Empirica (2008) 35:255–266
DOI 10.1007/s10663-008-9062-7

ORIGINAL PAPER

# Extending working hours: why not work 42 h rather than 38?—a CGE analysis for Germany

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Published online: 15 March 2008


**Abstract** Faced with a record level of unemployment, the present debate in Germany is to extend the weekly hours of work. In this paper the employment effects of an economy-wide increase in weekly hours are quantified on the basis of a computable general equilibrium model for different specifications of the wage setting rule and the use of additional policy-induced public income. The simulation results back the argument of the opponents of longer working time that not more jobs will be created. However, when the higher tax revenues from GDP growth are used to reduce social security contributions, then the claim of the proponents that more jobs will be created can be supported.

**Keywords** Unemployment · Labour market rigidities · Longer working hours · Computable general equilibrium modelling

## 1 Introduction

Recently, the number of hours people work has become an issue in some European countries, especially in Germany, where unemployment remains stubbornly high. The long-term trend in the past had been one of reducing the working time. In Germany, it fell from 1,939 h per full time employee in 1970 to 1,641 h in 1991 and to 1,636 h in 2003 (Spitznagel and Wanger 2004). This decline in annual hours has

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stopped, however, or even been reversed in several OECD countries. In Germany, too, several economists and politicians argue that increasing the working time or canceling holidays is an appropriate measure to reduce labour costs and thus unemployment.

The open question is how more jobs can be created if people work more hours for the same pay.[1] Economic theory can not give an unambiguous answer on whether employment will increase. On the one hand, the extension of working hours without wage compensation will lead to lower labour costs per hour and consequently to an increase in firms' demand for man-hours. On the other hand, more hours are being supplied by those already employed. It can not be concluded, however, that the additional demand for hours exceeds the supply. The open question is what happens on the goods market. Unpaid over-time working raises productivity per worker (like technological progress). More goods can be produced with the same number of people at the same wage bill. For demand to increase, prices should fall. It will depend on domestic price elasticities of demand, of exports and imports whether consumers buy at least the additional output. Furthermore, the additional supply of products in itself creates demand because of input-output inter-industry transactions. If profits rise, firms will have an increased demand for other goods and services. In principle, demand from an extension of working hours should rise by the same amount as supply. But that is not enough because the advocates of this policy wish to reduce unemployment. More support is needed for the success of this policy like the increase in machine running times, the strengthening of the international competitiveness, and the attractiveness of Germany as a firm's location because of the higher productivity per worker.

Since many years a rough consensus amongst economists emerged that high unemployment in Europe is due to labour market rigidities. Saint-Paul (2004) discusses the potential obstacles to labour market flexibility and offers some perspectives to explain why some countries have reformed their labour markets and others have not. There has been a widespread popular belief that unemployment can be combated by reducing the number of hours worked per person. Starting in 1985, (West) German unions began to reduce standard hours on an industry-by-industry basis, in an attempt to raise employment. The literature was theoretically ambiguous whether this "work-sharing" will be successful.[2]

[1] See Sinn (2004) for some economic arguments in favour of a positive effect on employment. See also the Report of the Economic advisors (Sachverständigenrat 2003, pp. 374–375) for a detailed theoretical analysis of the short-run and medium-run effects of an increase in working time on employment.

[2] See also Calmfors (1985) and Franz (1984) on that debate. Hunt (1999) exploited the cross-industry variation in standard hours reductions to examine their impact on actual hours worked, wages, and employment. Her finding using individual data from the German Socio-Economic Panel was that "work-sharing" may have reduced employment in the period 1984–1994. Studies finding also falling employment or no effect include Brunello (1989), König and Pohlmeier (1989) and Lehment (1991). Hart (1987) and Hart and Wilson (1988) use cross-section variation in hours, and found no effect. Wage restraint is implied by the results of Lehment (1991), while the results of Franz and Smolny (1994) conclude that hourly wages increased as a result of hours reduction. Papers finding that employment rises when hours are cut include Hart and Sharot (1978), Faini and Schiantarelli (1985) and Franz and König (1986).

The current debate on extending the working time can not be seen in a laterally reversed sense because wage compensation for the longer work week is not considered. Yet, similarly to the debate of reducing hours per week, it is in general not clear how an increase in working time affects the wage per unit of time and employment because of the number of countervailing effects. Therefore, we quantify the employment effects of an economy-wide increase in weekly hours on the basis of a computable general equilibrium (CGE) model for Germany for different specifications of the wage setting rule and the use of additional policy-induced public income. The simulation results back the argument of the opponents of longer working time that not more jobs will be created. However, when the higher tax revenues from GDP growth are used to reduce social security contributions, then the claim of the proponents that more jobs will be created can be supported.

## 2 Microeconomic analysis of an extended weekly working time

In this section some basis economic effects of a longer working week are presented. Figure 1 illustrates the partial equilibrium labour market effects in case of an increase in labour hours without pay compensation (from 37.8 to 42 h a week). The wage-setting curve (WS) is a horizontal line, representing exogenously given real wage rigidities. For reasons of simplicity, there is no tax wedge between real producer and consumer wage. Under this assumption the increase in working time is equivalent of a cut in the wage rate by around 10%. In the initial equilibrium, labour in hours is $L_0 = 37.8 \cdot n_0$ where 37.8 is assumed to be the weekly hours worked (Wanger and Bach 2005) and $n_0$ is the number of employed persons. $U_0$ is unemployment, measured as $37.8(n_s - n_0)$, where $n_s$ is the number of people supplying work at $\bar{w}$ while voluntary leisure $VL_0$ is calculated as the difference between total time resources $TT$ and individual labour supply $L^S$ (i.e. labour supply in the absence of labour market institutions). $L^D$ is the aggregated labour demand curve and $L_0$ at $\bar{w}$ is $L_0(n_0, 37.8, \bar{w})$ and $L_1$ at $0.9 \cdot \bar{w}$ is $L_1(n_1, 42, 0.9 \cdot \bar{w})$. Three cases are possible for $n_1$, representing the number of employed persons under the wage $0.9 \cdot \bar{w}$ :

$$\text{If } L_1(n_1, 42, 0.9 \cdot \bar{w}) < 42 \cdot n_0, \quad \text{then} \quad n_1 < n_0. \tag{1}$$

Demand for labour in hours is less than the hours worked by the current number of workers at 42 h/week. Hence the number of unemployed persons will increase.

$$\text{If } L_1(n_1, 42, 0.9 \cdot \bar{w}) = 42 \cdot n_0, \quad \text{then} \quad n_1 = n_0. \tag{2}$$

The same number of people will be employed but now they work 42 h/week. Their wage income will be unchanged $(\bar{w} \cdot L_0 = 0.9 \cdot \bar{w} \cdot L_1$ because $\bar{w} \cdot 37.8 \cdot n_0 = 0.9 \cdot \bar{w} \cdot 42 \cdot n_0)$.

$$\text{If } L_1(n_1, 42, 0.9 \cdot \bar{w}) > 42 \cdot n_0, \quad \text{then} \quad n_1 > n_0. \tag{3}$$

In this case the number of employed persons will increase and total wage income will be higher than before $(\bar{w} \cdot 37.8 \cdot n_0 < n_1 \cdot 42 \cdot 0.9 \cdot \bar{w})$.

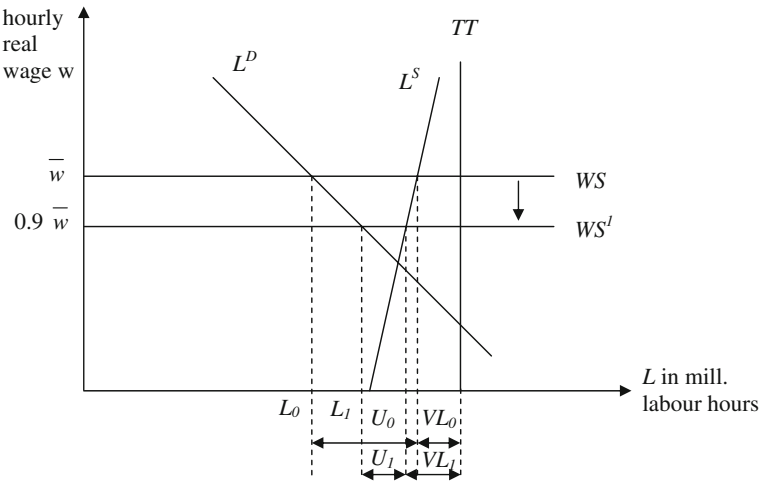


**Fig. 1** Labour market effects of working time extension with exogenous real wage rigidity

Until now, the analysis has been based on the assumption that the number of firms and output prices have not changed. However, since output will rise due to more hours worked, prices will decline, raising demand: The reduction of the producer wage lowers marginal cost, and the representative firm will produce more. On the labour market there will be a movement along the demand curve towards $L_1$ due to the textbook approach to cost-minimizing input combinations. In the new equilibrium, labour demand of the firm will increase due to the substitution effect. Since output has increased, even more labour will be employed. Due to reduced average costs, firms make profits at the present price level. New firms enter the market and the labour demand curve shifts to the right. Finally, since marginal costs have fallen, the supply function on the product market will also shift to the right which implies a drop in the price level. This price decrease, in turn, will raise the hourly real wage rate. Labour demand will finally be affected by the revised output decision of the firm as the price level dropped. It is obvious after this analysis that a CGE approach that concerns the interaction of consumers and producers in markets is necessary in order to find out the impact on the labour market under so many offsetting effects.

## 3 Quantitative effects of an extended weekly working time

In this section the quantitative labour market effects of an increase in labour hours without pay compensation in Germany are evaluated. To this end, we apply the single-country version of the computable general equilibrium model GEM-E3 for Germany with exogenously given real wage rigidities and involuntary unemployment in the initial equilibrium (see the GEM-E3 model description in the Appendix). In the literature, there are different theoretical microeconomic models to explain wage rigidities and involuntary unemployment. All models explain why the

actual consumer wage is marked up over the reservation wage or outside option of employees, but they differ in the variables that affect this mark up. In the context of the German labour market, the most important labour market institutions are trade unions, i.e. wages are the outcome of collective bargaining.[3] The simulations are based on a simplified ad hoc specification of a minimum wage model which can give insights into the labour market effects of an extension of working time and into the sensitivity of model results to wage formation. An increase in working time at unchanged pay provides the opportunity to cut the hourly wage even if real wages are rigid downwards.

The simulation results point out that an additional effect on labour demand and supply (apart from the effects discussed above) can occur if the tax wedge between producer and consumer wage is affected, for example, because a budget surplus is used to reduce the social security contribution rate of employees and employers. If the wage setting rule allows for real wage resistance, i.e. the real wage partially or fully resists the change in the rate of social security contributions, a reduction in the tax wedge will benefit not only employees but also employers leading to higher labour demand.

In the CGE model labour is homogeneous and mobile between sectors, but immobile between countries. In order to account for involuntary unemployment—in the base run the unemployment rate is 10% in 2005—a wage equation is introduced that fixes the real wage at a level above the equilibrium wage.[4] Individual labour supply depends on both the real consumer wage and non-wage income. As illustrated in Fig. 1, labour supply is computed as the difference between exogenous time resources and endogenous demand for voluntary leisure.[5]

All scenarios assume an economy-wide increase in the regular working time without pay compensation.[6] The scenarios, however, differ in the specification of the wage setting rule and the use of additional policy-induced public income.

[3] See Koschel (2001) for an application of a monopoly union model within a CGE framework for Germany.

[4] Concerning the unemployment benefit regime it is assumed that the benefit replacement ratio, i.e. the ratio of unemployment benefits to the net wage, is fixed and independent of a change in working hours per employee. Unemployment benefits are indexed to the nominal after-tax wage, while the benefit replacement ratio is fixed at a 50% level for Germany, i.e. nominal unemployment benefits which are paid within a period to the involuntarily unemployed people are calculated as a fixed share of the (equilibrium) nominal net wage of the same period. A replacement ratio of 50% is close to reality. Nickell and Layard (1999, p. 3045) estimate an average benefit replacement ratio of 63% over the period 1989–1994. Using a data sample of pooled cross sections and time series over 1978–1989 and eight EU countries, Brunello (1996) estimates a replacement ratio of 54% in Germany.

[5] Note that in the case of a non-zero labour supply elasticity (i.e. labour supply rises with the real net wage) an extension of working time without wage adjustment influences the labour-leisure choice of the representative household. In the GEM-E3 model the labour supply elasticity with respect to the net wage is around 0.1. Since the substitution effect exceeds the income effect, a fall in the hourly wage reduces the desired amount of individually supplied labour hours—in return, the demand of voluntary leisure rises (see Sect. 5). Concerning labour demand it is assumed that the total demand of labour hours is independent of the working time per employee, i.e. working hours and workers are perfect substitutes (see also EEAG 2005, p. 59).

[6] Note that the nominal wage income per employee remains constant (a lower nominal wage by 10% is compensated by an equivalent increase in hours worked). Since empirical evidence is weak, effects of a working time extension on the productivity of labour hour are ignored.

In order to test for the sensitivity of model results to wage formation two different wage setting (WS) rules are applied:

*WS rule I* assumes that the actual nominal gross wage per hour ($W_1^{\text{gross}}$), i.e. the hourly nominal net (after-tax) wage ($W^{\text{net}}$) plus labour income taxes ($t^{\text{dir}}$) and employees' social security contributions ($ss^C$), is exogenously fixed at the base year (0) level:[7]

$$W_1^{\text{gross}} = \alpha \cdot W_0^{\text{gross}} = \alpha \cdot \frac{W_0^{\text{net}}}{(1 - ss_0^C)(1 - t_0^{\text{dir}})}, \tag{4}$$

where $\alpha$ represents a "working-time factor" which is 1 in the reference run and 0.9 in the scenario run.

*WS rule II* assumes that the hourly real net (after-tax) wage is exogenously fixed at the base year level according to:

$$\frac{W_1^{\text{net}}}{PC_1} = \frac{W_1^{\text{gross}}}{PC_1} \cdot (1 - ss_1^C)(1 - t_1^{\text{dir}}) = \alpha \cdot \frac{W_0^{\text{net}}}{PC_0}$$

or, in terms of $W_1^{\text{gross}}$ :

$$W_1^{\text{gross}} = \alpha \cdot \frac{W_0^{\text{net}}}{PC_0} \frac{PC_1}{(1 - ss_1^C)(1 - t_1^{\text{dir}})} \tag{5}$$

where $PC$ represents the consumer price index. An exogenous increase in working time per employee without pay compensation leads to an equivalent fall in the hourly real net wage ($\alpha = 0.9$). In contrast to *WS rule I*, a cut in the social security contribution rate and a decrease in the consumer price index (resulting from output expansion due to working time expansion) lead to additional wage moderation. Obviously, *WS rule I* can be used to approximate short-term real wage rigidities, while *WS rule II* captures mid- or long-term effects.

Concerning the public budget specification, two cases are distinguished: a flexible public budget (representing rather short-term effects) and a budget restrain (i.e. fixed public deficit per gross domestic product with either the VAT rate or the rate of social security contributions as endogenous variable).[8] Table 1 depicts the simulation results for different scenarios of an increase in working hours.

*Scenario 1* applies the *WS rule I* and assumes that the public financial balance is kept variable, i.e. there are no feed backs of a reduction in the public financial balance per gross domestic product on the economy. Both assumptions are feasible particularly in the short term. The nominal consumer and producer wage rate decrease by exactly $-10\%$. Due to the fall in the consumer price index, employees take a loss in the real consumer wage by $-8.26\%$. The reduction in the nominal and

[7] Gross wage plus the employers' social security contributions then yield the producer wage, i.e. labour costs.

[8] In our model the public budget is determined by the tax revenue (including social security contributions) and public expenditure for transfer payments and subsidies (see Appendix). The decrease of the public budget deficit per GDP in *Scenario 1* can mainly be explained by the policy-induced decrease of involuntary unemployment (in hours) of the representative household. This together with a fixed benefit replacement ratio leads to a considerable reduction of public expenditure for unemployment benefits that outweighs the policy-induced tax deficits.

**Table 1** Macroeconomic effects of an increase in working hours in Germany in 2005 (numbers indicate percent changes from baseline)

| | 2005 | | | |
|---|---|---|---|---|
| | *Scenario 1* | *Scenario 2* | *Scenario 3a* | *Scenario 3b* |
| Gross domestic product | 2.46% | 2.58% | 3.16% | 4.34% |
| Employment (number of employed persons) | −4.40% | −3.68% | −2.47% | 1.05% |
| Employment (h) | 5.16% | 5.95% | 7.28% | 11.15% |
| Labour productivity (output/employed persons) | 6.96% | 6.16% | 5.38% | 2.71% |
| Labour productivity (output/labour hours) | −2.76% | −3.49% | −4.20% | −6.62% |
| Nominal producer wage/hour[a] | −10.00% | −10.00% | −12.24% | −17.76% |
| Nominal consumer wage/hour[b] | −10.00% | −10.00% | −6.49% | −10.81% |
| Real producer wage[c] | −6.34% | −7.91% | −9.48% | −14.40% |
| Real consumer wage[d] | −8.26% | −6.52% | −5.60% | −10.00% |
| Consumers' price index | −1.90% | −3.72% | −0.95% | −0.90% |
| GDP deflator in factor prices | −3.91% | −2.27% | −3.05% | −3.93% |
| Domestic production | 2.26% | 2.25% | 2.78% | 3.79% |
| Private investment | 0.81% | 1.32% | 1.32% | 1.71% |
| Private consumption | −1.52% | 0.80% | 0.66% | 0.58% |
| Real net disposable income | −1.61% | 0.85% | 0.69% | 0.61% |
| Domestic demand | 0.49% | 1.26% | 1.41% | 1.83% |
| Exports in volume | 6.85% | 4.77% | 6.25% | 8.07% |
| Imports in volume | 1.45% | 1.72% | 2.08% | 3.05% |
| Public deficit/gross domestic product[e] | 0.0125 | 0.0000 | 0.0000 | 0.0000 |

[a] $W^{\text{gross}}(1 + ss^{\text{P}})$, where $ss^{\text{P}}$ is the employers' share in social security contributions

[b] $W^{\text{net}} = W^{\text{gross}}(1-ss^{C})(1-t^{\text{dir}})$, where $ss^{C}$ is the employees' share in social security contributions, $t^{\text{dir}}$ is the income tax rate

[c] $W^{\text{gross}}(1 + ss^{P})/p^{\text{GDP}}$, where $p^{\text{GDP}}$ is the GDP deflator

[d] $W^{\text{net}}/PC$, where $PC$ is the consumer price index

[e] Absolute difference (in percentage points) from baseline

real producer wage, together with a positive effect on domestic production (2.26%), lead to a higher demand for labour hours by 5.16%. Output and substitution effects, however, are not strong enough to compensate for the negative effect of an increase in labour hours on the employment level in terms of employees: The number of employed persons drops by −4.40%. The overall drop in prices of consumption, production and labour leads to higher domestic demand (0.49%)[9] and (price elastic) export demand (6.85%). Imports increase as well (by 1.45%) since negative price effects are outweighed by positive output effects. Note that our model does not consider any feedback mechanism introduced by a balance-of-payments constraint,

[9] In spite of a significant loss in wage income the real net disposable income of the representative household is reduced by only −1.61%. This can be explained by an increase in real capital income by around 4%. Thus, private consumption falls only by moderate −1.52%. Savings of households—determined by the difference of disposable income and private consumption—are hardly affected.

e.g. established by the real long-term interest rate (see Appendix). Actually, the assumption of a flexible current account is compatible with the rather short- or medium-term perspective of our paper.[10]

The relatively higher increase in labour hours compared to domestic production is responsible for the decrease in labour productivity per hour by −2.76% while labour productivity per worker increases by 6.96%.

*Scenario 2* assumes that the ratio of public deficit to gross domestic product is fixed at the reference level. A budget surplus is used to reduce the VAT rate. This assumption is appropriate rather in the mid- or long term; nevertheless in *Scenario 2* it is combined with *WS rule I*. Since the consumer price index decreases by −3.72%—due to the drop in VAT, the price decrease is higher than in *Scenario 1*—employees take a loss in the real consumer wage by only −6.52%. Employment effects of an increase in labour hours are now slightly higher. Labour demand in hours increases by 5.95% while employment in persons falls by only −3.68%. The VAT rate reduction leads to a relatively higher fall in the consumer price index (by −3.72%) and a higher real consumer wage.

In *Scenario 3a* and *3b* the ratio of public deficit to gross domestic product is fixed as well. A policy-induced budget surplus is used to cut the rate of social security contributions of employers and employees equally. In *Scenario 3a* which applies *WS rule I* a cut in social security contributions leads to a relatively higher real consumer wage compared to *Scenario 3b* which is based on *WS rule II*. Here, the cut in the employers' and employees' social security contributions favours the employers in terms of lower labour costs. In *Scenario 3a* the real labour costs decrease by −9.48%. Labour demand in hours rises by 7.28% while employment in persons falls by −2.47%. In *Scenario 3b* the real producer wage is reduced by −14.40% while the real consumer wage is at a relatively low level (−10%) (a reduction of both the employees' social security contribution rate and of the price level will not raise the real consumer wage). The nominal consumer wage declines by more than 10% because of the decrease of the consumer price index by −0.9%. The wage decreases due to the extension of working time, the fall in the consumer price index and the employees' rate of social security contributions. This additional wage moderation allows for a rise of both employment in hours (11.15%) and persons (1.05%).

Obviously, longer working hours raise domestic demand and exports. In the model, the employment effects are sensitive to the way how a budget surplus is recycled and to the wage fixing rule. If the nominal wage can fall enough (since wage pressure is even further reduced like in *Scenario 3b*), real labour costs can decrease at a sufficient rate and the incentives for additional labour demand might be strong enough.

## 4 Conclusion

The simulation results have shown that an increase in working time without pay compensation will not solve the problem of high unemployment in Germany in the

[10] Koschel (2001) tested the sensitivity of GEM-E3 model results to assumptions on the flexibility of the current account. She found that the results of an ecological tax reform scenario do not differ in principle if the current account is constrained or is allowed to produce a surplus.

short run. They rather support the argument of the opponents of longer working time that not more jobs will be created. Only in the long run and under specific assumptions concerning wage formation and the use of higher tax revenues from economic growth, then more jobs might be created.

Many aspects of a transition to longer working time have been neglected in this paper. The assumption of exogenous real wage rigidities was used to approximate a model of collective bargaining which is standard in theoretical models. It was not taken into account that due to paid overtime the actual working time exceeds standard working time implying a lower income for those workers and lower labour costs for some firms if 42 h/week become standard working time.[11] But more important, the impact of working time on the utilization of the capital stock was not fully addressed. In our model, longer working time for employees will not increase the operating time of capital, but only the demand for capital services (for given capital stocks). This effect, however, can obviously make a positive employment effect more likely. Nevertheless, the results indicate that at least in the short-run employment effects are likely to be negative.[12]

**Acknowledgement** We are grateful for valuable comments of a referee made on an earlier version of this paper.

## Appendix: The GEM-E3 model

GEM-E3 is a multi-country computable general equilibrium model that was developed on behalf of the European Commission, Directorate-General for Research. A detailed presentation of the model structure and the empirical data basis is given in Capros et al. (1997) and Schmidt (1999). Each agent in GEM-E3 is a price-taker, in the sense that the market interactions, and not the agent, are setting the prices. Each agent is individually defining his supply or demand behaviour by optimising his own utility, profit or cost objectives.

A representative firm (at branch level) decides its supply of goods or services given its selling price and the prices of production factors. The firm supplies its output and selects a production technology so as to maximise its profit within the current year, given the fact that the firm cannot change the stock of productive capital within this period of time. The derived demands for inputs depend on the relative prices which are computed for all simultaneously interrelated markets by the model as a result of supply and demand interactions. In the single-country version for Germany 18 production sectors are included which are characterised by four-level nested CES production functions with labour, capital, and 18 intermediate inputs, including electricity, an input aggregate of three fossil fuel components (coal, oil, and gas), and an input aggregate of 14 nonenergy material components. Profit maximisation under constant returns to scale (in the long run) implies

[11] Overtime work which might rise in response to a fall in standard hours is an important aspect in many papers on standard hours reductions, see Stille and Zwiener (1987).

[12] See also Box 3.1 in the EEAG Report which lists some formulas for the short-run employment effects of longer working hours at unchanged pay per worker.

marginal revenues equal marginal costs, which explains the output price of domestic production in terms of a CES unit cost function. Labour is immobile across countries but mobile between sectors. The sectoral capital stock is quasi fixed for the current year at a level reached at the end of the previous year. Hence the demand function for capital is used to determine an endogenous ex post price of capital which clears the market for the fixed capital stock. It is used to calculate capital income, which is distributed among households (in form of interest payments from assets, dissemination of firms profits, entrepreneurs' salary), firms, and the government. Given the ex ante price of capital, which depends on the price of investment goods, the rate of return on risk-free government bonds, and the rate of replacement, the factor demand function for capital can be employed to determine the desired stock of capital. The difference between the desired capital stock and fixed capital stock defines net investment.

The behaviour of the representative household is assumed to perform a two-stage budgeting procedure: an intertemporal allocation of lifetime wealth endowment between present and future consumption of goods and leisure and an intratemporal allocation of total consumption of goods between durable and non-durable goods. The representative household determines an allocation of its resources between present and future consumption by maximising an intertemporal utility function subject to an intertemporal budget constraint. Under myopic expectations and the assumption of constant and equal growth rates for both inflation and the nominal wage rate the Fisher relation can be used to derive demand functions for consumption and leisure. Labour supply is given by the residual between total time resources and leisure demand.

In the standard version of the GEM-E3 model with a neo-classical labour market, the wage rate serves to balance labour demand of firms and leisure demand of households. The savings of households are determined by the difference of disposable income and consumption expenditures. In the version which is used in this paper, the real net wage rate is exogenously fixed which leads to involuntary unemployment in equilibrium. Labour demand at the fixed wage rate determines employment. Involuntary unemployment is calculated as the difference between exogenously given time resources minus voluntary leisure minus labour demand.

The model distinguishes between two types of consumption expenditure: expenditure for non-linked, non-durable goods, which are allocated on the second stage of the consumer decision problem, and expenditure associated with the use of durable goods—covering capital user costs and demand for linked non-durable goods.

The government's expenditure is exogenous in large parts while revenues are endogenous. Revenue categories are for example direct and indirect taxes, VAT, employers' and employees' social security contributions, export and production subsidies, or import duties.

The specification of Germany's import demand for tradable commodities is based on the Armington model of national product differentiation. Expenditure is allocated between domestic demand of domestically produced goods and imports from the rest of the world. Thus, import demand is price elastic. The Armington assumption for German import demand implies that the German price level is not

completely determined by (exogenous) world market prices. Domestically produced goods sold on the German market, however, are perfect substitutes for goods that are sold on foreign export markets. The rest of the world's production and consumption behaviour is exogenous. The rest of the world supplies exports at fixed world market prices. The foreign import demand function is modelled in complete analogy to Germany's import demand function (Armington). The Armington assumption for foreign import demand leads to a finitely price elastic import demand function of the rest of the world. Note that this specification allows for terms-of-trade effects: Higher prices of German exports can be partially shifted abroad (tax shifting effects towards the foreign sector). Both specifications modify the small-country assumption of exogenous world market prices.

In the model version used in this paper, asset markets and international capital flows are excluded, nominal exchange rates are fixed, and the balance-of-payments constraint for Germany is non-binding. Thus, a current account surplus or deficit has no feedback on the German economy. Since a flexible current account seems to be more reasonable in the short- or medium- than in the long-run, the simulations also reflect short- or medium-term results.

Since the demand system determines consumption goods by categories and the system of investment functions determines investment demand by destination, transition matrices are required to transform demand into deliveries from the industries. Therefore, the final demand is the result of the transition matrix of the type (branches categories) multiplied by the consumption categories. Similar to the matching of consumption categories to products, an investment matrix with fixed technical coefficients is used to calculate investment demand by origin (products) from investment demand by destination (branches).

The national accounting identity, which expresses that the private gross domestic production from both the flow of cost approach and the flow of product approach should be equal, is satisfied if and only if total saving, involving income distribution and fiscal policy relationships, equals total investment. Following Walras' Law, this market is in equilibrium if an equilibrium price vector is found for the other markets (supposing that the demand, supply and price functions are specified according to the needs of an Arrow-Debreu economy). Therefore, the saving-investment identity and the corresponding global shadow price of capital (mobility of (new) capital between sectors but not across countries is assumed) is automatically given.

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