60 to 64	Trend Erwerbsquote Männer im Alter von 60 bis 64	exo	4
PRTM6	Trend participation rate, males, age group 65 and older	Trend Erwerbsquote Männer im Alter von 65+	exo	4
QLD	Ratio of LE to LD	Umrechnungsfaktor zwischen (Aktiv)Beschäftigten u. Vollzeitäquivalente	exo	4
QLENA	Ratio of LENA to POP0	Faktor Nicht-Aktiv-Beschaeftigte an Kindern im Alter von 0 bis 14	exo	4
QLST	Ratio of dependent labour supply to total trend labour supply	Anteil d. Unselbständigen an den gesamten Erwerbspersonen	exo	4
QLSSA	Share of farmers in self emplyeed	Anteil d. Beschäftigten in Landwirtschaft an den Selbständigen	exo	4
QHSC	Share of private households in social contributions	Anteil der privaten Haushalte an den Sozialbeiträgens, Durchschnittssatz	exo	6
QHTDIR	Share of private households in direct taxes	Anteil der privaten Haushalte an den direkten Steuern, Durchschnittssatz	exo	6
QHTRM	Share of private households in monetary transfers	Anteil der privaten Haushalte an den Sozialtransfers, Durchschnittssatz	exo	6
QHTRO	Share of private households in other transfers	Anteil der privaten Haushalte an den sonstigen Transfers, Durchschnittssatz	exo	6
QHYI	Share of private household interest income in gross operating surplus	Anteil der Zinseinkommen privater Haushalte am Betriebüberschuß, Durchschnittssatz	exo	6
QHYL	Share of private household labour income in compensation to employees	Anteil der privaten Haushalte am Lohneinkommen, Durchschnittssatz	exo	6
QHYS	Share of private household entrepreneurial income in gross operating surplus	Anteil der Einkommen aus unternehmerischer Tätigkeit privater Haushalte am Betriebsüberschuß, Durchschnittssatz	exo	6
QGCN	Ratio of government consumption to government expenditures less social security expenditures, subisidies and expenditures on interest	Verhältnis der Konsumausgaben des Staates zu den Staatsausgaben abzüglich der Sozialausgaben, der Subventionen und Zinsen für die Staatsschuld	exo	7
QGDMV	Ratio of ex-budgetary transactions to government debt	Verhältnis der außerbudgetären Transaktionen zur Staatsschuld	exo	7
QGEOC	Ratio of other government spending to nominal GDP, constant spending rule	Anteil der sonst. Staatsausgaben am BIP bei konstanter Regel Ausgabenquot	exo	7
QGRO	Other government revenues, ratio	Restliche Staatseinnahmen, Quote	exo	7
QSC	Ratio of social contributions according to ESA to social security contributior	Verhältnis von Sozialbeiträgen lt. VGR zu Sozialversicherungsbeiträgen, Durchschnittssatz	exo	7
QSCL	Share of wage related contributions in total social security contributions	Anteil der lohnbezogenen Beiträge an den gesamten Sozialversicherungsbei	exo	7
QSUB	Ratio of subsidies to tax revenues	Verhältnis von Subventionen zu Steuereinnahmen, Durchschnittssatz	exo	7
RSCO	Other social contributions, ratio	Resltiche Sozialbeiträge, Quote	exo	7
RTC	Corporation taxes, average tax rate	Unternehmenssteuer (Köst+Gewst), Durchschnittssatz	exo	7
RTDIR	Other taxes on income and wealth, receivable, average tax rate	Restliche Einkommen u. Vermögensteuern, Durchschnittssatz	exo	7
RTIND	Taxes on production and imports, average tax rate	Produktions u. Importabgaben, Durchschnittssatz	exo	7
RTW	Wage taxes, average tax rate	Lohnsteuer inkl. AK u. Land AK Umlage, Durchschnittssatz	exo	7
MCBS	Minimum contribution basis of self employed	Mindestbeitragsgrundlage für Selbständige	exo	8
QPEN	Adjustment factor pension insurance	Pensionsanpassungsfaktor	exo	8
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	exo	8
QRP	Ratio retirees to population, age group 0 to 54	Quote d. Pensionisten an d. Bevölkerung im Alter von 0 bis 54	exo	8
QSCE	Adjustment factor, social contribution rates of employees to social security	Nettoanpassungsfaktor bei Löhnen	exo	8
QSCP	Adjustment factor, social (health) contribution rate of pensioners	Nettoanpassungsfaktor bei Pensionen	exo	8

Table A2 / continued:

RSA	Contribution rate, accident insurance	Beitragssatz, Unfallversicherung	exo	8
RSH	Contribution rate, health insurance	Beitragssatz, Krankenversicherung	exo	8
RSHR	Contribution rate, health insurance, for retirees	Beitragssatz, Krankenversicherung für Pensionisten	exo	8
RSPC	Contribution rate, pension insurance, for employers	Beitragssatz, Pensionsversicherung, Arbeitgeber	exo	8
RSPE	Contribution rate, pension insurance, for employees	Beitragssatz, Pensionsversicherung, Arbeitnehmer	exo	8
RSPF	Contribution rates of the pension insurance funds	Beitragssatz, Krankenversicherung d. PV Träger	exo	8
RSPS	Contribution rate, pension insurance, for self-employed	Beitragssatz, Pensionsversicherung, Selbständige	exo	8
RSU	Contribution rate, unemployment insurance	Beitragssatz, Arbeitslosenversicherung	exo	8
UTH	Upper threshold health insurance contributions, at current prices	Höchstbeitragsgrundlage d. Krankenversicherung	exo	8
UTPA	Upper threshold pension and accident insurance contributions, at current	Höchstbeitragsgrundlage d. Pensions u. Unfallversicherung	exo	8
UTU	Upper threshold unemployment insurance contributions, at current prices	Höchstbeitragsgrundlage d. Arbeitslosenversicherung	exo	8
QCAY	Adjustment factor, balance in income	Anpassungsfaktor für d. Einkommensbilanz	exo	9
PW	Deflator, imports	Deflator, Importe	exo	9
R	Real long term interest rate	Realer Zinssatz, Sekundärmarktrendite Bund	exo	9
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	exo	9

Alternative population scenarios:

Scenario 1B: High life expectancy

POPH	Population, Austria, in million persons	Bevölkerung von Österreich, Mio. Personen	exo	4
POPCH	Population, age group 0 to 4, in million persons	Bevölkerung im Alter von 0 bis 4	exo	4
POP0H	Population, age group 0 to 14, in million persons	Bevölkerung im Alter von 0 bis 14	exo	4
POP1_3H	Population, age group15 to 55, in million persons	Bevölkerung im Alter von 15 bis 55	exo	4
POP4_5H	Population, age group 55 to 65, in million persons	Bevölkerung im Alter von 55 bis 65	exo	4
POP6H	Population, age group 65 and older, in million persons	Bevölkerung im Alter von 65+	exo	4
POPEH	Population, age group 15 to 65, in million persons	Erwerbsfähige Wohnbevölkerung im Alter von 15 bis 65	exo	4
POPFH	Population, Austria, females, in million persons	Gesamtbevölkerung von Österreich, Frauen	exo	4
POPF0H	Population, females, age group 0 to 14, in million persons	Bevölkerung Frauen im Alter von 0 bis 14	exo	4
POPF1H	Population, females, age group 15 to 24, in million persons	Bevölkerung Frauen im Alter von 15 bis 24	exo	4
POPF2H	Population, females, age group 25 to 49, in million persons	Bevölkerung Frauen im Alter von 25 bis 49	exo	4
POPF3H	Population, females, age group 50 to 54, in million persons	Bevölkerung Frauen im Alter von 50 bis 54	exo	4
POPF4H	Population, females, age group 55 to 59, in million persons	Bevölkerung Frauen im Alter von 55 bis 59	exo	4
POPF5H	Population, females, age group 60 to 64, in million persons	Bevölkerung Frauen im Alter von 60 bis 64	exo	4
POPF6H	Population, females, age group 65 and older, in million persons	Bevölkerung Frauen im Alter von 65+	exo	4
POPMH	Population, Austria, males, in million persons	Gesamtbevölkerung von Österreich, Männer	exo	4
POPM0H	Population, males, age group 0 to 14, in million persons	Bevölkerung Männer im Alter von 0 bis 14	exo	4
POPM1H	Population, males, age group 15 to 24, in million persons	Bevölkerung Männer im Alter von 15 bis 24	exo	4
POPM2H	Population, males, age group 25 to 49, in million persons	Bevölkerung Männer im Alter von 25 bis 49	exo	4
POPM3H	Population, males, age group 50 to 54, in million persons	Bevölkerung Männer im Alter von 50 bis 54	exo	4
POPM4H	Population, males, age group 55 to 59, in million persons	Bevölkerung Männer im Alter von 55 bis 59	exo	4
POPM5H	Population, males, age group 60 to 64, in million persons	Bevölkerung Männer im Alter von 60 bis 64	exo	4
POPM6H	Population, males, age group 65 and older, in million persons	Bevölkerung Männer im Alter von 65+	exo	4

Table A2 / continued:

Scenario 1C: Low fertility

POPL	Population, Austria, in million persons	Bevölkerung von Österreich, Mio. Personen	exo	4
POPCL	Population, age group 0 to 4, in million persons	Bevölkerung im Alter von 0 bis 4	exo	4
POP0L	Population, age group 0 to 14, in million persons	Bevölkerung im Alter von 0 bis 14	exo	4
POP1_3L	Population, age group15 to 55, in million persons	Bevölkerung im Alter von 15 bis 55	exo	4
POP4_5L	Population, age group 55 to 65, in million persons	Bevölkerung im Alter von 55 bis 65	exo	4
POP6L	Population, age group 65 and older, in million persons	Bevölkerung im Alter von 65+	exo	4
POPEL	Population, age group 15 to 65, in million persons	Erwerbsfähige Wohnbevölkerung im Alter von 15 bis 65	exo	4
POPFL	Population, Austria, females, in million persons	Gesamtbevölkerung von Österreich, Frauen	exo	4
POPF0L	Population, females, age group 0 to 14, in million persons	Bevölkerung Frauen im Alter von 0 bis 14	exo	4
POPF1L	Population, females, age group 15 to 24, in million persons	Bevölkerung Frauen im Alter von 15 bis 24	exo	4
POPF2L	Population, females, age group 25 to 49, in million persons	Bevölkerung Frauen im Alter von 25 bis 49	exo	4
POPF3L	Population, females, age group 50 to 54, in million persons	Bevölkerung Frauen im Alter von 50 bis 54	exo	4
POPF4L	Population, females, age group 55 to 59, in million persons	Bevölkerung Frauen im Alter von 55 bis 59	exo	4
POPF5L	Population, females, age group 60 to 64, in million persons	Bevölkerung Frauen im Alter von 60 bis 64	exo	4
POPF6L	Population, females, age group 65 and older, in million persons	Bevölkerung Frauen im Alter von 65+	exo	4
POPML	Population, Austria, males, in million persons	Gesamtbevölkerung von Österreich, Männer	exo	4
POPM0L	Population, males, age group 0 to 14, in million persons	Bevölkerung Männer im Alter von 0 bis 14	exo	4
POPM1L	Population, males, age group 15 to 24, in million persons	Bevölkerung Männer im Alter von 15 bis 24	exo	4
POPM2L	Population, males, age group 25 to 49, in million persons	Bevölkerung Männer im Alter von 25 bis 49	exo	4
POPM3L	Population, males, age group 50 to 54, in million persons	Bevölkerung Männer im Alter von 50 bis 54	exo	4
POPM4L	Population, males, age group 55 to 59, in million persons	Bevölkerung Männer im Alter von 55 bis 59	exo	4
POPM5L	Population, males, age group 60 to 64, in million persons	Bevölkerung Männer im Alter von 60 bis 64	exo	4
POPM6L	Population, males, age group 65 and older, in million persons	Bevölkerung Männer im Alter von 65+	exo	4

Scenario 2: Dynamic activity rates

PRT2	Trend-participation rate	Trend Erwerbsquote	exo	4
PRT2F1	Trend participation rate, females, age group 15 to 24	Trend Erwerbsquote Frauen im Alter von 15 bis 24	exo	4
PRT2F2	Trend participation rate, females, age group 25 to 49	Trend Erwerbsquote Frauen im Alter von 25 bis 49	exo	4
PRT2F3	Trend participation rate, females, age group 50 to 55	Trend Erwerbsquote Frauen im Alter von 50 bis 54	exo	4
PRT2F4	Trend participation rate, females, age group 55 to 59	Trend Erwerbsquote Frauen im Alter von 55 bis 59	exo	4
PRT2F5	Trend participation rate, females, age group 60 to 64	Trend Erwerbsquote Frauen im Alter von 60 bis 64	exo	4
PRT2F6	Trend participation rate, females, age group 65 and older	Trend Erwerbsquote Frauen im Alter von 65+	exo	4
PRT2M1	Trend participation rate, males, age group 15 to 24	Trend Erwerbsquote Männer im Alter von 15 bis 24	exo	4
PRT2M2	Trend participation rate, males, age group 25 to 49	Trend Erwerbsquote Männer im Alter von 25 bis 49	exo	4
PRT2M3	Trend participation rate, males, age group 50 to 54	Trend Erwerbsquote Männer im Alter von 50 bis 54	exo	4
PRT2M4	Trend participation rate, males, age group 55 to 59	Trend Erwerbsquote Männer im Alter von 55 bis 59	exo	4
PRT2M5	Trend participation rate, males, age group 60 to 64	Trend Erwerbsquote Männer im Alter von 60 bis 64	exo	4
PRT2M6	Trend participation rate, males, age group 65 and older	Trend Erwerbsquote Männer im Alter von 65+	exo	4

Scenario 3B: Alternative pension indexation

NPS	Share of new pensions of total pensions	Anteil der Neupensionen	exo	8
NPB	Ratio of new pension benefits to average pension benefit	Verhältnis der Höhe der Neupensionen zum Durchschnittspensionsbezug	exo	8

Table A2 / continued:

Endogenus variables

DPN	Consumption of fixed capital, at current prices	Abschreibungen, laufende Preise	end	2
I	Gross capital formation, at constant 1995 prices	Bruttoinvestitionen, zu Preisen von 1995	end	2
K	Physical capital stock, at constant 1995 prices	Nettokapitalstock, zu Preisen von 1995	end	2
MPL	Marginal product of labour	Grenzprodukt der Arbeit	end	2
Q	Tobin's Q	Tobinsches Q	end	2
Y	Gross domestic product, at constant 1995 prices	Bruttoinlandsprodukt, zu Preisen von 1995	end	2
YN	Gross domestic product, at current prices	Bruttoinlandsprodukt, laufende Preise	end	2
CP	Private consumption, at constant 1995 prices	Privater Konsum, zu Preisen von 1995	end	3
HWF	Financial wealth of private households, at constant 1995 prices	Finanzvermögen der priv. Haushalte, zu Preisen von 1995	end	3
HWH	Human wealth of private households, at constant 1995 prices	Humanvermögen der priv. Haushalte, zu Preisen von 1995	end	3
NFA	Net foreign assets, at current prices	Netto-Auslandsvermögensposition, laufende Preise	end	3
LD	Economically active employees in full time equivalents, in million persons	Unselbständig (Aktiv)Beschäftigte in Vollzeitäquivalente, Mio. Personen	end	4
LE	Employees (incl. LENA), in million persons	Unselbständig Beschäftigte (inkl. KUG), Mio. Personen	end	4
LEA	Economically active employees (LE - LENA), in million persons	(Aktiv)Beschäftigte	end	4
LENA	Persons on maternity leave and persons in military services, in million persons	Kindergeldbezieher und Präsenzdiener, Mio. Personen	end	4
LF	Economically active population (Labour force), in million persons	Realisierte Erwerbspersonen	end	4
LFF	Economically active population, females, in million persons	Erwerbspersonen, Frauen	end	4
LFM	Economically active population, males, in million persons	Erwerbspersonen, Männer	end	4
LFT	Labour force, trend, in million persons	Erwerbspersonen Trend	end	4
LS	Dependent labour supply, in million persons	Arbeitsangebot unselbständig, Mio. Personen	end	4
LSS	Self employed, in million persons	Selbständig Beschäftigte, Mio. Personen	end	4
LSSA	Self employed, farmers, in million persons	Selbständig Beschäftigte Landwirtschaft, Mio. Personen	end	4
LSSNA	Self employed, non-farmers, in million persons	Selbständig Beschäftigte Gewerbe, Mio. Personen	end	4
LST	Labour supply, trend, in million persons	Trend unselbständiges Arbeitsangebot, Mio. Personen	end	4
LU	Unemployed, in million persons	Arbeitslose, Mio. Personen	end	4
QWT	Working time index	Arbeitszeitindex	end	4
PR	Participation rate	Erwerbsquote	end	4
PR4_5	Participation rate, age group 50 to 64	Erwerbsquote im Alter von 50 bis 64	end	4
PR6	Participation rate, age group 65 and older	Erwerbsquote im Alter von 65+	end	4
PRF1	Participation rate, females, age group 15 to 24	Erwerbsquote Frauen im Alter von 15 bis 24	end	4
PRF2	Participation rate, females, age group 25 to 49	Erwerbsquote Frauen im Alter von 25 bis 49	end	4
PRF3	Participation rate, females, age group 50 to 55	Erwerbsquote Frauen im Alter von 50 bis 54	end	4
PRF4	Participation rate, females, age group 55 to 59	Erwerbsquote Frauen im Alter von 55 bis 59	end	4
PRF5	Participation rate, females, age group 60 to 64	Erwerbsquote Frauen im Alter von 60 bis 64	end	4
PRF6	Participation rate, females, age group 65 and older	Erwerbsquote Frauen im Alter von 65+	end	4
PRM1	Participation rate, males, age group 15 to 24	Erwerbsquote Männer im Alter von 15 bis 24	end	4
PRM2	Participation rate, males, age group 25 to 49	Erwerbsquote Männer im Alter von 25 bis 49	end	4
PRM3	Participation rate, males, age group 50 to 54	Erwerbsquote Männer im Alter von 50 bis 54	end	4
PRM4	Participation rate, males, age group 55 to 59	Erwerbsquote Männer im Alter von 55 bis 59	end	4
PRM5	Participation rate, males, age group 60 to 64	Erwerbsquote Männer im Alter von 60 bis 64	end	4
PRM6	Participation rate, males, age group 65 and older	Erwerbsquote Männer im Alter von 65+	end	4
TWED	Tax wedge	Lohnschere	end	4
U	Unemployment rate	Arbeitslosenquote	end	4
W	Real wage per capita, in full time equivalents	Realer Lohn in Vollzeitäquivalenten	end	4
WA	Alternative wage path index	Index des Alternativlohns	end	4
YLN	Compensation to employees, at current prices, net wage taxes and social security contributions	Arbeitnehmerentgelt, laufende Preise, abzüglich Lohnsteuer u. Sozialversicherungsbeiträge	end	4

Table A2 / continued:

GOS	Gross operating surplus and gross mixed income, at current prices	Bruttobetriebsüberschuss u. Selbständigeneinkommen, laufende Preise	end	6
HSC	Social contributions, payable, private households, at current prices	Sozialbeiträge, priv. Haushalte, gezahlt, laufende Preise	end	6
HTRM	Social benefits other than social transfers in kind, receivable, private households, at current prices	Monetäre Sozialleistungen, priv. Haushalte, erhalten, laufende Preise	end	6
HTRO	Balance of other current transfers, private households, at current prices	Sonstige laufende Transfers, Saldo, priv. Haushalte, laufende Preise	end	6
HYI	Balance of property income, private households, at current prices	Vermögenseinkommen, Saldo, priv. Haushalte, laufende Preise	end	6
HYL	Compensation of employees, receivable, private households, at current pr	Arbeitnehmerentgelt, priv. Haushalte, erhalten, laufende Preise	end	6
HYNSI	Non-entrepreneurial disposable income of private households, at current p	Verfügbares Einkommen d. priv. Haushalte ohne Selbständigeneinkommen, laufende Preise	end	6
HYS	Mixed income, net, private households, at current prices	Selbständigeneinkommen, priv. Haushalte, erhalten, laufende Preise	end	6
S	Domestic savings	Inländisches Sparen	end	6
YDN	Disposable income of private households, at current prices	Verfügbares Einkommen d. priv. Haushalte, laufende Preise	end	6
YL	Compensation to employees, at current prices	Arbeitnehmerentgelt, laufende Preise	end	6
GC	Government consumption, at current prices	Konsumausgaben des Staates, zu laufenden Preisen	end	7
GD	Government debt, at current prices	Staatsschuld, laufende Preise	end	7
GDMV	Government debt management and valuation changes, at current prices	Staatsschuldenverwaltung und Bewertungsänderungen, laufende Preise	end	7
GE	Government expenditures, at current prices	Staatsausgaben, laufende Preise	end	7
GEC	Government expenditures under constant spending ratio rule, at current p	Staatsausgaben unter Regel konst. Staatsausgabenquote, laufende Preise	end	7
GEI	Government expenditures on interest, at current prices	Zinsen für die Staatsschuld, Staat konsolidiert, laufende Preise	end	7
GEIC	Government expenditures on interest under constant spending ratio rule, at current prices	Zinsen für die Staatsschuld unter Regel konst. Staatsausgabenquote, laufende Preise	end	7
GELTC	Government expenditures on long term care, at current prices	Ausgaben für Pflegegeld (Bundespflegeld), laufende Preise	end	8
GEO	Other government expenditures, at current prices	Sonstige staatliche Ausgaben, laufende Preise	end	7
GEOC	Other government expenditures under constant spending ratio rule, at cur	Sonst. Staatl. Ausg. unter Regel konst. Staatsausgabenquote, laufende Preise	end	7
GR	Government revenues, at current prices	Staatseinnahmen, laufende Preise	end	7
HTDIR	Current taxes on income and wealth, payable, private households, at current prices	Einkommen u. Vermögensteuern, priv. Haushalte, gezahlt, laufende Preise	end	7
RGD	Implicit average interest rate on government debt	Impliziter durchschnittlicher Zinssatz der Staatsschuld	end	7
RN	Nominal long term interest rate	Nominaler Zinssatz, Sekundärmarktrendite Bund	end	7
SC	Social contributions, at current prices	Sozialbeiträge, laufende Preise	end	7
SUB	Subsidies, at current prices	Subventionen, laufende Preise	end	7
TDIR	Current taxes on income and wealth, receivable, at current prices	Einkommen u. Vermögensteuern, Aufkommen, laufende Preise	end	7
TIND	Taxes on production and imports, at current prices	Produktions- u. Importabgaben, laufende Preise	end	7
PEN	Number of pensions, in million	Anzahl d. Pensionsbezüge (Direktpensionen+Hinterbliebenenpensionen)	end	8
SCA	Social security contributions - accident insurance, at current prices	Beitragseinnahmen d. Unfallversicherung, laufende Preise	end	8
SCH	Social security contributions - health insurance, at current prices	Beitragseinnahmen d. Krankenversicherung, laufende Preise	end	8
SCHE	Social security contributions - health insurance, employees, at current prices	Beitragseinnahmen d. Krankenversicherung, Arbeitnehmer, laufende Preise	end	8
SCHR	Social security contributions - health insurance, retirees, at current prices	Beitragseinnahmen d. Krankenversicherung, Beiträge für Pensionisten, laufende Preise	end	8
SCP	Social security contributions - pension insurance, at current prices	Beitragseinnahmen d. Pensionsversicherung, laufende Preise	end	8
SCPE	Social security contributions - pension insurance, employees, at current prices	Beitragseinnahmen d. Pensionsversicherung, Unselbständige, laufende Preise	end	8
SCPS	Social security contributions - pension insurance, self-employed, at current prices	Beitragseinnahmen d. Pensionsversicherung, Selbständige, laufende Preise	end	8
SCU	Social security contributions - unemployment insurance, at current prices	Beitragseinnahmen, Arbeitslosenversicherung	end	8

Table A2 / continued:

SE	Social security expenditures and long term care payments, at current price	Sozialversicherungsausgaben u. Plegegeld, laufende Preise	end	8
SEA	Total social security expenditures, accident insurance, at current prices	Gesamte Ausgaben, Unfallversicherung	end	8
SEAO	Other social security expenditures, accident insurance, at current prices	Sonstige Ausgaben, Unfallversicherung	end	8
SEH	Total social security expenditures, health insurance, at current prices	Gesamte Ausgaben, Krankenversicherung	end	8
SEHO	Other expenditures - health insurance, at current prices	Sonstige Ausgaben d. Krankenversicherung	end	8
SEP	Total social security expenditures, pension insurance, at current prices	Gesamte Ausgaben, Pensionsversicherung	end	8
SEPO	Other expenditures - pension insurance, at current prices	Sonstige Ausgaben d. Pensionsversicherung	end	8
STR	Social security and long term care transfers, at current prices	Transferausgaben Sozial u. Arbeitslosenversicherung sowie Pflegegeld, laufende Preise	end	8
TRA	Transfer expenditures, accident insurance, at current prices	Leistungsausgaben d. Unfallversicherung	end	8
TRH	Transfer expenditures, health insurance, at current prices	Leistungsausgaben d. Krankenversicherung	end	8
TRP	Transfer expenditures, pension insurance, at current prices	Leistungsausgaben d. Pensionsversicherung	end	8
TRU	Transfer expenditures, unemployment insurance, at current prices	Leistungsausgaben d. Arbeitslosenversicherung	end	8
CA	Current account balance, at current prices	Saldo d. Leistungsbilanz, laufende Preise	end	9
CAXM	Balance in goods and services trade, at current prices	Saldo d. Waren- u. Dienstleistungsbilanz, laufende Preise	end	9
CAT	Balance in transfers, at current prices	Saldo d. Transferbilanz, laufende Preise	end	9
CAY	Balance in income, at current prices	Saldo d. Einkommensbilanz, laufende Preise	end	9
M	Goods and services imports, at constant 1995 prices	Güter und Dienstleistungsimporte, zu Preisen von 1995	end	9
P	Deflator, GDP	Deflator, Bruttoinlandsprodukt	end	9
PC	Deflator, private consumption	Deflator, privater Konsum	end	9
PGC	Deflator, government consumption	Deflator, öffentlicher Konsum	end	9
PI	Deflator, gross capital formation	Deflator, Bruttoinvestitionen	end	9
PX	Deflator, exports	Deflator, Exporte	end	9
SDIFFN	Changes in inventory, acquisition less disposition of valuables, and statistical discrepancy, at current prices	Vorratsveränderungen, Nettozugang an Wertsachen und Statistischer Differenz, laufende Preise	end	9
X	Goods and services exports, at constant 1995 prices	Güter und Dienstleistungsexporte, zu Preisen von 1995	end	9
YDEN	Disposable income, at current prices	Verfügbares Einkommen, laufende Preise	end	9
YNPN	Gross national product, at current prices	Brutto Nationalprodukt, laufende Preise	end	9

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