ECONOMIC COUNCIL OF THE LABOUR MOVEMENT

FOUNDATION FOR EUROPEAN PROGRESSIVE STUDIES
FONDATION EUROPEENNE D'ÉTUDES PROGRESSISTES

HEIMDAL

Model Description and Properties

HEIMDAL - **H**istorically **E**stimated **I**nternational **M**odel of the **Da**nish **L**abour movement, is an international macroeconomic model

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The Economic Council of the Labour Movement was founded in 1936. ECLM is a Danish economic policy institute and think-thank. ECLM is aiming at a society where economic growth and wealth do not result in increased inequality and new social divisions. See more at www.eclm.dk

The international macroeconomic model HEIMDAL was developed in ECLM in the nineties. Today the Foundation for European Progressive Studies (FEPS) is a co-owner of the macroeconomic model HEIMDAL, and the model is developed and maintained in a joined cooperation between ECLM and FEPS, and it is used to illustrate the impact of policy changes in the European economy.

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1 Introduction

HEIMDAL[1] (**H**istorically **E**stimated **I**nternational **M**odel of the **Da**nish **L**abour movement) is an international model developed by The Economic Council of the Labour Movement (ECLM) in Copenhagen, Denmark. The HEIMDAL model focuses on the world economy from a European perspective, describes the European economies both on a country level as well on an aggregated EU level. Besides the European countries the two large countries the United States and Japan are modeled.

HEIMDAL describes the economy in 15 OECD countries, including 13 European economies: Germany, France, UK, Italy, Spain, Poland, Czech Republic, the Netherlands, Belgium, Finland, Norway, Sweden and Denmark. In addition, the model also accounts for the world trade on a country based level.

Each country is described by its own country model. The relations of each country model are estimated on annual data, which generally covers the period 1960-2010. The model structure and the estimated relations are based on the methods and theories traditionally used in the macroeconomic simulation models. The individual country models are based on a Keynesian theoretical background in the sense that production and employment are determined by aggregate demand in the short run. In the long run prices and wages will react to changes in unemployment and capacity utilization, e.g. a fall in unemployment will increase wages and prices which in turn affect competitiveness, lowering export and increasing import which lowers the aggregate demand. As inflation increases the interest rate will also increase which lowers investments, growth and employment. A major source of inspiration for the applied relations has been the international models QUEST III (EU-Commission), NiGEM (NIESR), GEM (IMF) and OECD's New Global Model (see Box 1 for further details on these models).

Data for estimation and simulation of HEIMDAL originates primarily from the OECD Outlook database which is published every six months along with OECD's economic forecasts. Since obtainment of international data - both in terms of historical data and forecasted data - is very resource intensive, it has generally been a guiding principle not to base HEIMDAL on data that does not exist in or can be derived from the OECD's Outlook database. The advantage of building HEIMDAL on the OECD Outlook database is that it ensures regular updates of consistent historical data. The data bank in HEIMDAL contains more than 6400 historical economic time series, most of them dating back to 1960.

Another advantage when using data from OECD Economic Outlook database is that HEIMDAL in the baseline model reproduces the OECD forecasts for the international economy. This is due to the model construction of HEIMDAL where the baseline model restores the OECD's prediction for the international economy. Hence, HEIMDAL produces the economic forecast of OECD as a starting point for ones economic forecasts or scenario analysis.

[1] Heimdal is also the name of a god in Nordic Mythology. With his sharp hearing and his horn *Gjalderhornet* he warns the other gods of danger.

Box 1. Overview of international macroeconomic models

QUEST III
Developed by DG ECFIN (Directorate-General for Economic and Financial Affairs) this global macroeconomic model is used for macroeconomic policy analysis and research. QUEST III is a New-Keynesian Dynamic Stochastic General Equilibrium (DSGE) model and have microeconomic foundations derived from utility and profit optimization. The QUEST III model has been estimated on euro area and US data.

NiGEM
Developed by NIESR (National Institute of Economic and Social Research), NiGEM is designed to correspond to macroeconomic policy needs. It has many of the same features as a DSGE model, but unlike a pure DSGE model, NiGEM is based on estimation using historical data.

GEM
The Global Economic Model (GEM) is a multi-country macroeconomic DSGE model developed by IMF (International Monetary Fund) and based on an explicit microeconomic framework. The microeconomic structure of GEM uses standard functional forms that allow firms and consumers to be aggregated as if they were a single entity.

OECD's New Global Model
Short-term Keynesian-type dynamics with a neo-classical supply-side in the long run are combined with country and regional models. All economies are assumed to have a constant returns-to-scale Cobb-Douglas production function, with the demand for labor and capital derived from the first-order conditions for profit maximization under imperfect competition.

2 General model structure

The individual country models are divided into the following submodels:

- Household sector
- Business sector
- Labor market
- Domestic prices
- Foreign sector
- Public sector
- Financial sector

In the **household sector**, private consumption and housing investment is determined. The major explanatory variables are disposable income and interest rate.

In the **business sector**, factor demand of the business sector, i.e. capital- and labor demand, and output price is determined. Important explanatory variables of the factor demand are the value added and relative factor prices, i.e. the interest rate and wages. Important explanatory variables of business sector output price in the long run are wages and capital cost whilst import prices and capacity utilization are important in the short run.

Wages and *labor supply* are determined in the **labor market**. *Wages* are determined taken into account the labor demand of the business sector. Consequently, the wage determination is influenced by a number of factors reflecting conditions for workers, business sector profits and the balance of power between workers and employers. Important explanatory variables for wage determination are thus unemployment, productivity, prices, wage ratio and foreign wages.

The *labor supply* is determined by the demographic trend and by the participation rate of the grown population. The participation rate is affected by the employment situation in the sense that an increase in employment also increases the participation rate. This means that an increase in employment does not reduce unemployment at the same rate because of the simultaneous increase in labor supply.

The **price model** determines the domestic prices of different demand components (private consumption, private investment etc.). Prices are determined by weighing the domestic output price (determined in the business sector) with import prices. The weights used here correspond to the import

share of the different demand components. Furthermore, indirect taxes are added to private consumption and housing investments in order to estimate prices at market value.

Import and export prices and quantities are determined in the **foreign sector**. The *import quantity* is determined by the development in domestic demand and the price ratio between domestic and foreign products. The *export quantity* is determined by the trading partner countries imports and the relative prices between the countries, measuring a cost competitiveness effect. Relative prices are determined by a country's export price (determined by the domestic price level) and by the exchange rate. Trade flows are combined using trade matrices with fixed weights measured in US dollars.

Also the *import and export prices* are determined in the foreign sector. For any given country import prices are determined by the exporting countries export prices which in turn are determined by wages and prices in these countries. Consequently, inflation is spread from one country to other countries by the prices in foreign trade. The exchange rates also enter the determination of import and export prices measured in US dollars (the common international currency).

Finally, the current account balance is determined in the foreign sector. Besides imports and exports the current account also includes net interest payments and other entries. The latter are treated as exogenous. Variation in the net interest payments is determined by the balance of the current account in previous period (= change in debt), the exchange rate and the foreign short interest rate.

The **public sector** is divided into an income side and an expenditure side. The income side is further divided into direct and indirect taxes and social security contributions. Each of these entries is determined by a tax rate and a measure of the tax base. Public investment and public spending is determined exogenous (politically) while income transfers are determined by the unemployment rate and the demographic trend. Finally, net interest payments are determined by the interest rate and total public debt.

Important variables in the **financial sector** are the short and long interest rates and the exchange rate. The short interest rate depends on a user defined monetary reaction function, whereas the long interest rate is a function of the short rate because it is assumed that the interest rate structure (relationship between short and long interest rates) is constant in the long term. The adjustment period can differ between countries. On an average, an increase in the short interest rate implies an increase of the long interest rate of half the size.

Thus, the economies are interlinked by a broad range of transmission mechanisms which includes:

- Quantities and prices in the foreign trade
- Interest rates and exchange rates
- Wages both directly through the wage relation and indirectly through prices

Some of these transmission mechanisms are functions of empirically determined relations (e.g. the foreign trade), whereas the interest rate and exchange rate transmissions are functions of both estimated relations and user defined reaction functions.

3 Household sector

Private consumption and housing investments are determined in HEIMDALS's household sector.

3.1 Private consumption

Economic theory tells us, that in the long run private consumption will be a constant share of the disposal income. In the short run however other factors such as the long run interest rate might also influence the private consumption.

To capture the idea that private consumption gradually converges towards some long run equilibrium where private consumption is a constant share of disposal income, private consumption is modeled in

an error correction model where an error correction mechanism ensures that in the long run, private consumption in fact will become a constant share of disposal income.

In the short run private consumption is determined as a function of household disposable income and the long interest rate. This measure of income, i.e. disposable income, varies between countries in the short run. This is largely due to differences in how private sector net interest income enters disposable income. Net interest income enters identically for all countries in the long run.

The empirical analysis determines which interest rate that enters the individual countries consumption relation. In many cases it turns out that the nominal interest rate is significant. This is due to the fact that changes in the nominal interest rate reflect changes in the real interest rate because the nominal interest rate is determined externally in small countries.

The empirical model is a single equation error-correction model and for each country the model is estimated in one step. Income, interest rate and other explanatory variables is a part of the model's short-run structure (i.e. they enter as differences), while the models long-run structure is determined by the lagged propensity to consume. Consequently, the long-run income elasticity is 1, whereas the long-run interest rate elasticity is 0. The structure of the empirical model is shown in (2.1).

$$\Delta \log(CPV) = f\left[\Delta \log(YDRH1), \Delta IRL, \Delta \log(Z), \log\left(\frac{CPV_{-1}}{YDRH_{-1}}\right), constant\right] \quad (2.1)$$

Where

CPV	Private consumption (in quantities).
YRDH1	Real disposable income of households with varying weights for private net interest income.
IRL	Long interest rate.
Z	Vector of other explanatory variables, e.g. real value of housing stock (only Denmark), housing investments, consumer price index and terms of trade.
YRDH	Real disposable income of households.

3.2 Housing investments

Housing investments are determined in a modified accelerator model, i.e. the level of housing investments is a function of changes in disposable income. Furthermore, the long interest rate in differences enters the model and because of rigidities in the housing investments, lagged housing investments have also been included. As it was the case with the determination of private consumption, different measures of income have been used and the empirical analysis has determined which of either the nominal or real interest rate to use. The structure is shown in (2.2).

$$\log(IHV) = f\left[\Delta \log(YRDH2), \Delta IRL, \log(IHV_{-1}), Z, constant\right] \quad (2.2)$$

Where

IHV	Housing investments (in quantities).
YRDH2	Real disposable income of households with varying weights for private net interest income (not necessarily equivalent to the income measure, *YRDH1*, in (2.1)).
IRL	Long interest rate.
Z	Vector of other explanatory variables, e.g. Tobin's q (only Denmark), employment in differences and the development of the work force.

The determination of housing investments in Denmark differs from other countries. In the case of Denmark there is a specific housing model where housing investments, cash price of housing and housing stock are determined (due to a larger amount of available data).

4 Business sector

The basis for modeling the business sector is a first degree Cobb-Douglas production function with labor and capital as input. Both the factor demand relations and the GNP price relation are consistent with this technology in the long-run which is why the error-correction mechanism in the empirical models is derivations of the Cobb-Douglas function.

4.1 Business investments

The fundamental GNP-Cobb-Douglas function with constant returns to scale in logarithmic form is given by (3.1).

$$\log(YFBV) = \log(A) + \alpha\log(EB) + (1-\alpha)\log(KBV) + \gamma \cdot trend \tag{3.1}$$

Where

YFBV	GNP in business sector (in quantities).
EB	Number of employed people in the business sector.
KBV	Capital in business sector.
A, α, γ	Constant parameters, where α and $(1-\alpha)$ is the wage ratio and profit ratio respectively, and γ is the annual growth in total factor productivity.

The firms cost function is the sum of wage expenses and capital expenses. Under the assumption of cost minimization with given input and output prices, the long-run capital demand relation can be derived using (3.1) and the cost function. The derived expression is displayed in (3.2):

$$\log(KBV) = \log(YFBV) - \alpha\log\left(\frac{UC}{WSSE}\right) + g[trend, constant] \tag{3.2}$$

Where

UC	User cost.
WSSE	Annual wage expense per person.
$g[trend, constant]$	Function of (3.1)'s parameters and trend.

The user cost term is of the form: $UC = PIB \cdot (IRL + \rho)$, where *PIB* is the investment price, *IRL* is the long interest rate and ρ is an estimated constant which is a function of the depreciation rate, inflation expectations and the tax rate.

The residuals from (3.2) are the error-correction terms of the net investment function. In the short-run, the change in capital stock is given by the change in GNP and the lagged capital stock. Lagged capital stock enters the relation because of investment decision rigidities, explaining the autoregressive structure in (3.3)

$$\Delta\log(KBV) = f[\Delta\log(KBV_{-1}), \Delta\log(YFBV), ECM_{-1}, constant] \tag{3.3}$$

Where

ECM	Error-correction mechanism equal to the residuals from (3.2).

Capital demand is thus estimated in a traditional single equation error-correction model. With the residuals from (3.2) inserted, (3.3) is estimated in one step.

4.2 Labor demand

In the short run the capital stock can be thought of as a fixed production factor because it takes time to build up the desired capital stock. Taking production (GNP) as given the necessary employment, EBN, to produce Y units of output can therefore be calculated by solving (3.1) for employment EB:

$$\log(EBN) = \frac{\log(YFBV) - (1-\alpha)\log(KBV)}{\alpha} + h(trend, constant) \tag{3.4}$$

For some given output level it can be shown that as the capital stock approaches the desired optimal cost minimizing capital stock, the necessary employment EBN will also approach the optimal cost minimizing employment level.

However in real life it takes time to hire the right kind of employees - the hiring process may take some time.

To capture this feature of the labor market the actual employment is assumed to approach the necessary level within a couple of years. For most countries the actual employment level reaches the necessary level within three years.

4.3 GNP price deflator

The long-run GNP price deflator is determined in accordance with the Cobb-Douglas technology in the GNP factor block. The price deflator of costs is homogenous of order one in the long-run and since the long run cost shares are constant in the Cobb-Douglas technology, the following long –run GNP deflator can be formulated in (3.5).

$$\log(PYFB) = \alpha\log(ULCB) + (1-\alpha)\log(UCCB) + constant \tag{3.5}$$

Where

PYFB	GNP price deflator in the business sector.
UCLB	Unit wage costs in the business sector.
UCCB	Unit capital cost in the business sector.
α	Constant parameter, determined in (3.1).

An increase of 1 percent in both unit wage costs and unit capital costs will result in a price increase of GNP of 1 percent. In several countries, especially the small countries, a trend is included in the long-run relation for the GNP price deflator (3.5). This (negative) trend can be explained by an increase in competition on the goods market because of globalization. This in turn has the effect of dampening the pressure on domestically determined prices.

5 Labor market

5.1 Wage formation

One of the key components in the model for the labor market is the wage rate. The wage rate is set in a so called "Right to manage" model where the business sector and workers engage in a collective bargaining process and agree on the wage rate. After having agreed on the wage rate the business sector decides on how many works to employ.

In the long run the wage rate is a function of the output price, the productivity and the unemployment level:

$$\log(WR) = \log(PYFB) + \log(EYFB) + \alpha \cdot UNR \tag{4.1}$$

Where

WR	Wage rate.
PYFB	Output price.
EYFB	Productivity index.
UNR	Unemployment rate.

The effect of a rise in the output price and the productivity of 1 percent will in the long run raise the wage rate with 1 percent. The elasticity with respect to output price and productivity is thus 1.

In the short run the wage is also influenced by changes in the output price and the productivity and in addition the so called wedge which measures the ratio between the consumer prices and the output prices. If the consumer prices increase relative to the output price workers will want to be compensated so wages will increase.

In the short run the wage rate might also be influenced by the development in foreign wages and by the change in the unemployment rate. The latter effect is due to the presence of persistence on the labor market. Workers might not only care about the unemployment level but also about the change in the unemployment. If that is the case persistence is present.

In the extreme case of persistence workers do not care about the unemployment level but only how the unemployment level changes. This extreme case is known as hysteria (*SFB: hysteresis?*) and has in fact been estimated for Norway, Germany and France in the model.

All these features are captured in an error correction model where the error correction term ensures that (4.1) is satisfied in the long run.

$$\Delta\log(WR) = f\begin{bmatrix}\Delta\log(PYFB), \Delta\log(EYFB), \Delta\log(PWEDGE),\\ \Delta UNR_{-1}, \Delta WU, ECM_{-1}, constant\end{bmatrix} \tag{4.2}$$

Where

PWEDGE	Ratio between consumer prices and the output price.
WU	Foreign wage infrx.
ECM	Error correction term given by (4.1)

5.2 Labor supply

The labor supply, LF, depends on the development in the population, POPT, the employment, ET, and other variables, Z, such as trends:

$$\Delta\left(\frac{LF}{POPT}\right) = f\left[\Delta\log(ET), Z, constant\right] \tag{4.3}$$

If the population increases with 1 percent so will labor supply. If employment is doing well it will have a positive effect on the labor supply as well. The effect varies among the countries.

So in the long run the labor supply is determined by demographics and in the short run labor supply depends on how well the economy is doing.

6 Domestic prices

The domestic consumer price net of indirect taxes, PCPN is determined as a weighted average of the output price, PYFB, and the price of imports, PMGS. The weight is the import share of private consumption.

$$PCPN = (1-\beta)\,PYFB + \beta \cdot PMGS \tag{5.1}$$

Indirect taxes are then added with full weight to the final consumer price.

Other price deflators for investments, public consumption and exports are modeled in a similar fashion.

7 Foreign sector

In the long run the import of goods and services is a function of the demand, WMV, and the relative prices, PYFB/PMGS. The demand WMV is calculated as a weighted sum of consumption, investments and export, where the weights are the share of imports in each component.

$$\log\left(\frac{MSGV}{WMV}\right) = f\left[\log\left(\frac{PYFB}{PMGS}\right), constant\right] \tag{6.1}$$

If domestic output prices increase relative to import prices, the import of services and goods will increase and vice versa.

The transition towards the long run is again modeled in an error correction model, where the error correction term is given by (6.1).

$$\Delta\log\left(\frac{MGSV}{WMV}\right) = f\left[\Delta\log(WMV), \Delta\log\left(\frac{PYFB}{PMGS}\right), ECM_{-1}\right] \tag{6.2}$$

Exports of goods and services are based on import of the rest of the world whereas the price of exports and imports are based on domestic prices and import prices of the rest of the world.

8 Financial sector

One of the key variables in the financial sector is the short term interest rate in the EURO area. The short term interest rate in the EURO area is determined by the inflation and growth. This way of modeling the short interest rate is a special case of the Taylor rule where the parameter for the lagged short term interest rate is restricted to zero and there is no additive constant:

$$EURIRS = 150\Delta\log(PCPN) + 50\Delta\log(GDPV) \tag{7.1}$$

where $\Delta\log(PCPN)$ is a measure for the inflation and $\Delta\log(GDPV)$ measures growth. The parameters are estimated parameters.

Ii is possible to make calculations with Heimdal where the interest rate is exogenous and does not respond to changes in inflation or growth.

Members of the EURO simply follow the short term interest rate of the EURO whereas a few countries like Sweden, Great Britain, Norway, Japan and the US have their own Taylor rule, which is identical to (7.1).

The long term interest rate, IRL, is affected by changes in the short term interest rate, IRS, and in the long rung there is a difference between the long and short term interest rate which is approximately constant:

$$\Delta \log\left(1+\frac{IRL}{100}\right) = \theta \Delta \log\left(1+\frac{IRS}{100}\right) + \mu\left[\Delta \log\left(1+\frac{IRL_{-1}}{100}\right) - \log\left(1+\frac{IRS_{-1}}{100}\right) + \rho\right] \quad (7.2)$$

The exchange rate for the EURO is a function of the ratio between short term interest rate in the Euro area and in the US. When the short term interest rate in the EURO area increases relative to the short term interest rate in the US, the EURO exchange rate increases.

Like with the interest rate it is possible to make calculations with Heimdal where the exchange rate is exogenous.

9 Simulation properties of HEIMDAL

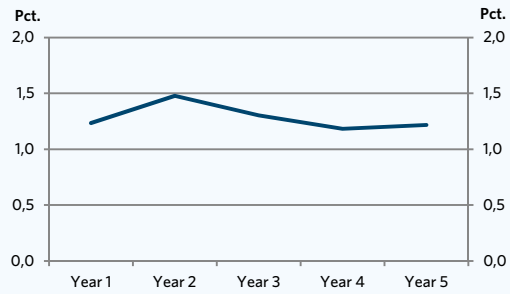
This section presents the results for different shocks made on the basis of the current version of the model. These simulations are not intended to provide a detailed analysis of specific policy issues, but rather to give a broader introduction to the model's general properties in different scenarios. In each scenario, a shock hits the economy and the multiplier effect on GDP and employment for selected European countries are reported. The shocks to be explored in the following consist of 1) increased government investment 2) a tax cut, 3) a positive interest rate shock and 4) a positive confidence shock. The choice of either a positive or negative shock in the before mentioned scenarios is essentially arbitrary and has no specific implications for model properties which are essentially symmetric.

9.1 Effects of increased government investment

In this scenario the effects of an increase in government investments are explained. The rise in fiscal stimuli is assumed to be a sustained increase in government investments equivalent to 1% of baseline GDP.

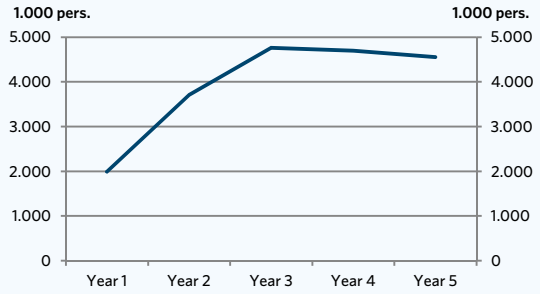
Figure 1A and 1B show the multiplier effects of government *investment*. The GDP multiplier is around 1,2-1,5 percent in all years and the employment multiplier reaches almost 4,8 million people in year 3 and subsequently falls a bit.

Figure 1A. Government investment multiplier, EU-27 GDP



Source: ECLM based on the international macroeconomic model HEIMDAL.

Figure 1B. Government investment multiplier, EU-27 employment



Source: ECLM based on the international macroeconomic model HEIMDAL.

The mechanisms governing the effects of increased government investment is described in the following.

Increased government demand, coming from increased investments, leads to a higher production which in turn increases labor demand. Consequently, unemployment falls.

Private consumption is also increased and in time private investments also increases.

But the increased demand increases imports and so the current account balance is worsened and the fall in unemployment leads to higher wages, thereby increasing product prices (inflation) which tends to worsen competitiveness. This in turn reduces exports and consequently production.

Also due to the increased inflation the interest rate goes up which again lowers private investments.

The effects of the increased government *investment* on GDP and employment, i.e. the multipliers, are shown in Table 1A and 1B for selected European countries.

Table 1A. Government investment multiplier, GDP (pct.)

	Year 1	Year 2	Year 3	Year 4	Year 5
EU-27	1,2	1,5	1,3	1,2	1,2
Germany	1,3	1,9	1,8	1,5	1,3
France	0,9	1,0	0,8	0,8	0,9
Italy	0,7	0,6	0,5	0,4	0,4
Spain	1,1	1,5	1,7	1,8	2,0
Poland	1,0	1,5	1,9	2,2	2,6
Belgium	1,3	1,4	1,3	1,2	1,2
Finland	1,3	1,7	1,7	1,5	1,4
Great Britain	1,1	1,3	1,1	1,1	1,2
Sweden	0,9	1,2	1,1	1,1	1,2
Denmark	1,5	1,6	1,3	1,2	1,2

Source: ECLM based on the international macroeconomic model HEIMDAL.

Table 1B. Government investment multiplier, employment (1.000 pers.)

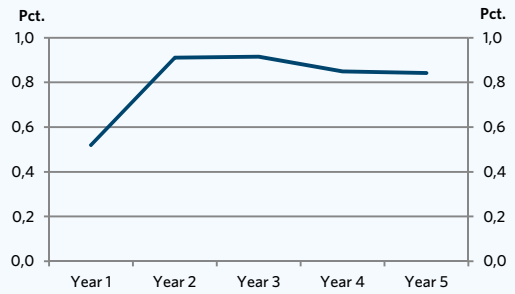
	Year 1	Year 2	Year 3	Year 4	Year 5
EU-27	1.987	3.712	4.761	4.695	4.556
Germany	463	893	1.151	1.149	1.048
France	212	332	425	437	459
Italy	108	230	354	390	397
Spain	197	308	408	460	495
Poland	83	233	300	355	412
Belgium	31	65	79	75	70
Finland	23	39	53	54	51
Great Britain	186	311	449	429	388
Sweden	22	48	65	64	62
Denmark	30	45	58	56	52

Source: ECLM based on the international macroeconomic model HEIMDAL.

9.2 Effects of a tax cut

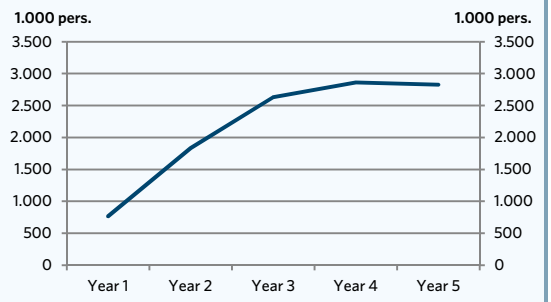
In this scenario the effects of a tax cut are explained. The tax cut is assumed to be a sustained decrease in the tax rate equivalent to 1% of baseline GDP. Figure 2A and 2B show the tax cut multipliers for EU-27. In Figure 2A the effect increases from around 0,5 pct. of GDP the first year to 0,9 pct. of GDP the second year. The multiplier effect subsequently falls a bit to a level a bit greater than 0,8 pct. of GDP. The tax cut multiplier in Figure 2B illustrates strong effects on employment. Employment increases 2.6 million after the first three years, after which employment stays relatively constant.

Figure 2A. Tax cut multiplier, EU-27 GDP



Source: ECLM based on the international macroeconomic model HEIMDAL.

Figure 2B. Tax cut multiplier, EU-27 employment



Source: ECLM based on the international macroeconomic model HEIMDAL.

The country specific model results reported in Table 2A and 2B below illustrate a tendency for the effects of the sustainable tax cut to be increasing the first 2-3 years, with the effect wearing off in the subsequent years. An intuitive explanation of this observation is outlined below.

A tax cut increases the disposable income of households which again increases private consumption. This again increases the demand for labor so unemployment is lowered.

But higher private consumption results in higher import, worsening the current account balance and lower unemployment increases wages and thereby product prices (inflation) which reduces competitiveness. This in turn reduces total exports and thereby production. The effects of the tax cut on GDP and employment, i.e. the multipliers, are shown for selected European countries in Table 2A and 2B.

Table 2A. Tax multiplier, GDP (pct.)

	Year 1	Year 2	Year 3	Year 4	Year 5
EU-27	0,5	0,9	0,9	0,8	0,8
Germany	0,5	1,0	1,1	1,0	0,9
France	0,3	0,6	0,6	0,6	0,6
Italy	0,3	0,4	0,4	0,3	0,3
Spain	0,6	1,1	1,3	1,4	1,5
Poland	0,4	0,8	1,0	1,3	1,5
Belgium	0,5	0,8	0,9	0,8	0,8
Finland	0,4	0,9	1,1	1,1	1,1
Great Britain	0,7	0,9	0,8	0,8	0,8
Sweden	0,3	0,6	0,7	0,7	0,7
Denmark	0,7	1,1	1,0	0,9	0,9

Source: ECLM based on the international macroeconomic model HEIMDAL.

Table 2B. Tax multiplier, employment (1.000 pers.)					
	Year 1	Year 2	Year 3	Year 4	Year 5
EU-27	767	1.836	2.632	2.860	2.828
Germany	147	393	580	654	640
France	55	139	192	218	228
Italy	38	99	162	197	208
Spain	115	210	288	336	364
Poland	30	102	160	201	237
Belgium	10	28	40	42	42
Finland	6	17	26	31	32
Great Britain	101	197	292	304	280
Sweden	6	19	30	34	35
Denmark	13	26	35	37	36

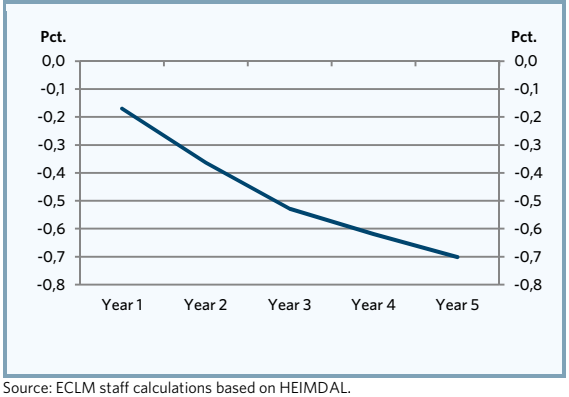
Source: ECLM based on the international macroeconomic model HEIMDAL.

9.3 Effects of an interest rate increase

This scenario illustrates the effects of an increase in the interest rate. The interest rate increase is assumed to be a sustained increase of 1 pct. in the ECB interest rate. Again, it should be emphasized that the choice of an increase as opposed to a decrease in the interest rate is essentially arbitrary and has no specific implications for model properties which are essentially symmetric.

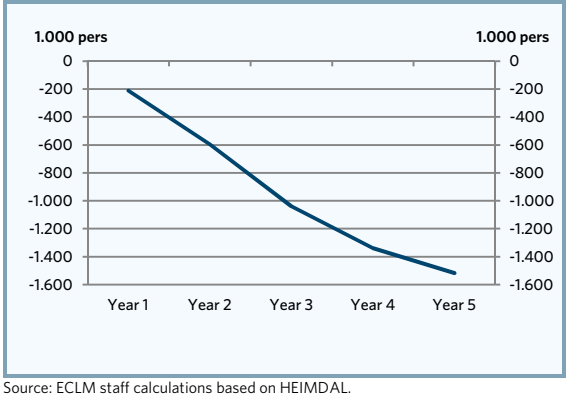
The interest rate multiplier on GDP and employment is shown for EU-27 in Figure 3A and 3B. Both GDP and employment drop persistently in all years; GDP drops with 0,7 pct. and employment drops with 1,5 million people.

Figure 3A. Interest rate multiplier, EU-27 GDP



Source: ECLM staff calculations based on HEIMDAL.

Figure 3B. Interest rate multiplier, EU-27 employment



Source: ECLM staff calculations based on HEIMDAL.

The mechanisms guiding the effects of an interest rate increase are described in the following.

An increase in the interest rate leads to a fall in private investments and thereby a decrease in production and an increase in unemployment.

Higher unemployment increases government expenses to welfare support. This income transfer reduces the initial fall in household disposable income (however, the fall in income is still dominant so private consumption still drops).

The effects of an interest rate increase on GDP and employment, i.e. the multipliers, are reported in Table 3A and 3B for selected European countries.

Table 3A. Interest rate multiplier, GDP (pct.)

	Year 1	Year 2	Year 3	Year 4	Year 5
EU-27	-0,2	-0,4	-0,5	-0,6	-0,7
Germany	-0,2	-0,5	-0,8	-1,0	-1,2
France	-0,1	-0,2	-0,3	-0,4	-0,4
Italy	-0,1	-0,2	-0,3	-0,3	-0,4
Spain	-0,2	-0,5	-0,8	-1,0	-1,2
Poland	-0,1	-0,1	-0,1	-0,1	-0,1
Belgium	-0,3	-0,4	-0,5	-0,6	-0,6
Finland	-0,2	-0,4	-0,6	-0,7	-0,8
Great Britain	-0,1	-0,2	-0,2	-0,2	-0,2
Sweden	0,0	-0,1	-0,2	-0,2	-0,2
Denmark	-0,4	-0,7	-0,9	-0,9	-1,0

Source: ECLM based on the international macroeconomic model HEIMDAL.

Table 3B. Interest rate multiplier, employment (1.000 pers.)

	Year 1	Year 2	Year 3	Year 4	Year 5
EU-27	-211	-595	-1.038	-1.338	-1.518
Germany	-23	-96	-203	-310	-403
France	-0	-13	-33	-48	-52
Italy	-8	-26	-53	-76	-92
Spain	-51	-109	-179	-230	-267
Poland	-8	-24	-34	-36	-32
Belgium	-6	-16	-25	-29	-32
Finland	-2	-6	-11	-14	-16
Great Britain	-18	-43	-75	-92	-100
Sweden	-2	-7	-14	-19	-22
Denmark	-7	-15	-24	-28	-29

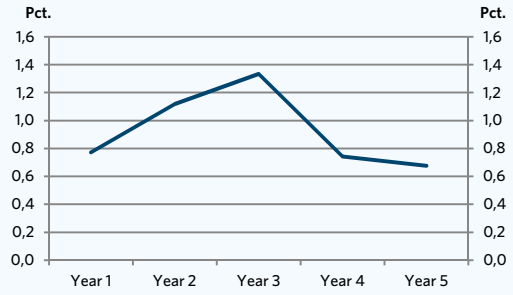
Source: ECLM based on the international macroeconomic model HEIMDAL.

9.4 Effects of increased confidence

The last scenario illustrates the effects of increased confidence in all European countries listed in Table 4A. The increased confidence is assumed to consist of increments of 1/3 pct. in private consumption, housing investments and capital stock in the first year. Another 1/3 pct. is added in the second year and third year respectively, resulting in a total increment of 2/3 pct. in year 2 and 1 pct. in year 3. For years 4 and 5 the increment of 1 pct. is sustained.

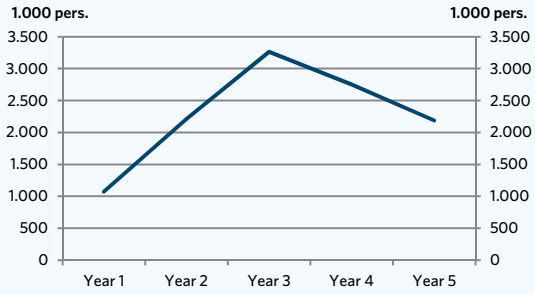
Figure 4A and 4B illustrates the multiplier effects of increased confidence on GDP and employment in EU-27. Large and increasing effects of almost 1.4 pct. of GDP can be seen in the first three years. The effect subsequently drops and ends at around 0.7 pct. of GDP. The same tendencies can also be observed for employment which increases with 3.3 million people during the first three years. In subsequent years employment falls to 2.2 million.

Figure 4A. Confidence multiplier, EU-27 GDP



Source: ECLM based on the international macroeconomic model HEIMDAL.

Figure 4B. Confidence multiplier, EU-27 employment



Source: ECLM based on the international macroeconomic model HEIMDAL.

The effects of increased confidence on GDP and employment are shown in Table 4A and 4B. Furthermore, the multipliers for EU-27 are depicted graphically in figure 4A and 4B.

Table 4A. Confidence multiplier, GDP (pct.)

	Year 1	Year 2	Year 3	Year 4	Year 5
EU-27	0,8	1,1	1,3	0,7	0,7
Germany	1,0	1,4	1,7	0,8	0,6
France	0,5	0,7	0,8	0,5	0,5
Italy	0,5	0,6	0,7	0,3	0,3
Spain	0,6	1,1	1,5	1,3	1,3
Poland	0,7	1,1	1,6	1,4	1,6
Belgium	0,4	0,8	1,1	1,1	1,0
Finland	0,7	1,1	1,4	1,0	0,8
Great Britain	0,6	1,0	1,2	0,8	0,8
Sweden	0,6	0,9	1,2	0,9	0,8
Denmark	0,7	0,9	1,1	0,7	0,7

Source: ECLM based on the international macroeconomic model HEIMDAL.

Table 4B. Confidence multiplier, employment (1.000 pers.)					
	Year 1	Year 2	Year 3	Year 4	Year 5
EU-27	1.075	2.211	3.262	2.751	2.183
Germany	283	576	847	713	540
France	94	164	228	184	167
Italy	54	122	201	197	168
Spain	108	199	308	287	289
Poland	47	138	199	219	206
Belgium	5	15	25	33	37
Finland	9	19	29	27	23
Great Britain	93	180	299	257	223
Sweden	13	30	46	42	34
Denmark	12	21	32	26	22

Source: ECLM based on the international macroeconomic model HEIMDAL.

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