WORKING PAPER

12-04

The macro-economic effects of labour market reforms in the European Union.

Some selected simulations with the NIME model.

E. Meyermans

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Abstract:

In this paper, we use the NIME model to asses the medium-term macro-economic effects for the European Union of a 1 percentage point cut in the social security contribution rate, and an increase in the labour participation rate. In the case of a cut in the social security contribution rate, we consider two alternative ways to finance the loss of tax revenues. First, we study the variant in which the tax cut is financed by an across the board cut in public outlays. Next, we examine the variant in which the tax cut is financed by an increase in the indirect tax rates.

The proposed policy measures raise unambiguously potential output. However, all kinds of rigidities prevent an immediate adjustment towards the new equilibrium, so that economic activity may be less buoyant in the medium-term. This paper describes these medium-term effects. The simulations show, for instance, that the initial effect of a cut in the social security contribution rate, financed by a cut in public expenditures, may be modest, and that it even decreases total employment during the first three years. However, once the measure starts to have its full impact, the tax cut reduces unemployment and increases output significantly.

In the appendix of this paper, we present some modifications to the NIME model, including a change to the specification of the natural rate of unemployment, and the introduction of a new country block for the EU accession countries.

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Executive Summary

In this paper, we use the NIME model to assess the medium-term macro-economic effects for the European Union (EU) of a one percentage point cut in the social security contribution rate, and a one percentage point increase in the labour participation rate. In the case of a cut in the social security contribution rate, we consider two variants. First, we consider the variant in which the tax cut is ex ante financed by an across the board cut in public outlays. Next, we consider the variant in which the tax cut is ex ante financed by an increase in the indirect tax rates. In the long run, such measures increase unambiguously employment and potential output, thereby raising the standard of living of the EU citizens and reinforcing the sustainability of the social protection system. However, all kinds of rigidities prevent an immediate adjustment towards the new equilibrium, so that economic activity may be less buoyant in the medium-term. This paper describes these medium-term effects.

The outline of the paper is as follows. In the second section of the paper, we present a brief overview of the NIME model, including a non-technical outline of the new equation for the natural rate of unemployment. In the third section, we examine the macro-economic effects of a 1 percentage point cut in the social security contribution rate in the European Union. There we consider two ways to finance the loss of tax revenues.

In the first variant of the third section, we examine the case in which the loss of tax revenues is ex ante financed by an across the board cut in public expenditures. The simulations learn, for instance, that in the long run a 1 percentage point cut in the social security contribution rate reduces the natural rate of unemployment by about 0.4 percentage points in the euro area, thereby unambiguously raising potential output. However, in the medium-term several forces are pulling in a different direction so that the medium-term outlook is less clear-cut. The simulations show that real GDP and the GDP deflator of the euro area are almost unaffected in the first year, indicating that the different forces cancel each other out in the first year. However, the interest rate cut, the expectation of higher future income, and the fall in the producer wage facilitate adjustment, and in subsequent years, real GDP starts to increase, reaching 0.29 percent above the baseline after five years and 0.39 percent after ten years, while the GDP deflator falls from 0.17 percent below the baseline after five years to 0.25 percent after ten years. At the same time, overall employment falls below the baseline during the first three years, mainly due to the loss of employment in the public sector. Afterwards, the growth in private sector employment is strong enough to compensate for the loss of public sector employment. Due to the working of the automatic fiscal stabilisers, the public deficit to GDP ratio and the debt to GDP ratio increase by about 0.3 percentage points in the first year. However, in subsequent years when the measures start to have their full effect, and output and employment increase, revenues increase and outlays decrease, so that as of the sixth year the deficit to

GDP ratio becomes smaller than in the baseline. The public debt to GDP ratio starts only to fall below the baseline as of the end of the simulation period, mainly due to the low growth in nominal GDP.

In the second variant of the third section, we consider the case in which the loss in tax revenues is ex ante financed by an increase in the indirect tax rate. As a result, the overall tax burden decreases less than in the previous variant, and the natural rate of unemployment falls only by 0.1 percentage points in the euro area, compared with 0.4 percentage points in the previous variant. The simulations learn, for instance, that total employment in the euro area increases by 0.02 percent in the first year and stays above the baseline afterwards. In the previous variant, total employment fell initially by 0.19 percent, reflecting the strong fall in public employment, and it took three years before total employment rose above the baseline. However, in this variant, total employment is only 0.12 percent above the baseline after ten years, compared with 0.40 percent in the previous variant, reflecting the smaller drop in the natural rate of unemployment. Real GDP of the euro area rises by 0.08 percent in the first year, compared with a 0.03 percent fall in the previous variant, and increases further to 0.12 percent above the baseline after 10 years, compared with 0.39 percent in the previous variant. In the previous variant, the initial fall in public demand triggered immediately a fall in GDP. However, the stronger decrease in the natural rate of unemployment, also allowed for a larger increase in GDP after ten years. Once again, the simulations illustrate the importance of the behaviour of the wages as a determinant in the adjustment process.

In the fourth section, we discuss the simulation results for the variant where the labour participation rate in the European Union is raised by 1 percentage point. This shock increases potential output and raises income. However, the additional supply of labour will not be absorbed immediately. The simulation results of the fourth section show that in the first year real GDP of the euro area increases by 0.50 percent, while the GDP deflator falls by 0.05 percent. This rise in GDP is possible because domestic demand is supported by the expectation of higher future labour income and by a fall in the interest rates, while at the same time external demand is stimulated by the depreciation of the effective exchange rate and the increase in the foreign effective demand. In subsequent years, real GDP increases further reaching 0.91 percent above the baseline after five years and 1.11 percent after ten years, while the GDP deflator falls to 0.37 percent below the baseline after ten years. Total employment increases gradually, and after five years more than half of the additional labour supply has been absorbed. The public deficit to GDP ratio increases initially, primarily because the additional outlays for the increased number of unemployed is higher than the additional revenues generated by higher economic activity. In later years, the public finances improve due to higher tax revenues, and the fall in the outlays for the unemployed and the other dependents, and the fall in interest payments.

Finally, in the appendix, we present some modifications to the NIME model, including a change to the specification of the natural rate of unemployment, and the introduction of a new country block for the EU accession countries. The new specification of the natural rate of unemployment is based on the idea that the unemployment rate disciplines the reservation wage aspirations of employees.

I Introduction and summary

During the European Council in Lisbon in March 2000 and subsequent Councils, European policy makers developed a comprehensive strategy to deal with the economic, social and environmental challenges of the European Union (EU)[1]. Such a strategy requires a broad mix of policies, including policies that increase potential output (growth) in a sustainable way, and policies that keep economic activity close to its potential. Meyermans (2002.a, 2002.b, and 2003) used the NIME model to study to what extent the working of the automatic fiscal stabilisers and monetary policy can contribute to the full realisation of potential output and price stability. In this paper, we focus on macro-economic policies that affect potential output. More specifically, we use the NIME model to assess the medium-term macro-economic effects of a fall in the natural rate of unemployment[2], engineered by a decrease in the social security contribution rate, and an increase in the labour participation rate. In the long run, such measures increase unambiguously potential output and the employment level, thereby raising the standard of living of the EU citizens and reinforcing the sustainability of the social protection system. However, all kinds of rigidities prevent an immediate adjustment towards the new equilibrium, so that economic activity may be less buoyant in the medium-term. This paper describes these medium-term effects. A clear understanding of these issues is useful for policy makers who want to refine the quality of their policy design, and for economists who want to assess the medium term outlook of the economy of the European Union.

The paper is structured as follows. In the second section, we give a brief outline of the NIME model[3]. The NIME model is a macro-econometric model which distinguishes 6 different economic areas: the euro area (EURO), the non-euro EU countries (NE), the candidate EU accession countries (EC), the United States (US), Japan (JP), and the rest of the world (RW). In each block, except for the EC and RW block, there is a household sector, an enterprise sector, a monetary sector, and a fiscal sector, and for each of these sectors a set of behavioural equations is estimated applying econometric techniques to the aggregated data of the different blocks. The EC and RW block consist only of a limited set of equations.

In the third section, we examine the macro-economic effects of a one percent cut in the social security contribution rate in the European Union, and we consider two alternative variants that compensate the loss in tax revenues. First, we consider the variant in which the tax cut is ex ante financed by an across the board cut in public outlays. Next, we consider the variant that the tax cut is financed by

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1. See http://europa.eu.int/comm/lisbon_strategy/reports/index_en.html for a comprehensive overview of the Lisbon Strategy.
2. See Cross (1995) and Journal of Economic Perspectives (1997) for a thorough discussion of the natural rate of unemployment hypothesis.
3. More technical details regarding the model can be found in Meyermans and Van Brusselen (2000.a, 2000.b, and 2001) and Meyermans (2003).

an increase in the indirect tax rates. In the first variant, the simulations learn, for instance, that in the long run a 1 percentage point cut in the social security contribution rate of the euro area reduces the natural rate of unemployment by about 0.4 percentage points, thereby unambiguously raising potential output. However, several forces are at work which make the medium-term outlook less clear-cut. First, the reduction in the social security contribution rate increases total demand through its impact on the real take home wage and the employment level. Second, the cut in public outlays reduces total demand and public sector employment. Third, the reduction in the social security contribution rate increases potential output via its impact on the natural rate of unemployment. Fourth, the monetary authorities reduce the short-term interest rate in order to temper the deviation of output from potential output, and of inflation from its target. Fifth, the producer real wage falls in order to accommodate the reallocation of employment from the public sector to the private sector, and to absorb the additional labour inflow, which is caused by the fall in the natural rate of unemployment. Sixth, households discount the long run gains in employment and the after tax take home wages to the present, and they adjust their spending plans accordingly. The simulation results show that real GDP and the GDP deflator of the euro area are almost unaffected in the first year, indicating that the different forces cancel each other out. In subsequent years, real GDP starts to increase, reaching 0.29 percent above the baseline after five years and 0.39 percent above the baseline after ten years, while the GDP deflator falls gradually from 0.17 percent below the baseline after five years to 0.25 percent below the baseline after ten years. The short-term interest rate is immediately cut by 37 basis points and kept below the baseline in subsequent years, reflecting that initially potential output increases by more than total demand. Ex ante[1], the cut in public expenditures is enough to compensate the decrease in fiscal revenues caused by the 1 percent cut in the social security contribution rate. However, since the automatic fiscal stabilisers are free to operate, the fall in expenditures will be smaller ex post than ex ante calculated. As a consequence, the public deficit to GDP ratio and the debt to GDP ratio increase by about 0.3 percentage points in the first year. However, in subsequent years when the measures start to have their full effect, and output and employment increase, revenues increase and outlays decrease, and the deficit to GDP ratio is smaller than the baseline as of the sixth year. The public debt to GDP ratio starts only to fall below the baseline as of the end of the simulation period, mainly due to the low growth in nominal GDP.

In the second variant of the third section, we consider the case in which the loss in tax revenues is ex ante financed by an increase in the indirect tax rates. In this variant, the increase in indirect taxes tempers the fall in the natural rate of unemployment. Indeed, in equilibrium, the producer real wage, defined as the nominal wage rate deflated by the producer price[2], is equal to a weighted average of trend productivity and the reservation wage of the employees. Assuming that trend productivity and the reservation wage do not change, a rise in the indirect tax rate has to be compensated by a fall in the nominal wage rate (or an increase in the general price level[3]) in order to maintain equilibrium. However, the fall in the nominal wage rate (or the increase in the price level) reduces also the take home wage of the employees, so that the employees become less willing to accept employment and unemployment rises. The simulations show, for instance, that the

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1. I.e., without taking into account, for instance, the supply side effects of the tax cut.
2. The producer price is equal to the market price minus indirect taxes.
3. It depends on monetary policy what will happen: a rise in the general price level or a fall in the wage rate.

natural rate of unemployment falls only by 0.1 percentage points, compared with 0.4 percentage points in the previous variant. However, total employment in the euro area increases by 0.02 percent in the first year, compared with a fall of 0.19 percent in the previous variant. In the previous variant, the initial fall in total employment was caused by the strong fall in public employment, and it took three years before total employment rose above the baseline. After ten years, total employment is now only 0.12 percent above the baseline, compared with 0.40 percent in the previous variant, reflecting the smaller fall in the natural rate of unemployment. Real GDP of the euro area rises by 0.08 percent in the first year, compared with a 0.03 percent fall in the previous variant, and increases further to 0.12 percent above the baseline after 10 years, compared with 0.39 percent in the previous variant. In the previous variant, the fall in public demand triggered an immediate fall in GDP. However, the stronger decrease in the natural rate of unemployment, also allowed for a larger increase in GDP in the long run.

In the fourth section, we discuss the simulation results for the case where the labour participation rate in the European union is raised by 1 percentage point. In practice, this target is to be reached primarily through a higher participation rate by female and older employees. However, the modelling of the micro-economic policies which support such an outcome is beyond the scope of the current version of the NIME model. In this paper, we simply postulate that the participation rate increases, and we investigate its implications for the main macro-economic variables of the euro area. The shock increases potential output and raises income. However, the additional supply of labour will not be absorbed immediately, and the number of unemployed will increase on impact. Here, similar mechanisms as discussed in the third section will induce the necessary adjustment. The simulation results of the fourth section show that in the first year real GDP of the euro area increases by 0.50 percent, while the GDP deflator falls by 0.05 percent. This rise in GDP is possible because domestic demand is supported by the expectation of higher future labour income and the cut in the interest rates, while at the same time external demand is stimulated by the depreciation of the effective exchange rate and the increase in the foreign effective demand[1]. In subsequent years, real GDP increases further reaching 0.91 percent above the baseline after five years and 1.11 percent after ten years, while the GDP deflator falls to 0.37 percent below the baseline. The public deficit to GDP ratio increases initially, primarily because the additional outlays for the increased number of unemployed is higher than the additional revenues caused by higher economic activity. In later years, the public finances improve due to higher economic activity which raises tax revenues, and the decline in the outlays for the unemployed and the other dependents, and the fall in interest payments.

In Appendix A, we propose a new specification for the natural rate of unemployment. In the previous version of the NIME model, as described in Meyermans and Van Brusselen (2000), the natural rate of unemployment was exogenous and estimated applying a Hodrick-Prescott filter to the unemployment rate series. This approach is not entirely satisfying since it does not allow for a careful analysis of shocks that affect the natural rate of unemployment. In Appendix A, we specify an equation for the natural rate of unemployment based on the idea that the unemployment rate disciplines the reservation wage aspirations of employees. There, we find, for instance, that a 1 percentage point cut in the tax wedge reduces the natural rate of unemployment by about 0.4 percentage points in the euro area,

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1. Remember that in the NE block a similar shock occurs.

compared with about 0.2 percent in the non-euro EU countries, and 0.5 percent in the United States. In Appendix A, we also re-specify the labour supply equation and the equation describing public transfers to the household sector. In the new equation, the labour supply responds also to a temporary deviation of the contemporaneous wage from the equilibrium wage, reflecting that in the NIME model the income effect and the substitution effect of a permanent wage increase (decrease) cancel each other out, but that a temporary wage increase (decrease) induces people to work more (less). However, it should be noted that the estimated responses are rather small. The equation describing public transfers to the household sector is also altered by giving it a more detailed breakdown with respect to the different recipients. However, it should be noted that the scope of this exercise is to a large extent limited by the availability of data (in the NIME database). Finally, we discuss the addition of a new country block for the EU candidate accession countries, i.e. the EC block. Here, we follow a pragmatic modelling strategy as the degrees of freedom and quality of the data are rather limited.

Before we proceed with a discussion of the results, we want to make the following remarks. First, in the following sections we focus mainly on the macro-economic effects for the euro area, because this is the main trading partner of Belgium. Second, we want to emphasise that the simulation results presented in this paper are of an illustrative and technical nature, and they should not be considered as predictions. Third, interpreting the simulation results of this paper, it should be remembered that the NIME model is a Keynesian model with classical long run properties. However, in the medium run, the model has typical Keynesian features, whereby prices adjust sluggishly, supply is determined by demand, and expectations have some backward looking features. Fourth, it should also be remembered that, in contrast to the Belgian Federal Planning Bureau's models that describe the Belgian economy in great detail, the NIME model is a highly aggregated model of the world economy whereby, for instance, in the fiscal sector of the country blocks only a highly aggregated set of (implicit) direct and indirect tax rates and public expenditure items is considered.

II The NIME model

The NIME model is a macro-econometric world model developed at the Belgian Federal Planning Bureau. This model is built to make medium-term forecasts of the international economy and to study the transmission of the effects of economic policies and exogenous shocks on the Belgian international economic environment. This section gives a very brief overview of this model. More technical details regarding the model can be found in Meyermans and Van Brusselen (2000.a, 2000.b, and 2001), Meyermans (2003), and the appendix of this paper.

The current version of the NIME model divides the world into the following country blocks: the euro area (EURO), a block consisting of the countries of the European Union that did not adopt the euro (NE), the EU accession countries (EC)[1], the United States (US), Japan (JP) and the rest of the world (RW). These country blocks are linked to each other through trade and financial flows. In each of these country blocks, except for the RW and EC block, we distinguish a household sector, an enterprise sector, a public sector, and a monetary sector. A similar set of behavioural equations and accounting identities is specified for each sector across blocks, while the parameter values of the equations are obtained using econometric techniques applied to the aggregated data of the different blocks[2].

The NIME model makes an analytical distinction between three different time horizons: the short run that is demand driven and during which the plans of the agents are not fully realised due to the existence of adjustment costs, the medium run during which the plans are realised but still changing due to lagging adjustment of the other endogenous variables, and a steady state long run. In the steady state, productivity, inflation, the real interest rate, the labour participation rate, and population growth are exogenous, while the steady state values of the other variables, such as potential output, are determined by these exogenous variables and the structural equations of the model.

The expectations of the agents are partly forward-looking, and partly backward-looking. The forward-looking expectations are quasi-rational in the sense that agents have model consistent expectations about the steady state but the speed of convergence towards this steady state is determined by a reduced form function rather than by the underlying structural parameters of the model.

The version of the NIME model used in this paper is a modified version of the model described in Meyermans and Van Brusselen (2001) and Meyermans (2003). The modifications are described in Appendix A, and they include a new specifi-

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1. The EC block includes Bulgaria, Cyprus, the Czech republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Romania, Slovakia, and Slovenia.
2. The RW block consists of a limited number of equations describing overall economic activity in the rest of the world.

cation for the natural rate of unemployment, the labour supply, the transfers to the household sector by the public sector, and the new EC block.

Before we proceed with a discussion of the results, we will have a brief look at each of the sectors of the NIME model, i.e., the household sector, the enterprise sector, the fiscal sector, and the monetary sector. We also discuss briefly the new specification of the natural rate of unemployment, more technical details can be found in Appendix A of this paper.

1. The household sector

The household sector allocates its total available means over goods and services, real money balances, residential buildings, and other assets as a function of the nominal interest rate, the real interest rate, the user cost of residential buildings, and a scale variable. The scale variable consists of inherited assets, plus current income from assets, plus current and expected future take home labour income, plus transfers. Error correction mechanisms and partial adjustment schemes are used to capture sluggish adjustment in the expenditure plans of the household sector. Moreover, in the short run, the household sector is liquidity constrained so that a fraction of its expenditures must be financed by disposable income.

The interest rate affects household demand through several channels. First, an interest rate hike increases the asset income of the household sector in the next period. Second, an increase in the interest rate decreases the financial wealth of the household sector and it lowers the present value of expected future income. Third, an increase in the nominal interest rate raises the opportunity cost of money, thereby lowering the demand for money. The impact of changes in the opportunity cost of money on the demand for the other goods and services is less clear a priori, and it is an empirical issue to determine the sign of this cross-elasticity. Fourth, an increase in the real interest rate reduces contemporaneous consumption and induces the household sector to increase savings by holding more interest-bearing assets. Finally, an increase in the nominal interest rate increases the user cost of residential buildings, thereby decreasing the demand for residential buildings.

2. The enterprise sector

The enterprise sector maximizes its profits by hiring production factors and selling its products to the final users. There are three production factors, i.e., labour, capital and intermediary imports. Error correction mechanisms and partial adjustment schemes are used to model short run demand for the production factors. In these demand schemes, the long run factor demand equations are derived from a Cobb-Douglas production function with constant returns to scale.

The natural rate of unemployment is determined by the fact that employees' willingness to accept a job is function of the gap between the after tax take home wage and their reservation wage. The reservation wage is determined by the unemployment benefit, the income earned in the informal sector of the economy, and by the non-labour income.

In the long run, the real wage rate is a weighted average of labour productivity and the reservation wage, whereby the weights are determined by the relative bargaining power of the household sector. In the medium run, changes in the wage rate are also affected by changes in the tax wedge and the deviation of the contemporaneous unemployment rate from the natural unemployment rate, and by the deviation of the lagged wage rate from the equilibrium wage rate. In the long run, labour supply is determined outside the model[1], however, in the medium run, labour supply is affected by the deviation of the lagged unemployment rate from the natural rate of unemployment, and by the deviation of the contemporaneous wage rate from the equilibrium wage rate, reflecting that in the NIME model the income effect and the substitution effect of a permanent wage increase (decrease) cancel each other out, but that a temporary increase (decrease) induces people to work temporarily more (less).

In the long run, the level of gross fixed capital formation is determined by the rate of depreciation, the capital stock, and the change in the equilibrium capital stock, while its growth rate is determined by population growth[2]. In the medium run, gross fixed capital formation by the enterprise sector is determined by a partial adjustment scheme whereby gross fixed capital formation responds to changes (and changes in the change) in the supply for final demand and the user cost of capital. The user cost of capital is determined by the interest rate, the rate of depreciation, the price of capital, the expected price change and a risk premium.

Imports and exports are determined by a scale variable and relative prices. The scale variable for imports is domestic total supply for final demand, while the scale variable for exports is the foreign effective total supply for final demand (short "foreign effective output"). Here it may be useful to remind that in the long run, prices of inputs and outputs clear the markets, but they adjust only sluggishly to their equilibrium value. As a consequence, it is quantities that adjust in order to meet demand in the short run. Here, it may be worthwhile to recall price setting for international trade in the NIME model. Country blocks are engaged in multilateral trade, whereby importers are price setters and exporters are price takers. Imports are used as intermediary inputs in the production of total supply for final demand. As such, their price is determined by their productivity, and in equilibrium importers are not prepared to pay in excess of their productivity. The flip side of this is that exporters have to set their export price with a view on the willingness of importers to pay for their imports. Hence, exporters are price takers. However, it should also be noted that these are equilibrium conditions to which the economy converges in the long run. In the medium run, all kind of rigidities prevent exporters and importers to set their prices immediately equal to their equilibrium level.

3. The fiscal sector

Public sector receipts are determined by endogenous tax bases and predetermined tax rates, while the public expenditures are to a large extent determined by the business cycle and trend growth. In the NIME model, the automatic fiscal stabilisers operate on the expenditure side mainly through the unemployment

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1. Trend labour supply is determined by a Hodrick Prescott filter.
2. Provided there are no differences in trend productivity growth of labour and capital, or changes in the rate of depreciation.

benefits and interest payments on public debt, and on the revenue side mainly through direct labour income taxes, profit taxes, social security contributions, and indirect taxes[1].

4. The monetary sector

The long-term interest rate is determined by the term structure of interest rates. In the version used for this paper, the short-term interest rate is set according to a Taylor rule, i.e., the short term interest rate deviates from the steady state interest rate to the extent that inflation and output deviate from their target value[2]. The effective exchange rate is determined by a weighted average of the equilibrium nominal exchange rate and the lagged exchange rate, by the interest rate differential, and by the expected inflation differential. The equilibrium exchange rate clears the current account in the long run and it is equal to the relative price level multiplied by the real exchange rate. The equilibrium real exchange rate is determined by the relative indirect tax rates and the relative level of economic activity, corrected for a term related to the ratio of net factor income and net current transfers to the rest of the world. If the domestic price level increases, ceteris paribus, then the equilibrium nominal exchange rate will depreciate. Moreover, if domestic output increases, ceteris paribus, then the equilibrium real exchange rate will also depreciate. The latter effect is due to the fact that if domestic output increases, then the import volume will also increase. Hence, to maintain equilibrium in the current account, the exchange rate has to depreciate[3].

5. Selected modifications to the NIME model: the natural rate of unemployment

An important new feature of the NIME model is the specification of the natural rate of unemployment. In Meyermans and Van Brusselen (2001), the natural rate of unemployment is calculated by applying a Hodrick-Prescott filter to the unemployment rate series and it is kept constant troughout the simulation of a shock. This approach is not entirely satisfying since it does not allow for a careful analysis of shocks that affect the natural rate of unemployment. In Appendix A, the natural rate of unemployment is made endogenous. In this section, we give a brief summary of the results derived in Appendix A.

Meyermans and Van Brusselen (2001) derive that the equilibrium wage is a function of the reservation wage and labour productivity, and they assume that the reservation wage is proportional to the take home wage, whereby the proportion is exogenously determined. Here, we modify this assumption by postulating that the proportionality between the reservation wage and the take home wage varies with the unemployment rate. Indeed, when the unemployment rate increases, the public outlays for unemployment benefits also increase, so that in order to limit its outlays, the public sector will have an incentive to reduce the unemployment benefit. Moreover, here we also assume that the reservation wage is also deter-

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1. See Meyermans (2002.a) for more details on fiscal policies in the NIME model.
2. See Meyermans (2002.b) for more details on monetary policies in the NIME model.
3. It should be noted that this is a partial equilibrium. This depreciation may be offset by the appreciation which is induced by an increase in the short-term interest rate. See Meyermans and Van Brusselen (2001) for more details.

mined by the options which the unemployed have in the informal economy and by their non-labour income, whereby the latter is determined by the real interest rate.

Based on these new assumptions regarding the reservation wage, we derive in Appendix A an equation which determines the natural rate of unemployment as a function of the direct and indirect taxes, the real interest rate and the market power of the enterprises in the goods market. Indeed, when the tax rates are lowered the gap between the reservation wage and the take home wage increases, and the employees become more willing to accept a job offer so that the natural rate of unemployment falls. When the real interest rate increases the non-labour income of the unemployed increases and the unemployed will be more reluctant to accept a job offer so that the natural rate of unemployment increases. When the enterprises' market power in the goods market increases, the output level decreases and the demand for labour falls so that the natural rate of unemployment increases. We estimate the cointegrating vector between the unemployment rate, the tax rates, the real interest rate and the market power[1], and we use these results to calculate the natural rate of unemployment of the different areas for the period ranging from 1970 until 2001.

The estimates of the natural rate of unemployment are shown in figures 1 to 4. In the euro area, the natural rate of unemployment rose until the early nineties, and fell only gradually thereafter. In the non-euro EU country block and the US, the natural rate of unemployment rose from the early seventies until the mid-eighties when it started to fall. In Japan, there has been a gradual increase in the natural rate of unemployment as of the seventies. In recent years, the unemployment rate of the euro area has been close to its natural level, while it has been below its natural rate in the non-euro EU countries and the US - with the exception of 2001 in the US. In Japan the unemployment rate has been above the natural rate of unemployment in recent years.

FIGURE 1 - The unemployment rate in the euro area

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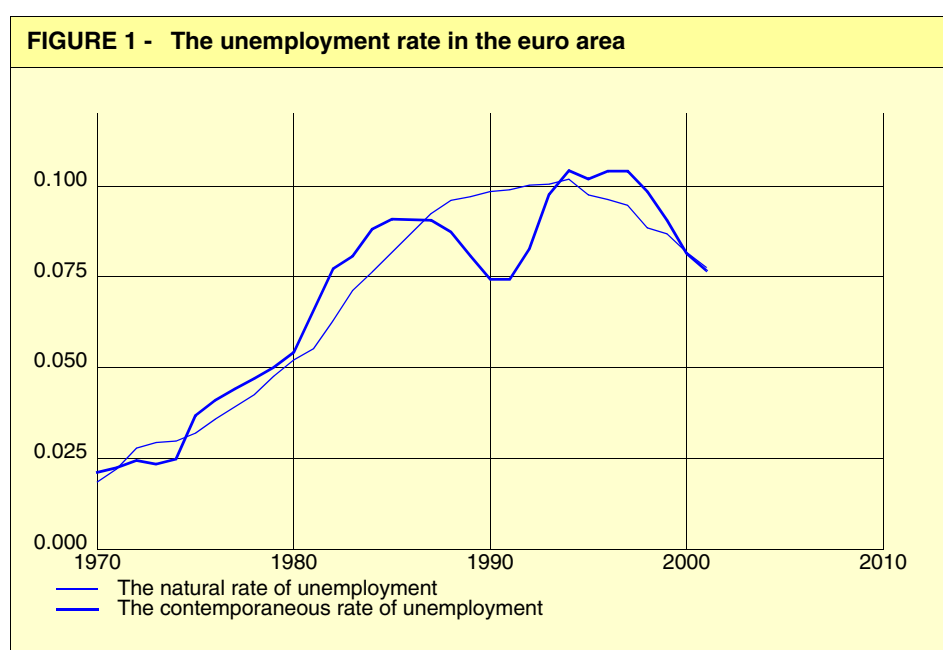
1. Market power is measured by the ratio of exports plus imports to GDP.

FIGURE 2 -   The unemployment rate in the NE block

The natural rate of unemployment
The contemporaneous rate of unemployment

FIGURE 3 -   The unemployment rate in the United States

The natural rate of unemployment
The contemporaneous rate of unemployment

FIGURE 4 -   The unemployment rate in Japan

The natural rate of unemployment
The contemporaneous rate of unemployment
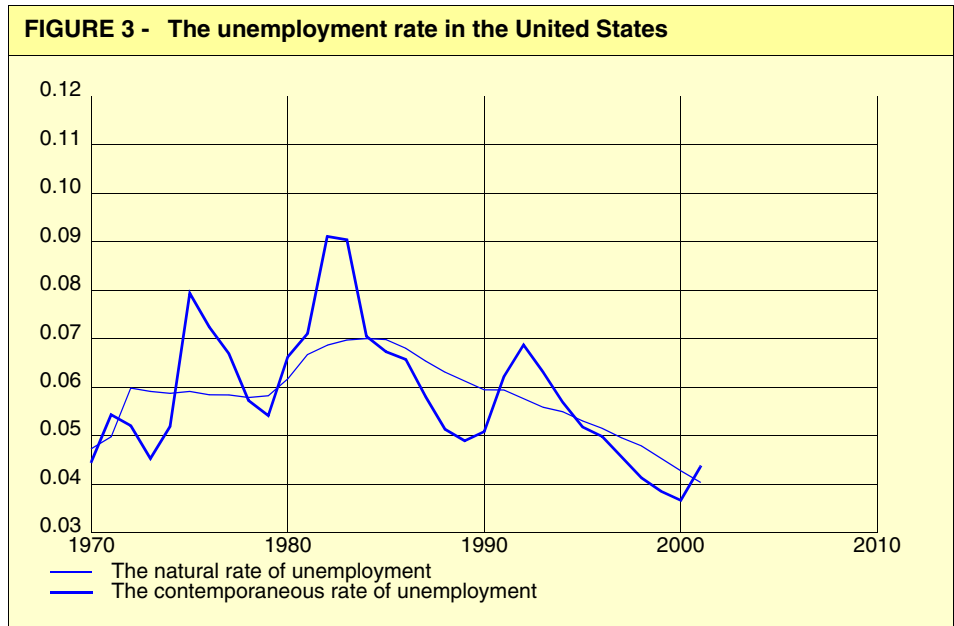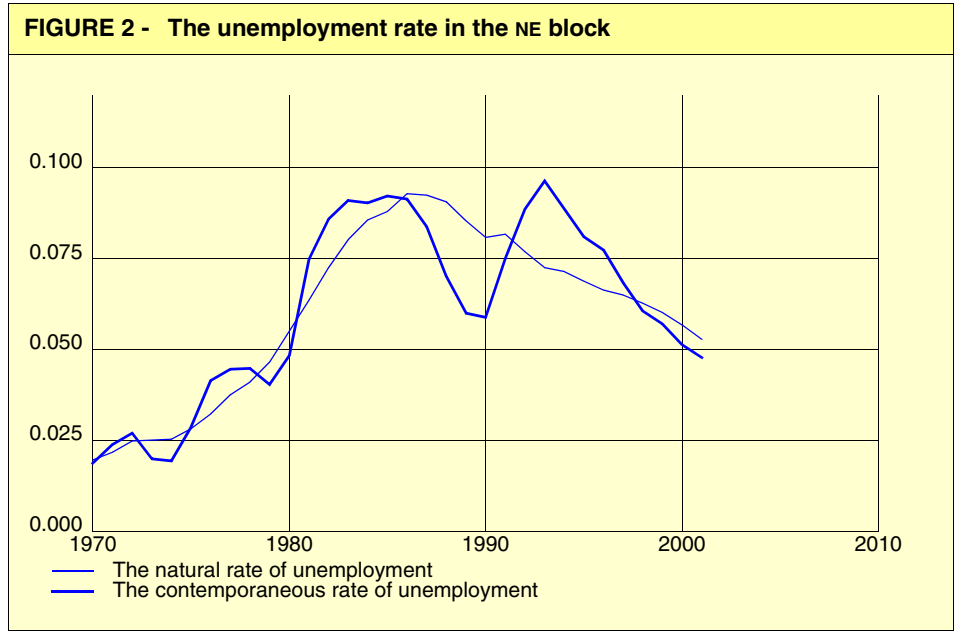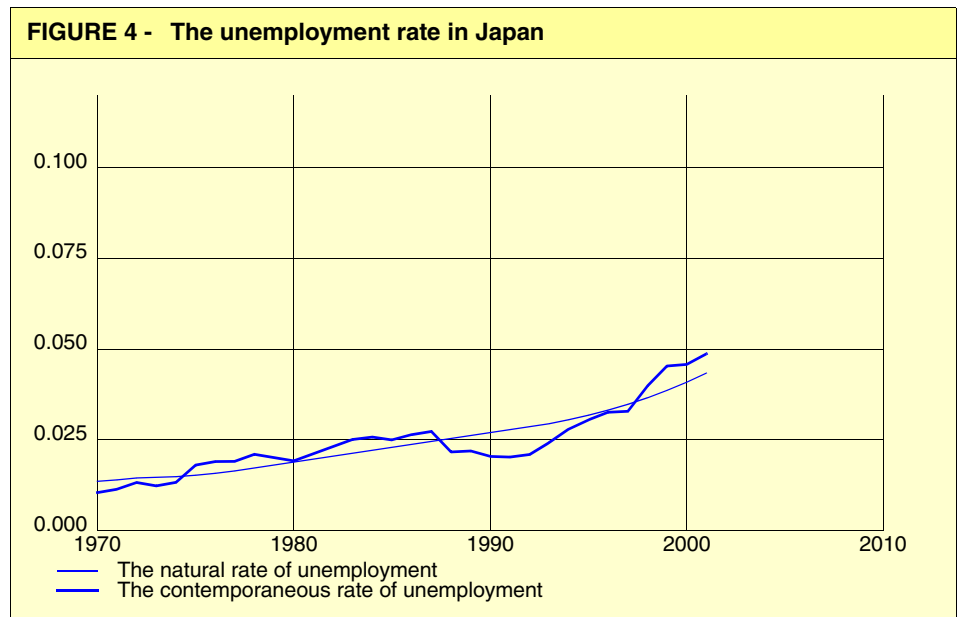
III A cut in the social security contribution rate

A. Introduction

Potential output can be raised in a non-inflationary way by lowering the natural rate of unemployment, by increasing the labour participation rate, or by increasing trend factor productivity. In this section, we investigate the macro-economic implications of policies aimed at lowering the natural rate of unemployment. In the following section, we investigate the macro-economic effects of an increase in the labour participation rate.

Several policy measures are discussed in the literature to reduce the natural rate of unemployment. See, for instance, Layard, Nickell and Jackman (1994). Such policies include, for instance, the reform of the tax and benefit system, an active manpower policy, and when hysteresis is strong and inflation is low, the stabilisation of nominal demand. Here, we simulate with the NIME model the macro-economic effects of a 1 percentage point cut in the social security contribution rate, and we consider two alternative ways which allow to compensate for the loss in tax revenues. First, we examine the variant in which the tax cut is ex ante financed by an across the board cut in public outlays[1]. Next, we consider the variant in which the tax cut is financed by an increase in the indirect tax rate. We apply these shocks to the euro area and the non-euro EU country block. Before we have a closer look at the simulation results, we want to make the following remarks.

First, in the NIME model, a cut in the social security contribution rate decreases the natural rate of unemployment. As discussed in Appendix A of this paper, such a tax cut increases the gap between the take home wage and the reservation wage so that employees become more willing to accept a job offer and the natural rate of unemployment falls. Moreover, because the shock concerns a permanent cut in taxes which increases the real take home wage permanently, the labour supply will not be affected, as it is assumed in the NIME model that the income effect and the substitution effect of a permanent wage increase cancel each other out. As a consequence, the cut in direct taxes increases unambiguously employment and potential output in the long run. However, in the case that the cut in the social se-

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1. These expenditures include public consumption of goods and services, the public wage bill, which is decreased through a decrease in the number of employees, public gross fixed capital formation, and transfers to households, enterprises and the rest of the world. The public wage rate and the tax base adjust endogenously, while the tax rates, except for the social contribution rate, are kept at their baseline level. The cut in expenditures is modelled as a correction on the constant term of the equation, i.e., a fixed amount is subtracted from the planned expenditures. This implies that once a shock is introduced there can still be some endogenous change in the expenditures, depending on changes in the right hand side variables of the equation.

curity contribution rate is financed by an increase in the indirect tax rates the fall in the natural rate of unemployment will be rather limited as the overall tax burden is only slightly reduced.

Second, in the case that the cut in the social security contribution rate is financed by a cut in public outlays, it should be noted that the cut in public expenditures decreases domestic demand directly through lower public investments and spending on goods and services, and indirectly through decreased public sector employment and public transfers (to the household sector). At the same time, the cut in social security contribution rate causes a permanent increase in output through its impact on the natural employment level. Hence, there tends to exist an excess supply in the goods market. As a consequence, private demand will have to increase in order to restore long run equilibrium between demand and supply[1]. This increase will be induced by the income effect generated by the tax cut and by the income and price effect generated by a fall in the relative price of private consumption. Note also that in the case that the cut in the social security contribution rate is financed by a cut in the indirect tax rate, whereby public demand is almost unaffected, the adjustment in the relative prices of private consumption will be smaller.

Third, the expectations are an important transmission channel of the shock because households discount the long run gains in employment and take home wages to the present and adjust their spending plans immediately.

Fourth, it is beyond the scope of the current version of the NIME model to measure the effects of taxes on trend growth, so that the following analysis will only focus on the level effects. Moreover, the shock in this and the next variant are introduced as a once-and-for-all shock to the trend level, and not to trend growth, implying that labour demand absorbs only gradually the additional labour inflow.

We start with a discussion of the variant in which the 1 percentage point cut in the social security contribution rate is financed by a cut in public outlays.

B. A cut in the social security contribution rate and a cut in public outlays

1. The euro area

Table 1 shows for the euro area the first ten years of the adjustment path for a 1 percentage point cut in the social security tax rate. The numbers in this table are, unless otherwise indicated, percentage deviations from a technical baseline.

Although the long-term effects are unambiguous, in the medium-term there are several forces pulling in a different direction, and it is an empirical matter to determine the net effect of all these forces. First, the cut in the social security contribution rate increases total demand through its impact on the (expected) real

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1. Remember that only in the non-euro EU countries a similar shock occurs. Hence, the increase in the exports of the euro area will be limited so that domestic demand will have to increase by more in order to equilibrate demand and supply.

take home wage and the (expected) employment level. Second, the autonomous cut in public outlays reduces total demand directly through its impact on public investment and public consumption, and indirectly through its impact on public employment and transfers to the household sector. Third, the cut in the social security contribution rate increases potential output via its impact on the natural rate of unemployment. Fourth, the monetary authorities cut the short-term interest rates because output is below potential output and inflation is subdued. These interest rate cuts reduce the long term interest rate and stimulate total demand because they decrease the user cost of capital, increase the value of financial assets of the household sector, depreciate the exchange rate, and reduce the real interest rate. Fifth, the shock implies that the take home real wage and the producer real wage will behave in a different way[1]. In the long run, the producer real wage will be unaffected. This is because once the unit labour cost falls as a result of a nominal wage decrease, competition in the goods market will drive prices down until the real wage is equal to labour productivity - adjusted for a mark-up. Only structural measures, including an increase in trend productivity and a decrease in the market power of the enterprise sector in the goods market[2], can increase the producer real wage permanently. In the long run, the take home real wage will increase, because the income tax rate and the relative consumer price fall. Nevertheless, in the medium-term, the producer real wage will decrease in order to accommodate the reallocation of employment from the public sector to the private sector, and to absorb the additional labour inflow, which is caused by the fall in the natural rate of unemployment.

Table 1 shows that real GDP and the GDP deflator of the euro area are almost unaffected in the first year, indicating that the different forces cancel each other out at the aggregate level. In subsequent years, real GDP starts to increase, reaching 0.29 percent above the baseline after five years and 0.39 percent above the baseline after ten years, while the GDP deflator gradually falls from 0.17 percent below the baseline after five years to 0.25 percent below the baseline after ten years. At the same time, overall employment falls below the baseline during the first three years, due to the loss of employment in the public sector and the initial sluggish increase in private sector employment. Afterwards, the growth in private sector employment is strong enough to compensate for the loss of public sector employment. In view of these developments, the short-term interest rate is immediately cut by 37 basis points and kept below the baseline in subsequent year. The real interest rate falls by less because the general price level is also falling. Let us now have a closer look at the different components of demand in the euro area.

In the first year, private consumption increases by 0.32 percent, primarily due to a higher (expected) labour income and available means, and a lower interest rate. Disposable income increases by 0.22 percent because private sector employment and the real take home wage increase by 0.06 and 0.24 percent, respectively, thereby offsetting the effects of the 1.4 percent fall in public employment and the 1.15 percent fall in real public transfers to the household sector[3]. The expected future

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1. Remember that the producer real wage is defined as the nominal wage rate divided by the producer price, i.e., the final prices less net indirect taxes. The real take home wage is defined as the nominal wage divided by the consumer price and corrected for the direct income taxes.
2. See Section A.4 in Appendix A, especially equation (18).
3. The public transfers to the household sector, which include unemployment benefits, fall by less than the ex ante programmed 1.4 percent cut, because there is an endogenous increase in the number of unemployed. As time progresses, and the number of unemployed decreases the public transfers to the household sector will fall below the ex ante programmed cut. See below for a discussion why the unemployment rate increases initially.

non-asset income is 0.86 percent above the baseline, reflecting future gains from the cut in taxes, the fall in the price of private consumption, and the higher overall employment level. It should also be noted that the interest rate cuts increase the real value of the nominal assets. In the second year, private consumption increases further to 0.59 percent above the baseline, and it reaches 0.83 percent above the baseline after five years, primarily because employment and the take home real wage grow strongly. Afterwards, private consumption increases only gradually, because the household sector also wants to save in order to increase its stock of assets, in line with its increased income.

Gross fixed capital formation by the enterprise sector increases by 0.38 percent in the first year, due to the interest rate cut and the increase in output. Gross fixed capital formation by the household sector increases immediately by 0.57 percent, reflecting the increase in disposable income and the total available means, and the cut in interest rates. Gross fixed capital formation by the public sector falls in line with the ex ante cut in public expenditures. All in all, the rise in private capital formation is large enough to compensate for the fall in public capital formation, so that total gross fixed capital formation is above the baseline in the first year. In subsequent years, gross fixed capital formation increases further, reaching after ten years 0.64 percent above the baseline for the enterprise sector and 1.29 percent for the household sector, while public investments recover only gradually. Here, it should be remembered that in the long run, gross fixed capital formation will increase in line with the increase in the employment level and changes in relative prices. This implies, for instance, that gross fixed capital formation by the public sector, which is in equilibrium proportional to GDP, will gradually increase, not only to compensate for the initial 1.4 autonomous cut in expenditures, but also to meet the increase in total output. The investments in residential buildings will get an additional boost because income of the household sector increases not only due to the increase in employment, but also due to the increase in the real take home wage (see below).

The nominal effective euro exchange rate depreciates by 0.32 percent in the first year, which is to a large extent caused by the expected depreciation of the equilibrium real exchange rate. Indeed, the equilibrium exchange rate will depreciate because domestic potential output increases much more than foreign effective potential output, thereby raising imports more than exports, so that a depreciation is required to restore equilibrium in the current account. In the short run, the euro depreciation is strengthened by the cut in the short term interest rate. In subsequent years, the nominal effective exchange rate depreciates further to about 1 percent below the baseline[1]. The money supply increases by 1.8 percent in the first year, due to the increase in the total available means of the household sector and the fall in the interest rate. In later years, the money supply falls as the interest rates are raised, reaching 1 and 0.7 percent above the baseline after, respectively, five and ten years.

The relative prices have to adjust because the drop in public consumption and the increase in potential output create an excess supply in the goods market. In the long run, the excess supply will be absorbed by higher private consumption, because public consumption is constrained by the nature of the shock, gross fixed capital formation responds in the long run only to the change in potential output

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1. Note that the exchange rate depreciates gradually because an important part of the trade in foreign exchange market is made by backward looking chartists. See Meyermans and Van Brusselen (2001) for more details.

(and the user cost which does not change), and exports increase in line with the output increase in the other country blocks (i.e., the NE block). As of the second year, the price of private consumption starts to fall vis-à-vis the GDP deflator, and by the tenth year the price of private consumption has fallen by 0.54 percent, compared with 0.25 percent for the GDP deflator. Price increases are found for exports and imports, reflecting to a large extent the depreciation of the euro. Remember that, as discussed in Section 2 of this paper, in the NIME model it is assumed that the euro area is a price maker for imports and a price taker for exports (in the long run). Hence, the depreciation will create room to increase export prices, while the import prices will have to stay competitive with the other domestic factors and change only in line with the domestic prices (in the long run).

Exports and imports increase, respectively, by 0.11 and 0.08 percent in the first year, hardly affecting the current account to GDP ratio. The rise in exports is explained by the increase in the foreign effective output level, and the depreciation of the real effective exchange rate. In subsequent years, exports increase further in line with the increase in the foreign effective output level and the depreciation of the euro. Imports increase primarily because private supply for final demand increases by 0.13 percent in the first year, followed by further increases in subsequent years. Throughout the simulation period the current account to GDP ratio is rising, reflecting higher export growth.

In the first year, private sector employment increases by 0.06 percent, because the private supply for final demand increases by 0.13 percent and the producer real wage falls by 0.72 percent. However, the increase in private sector employment is insufficient to compensate for the 1.4 percent fall in public sector employment so that the unemployment rate increases by 0.17 percentage points in the first year, putting further downward pressure on real wages. In subsequent years, private sector employment increases further, because total demand increases and the producer real wages are lowered, and these increases become large enough to compensate for the autonomous fall in public sector employment. As a consequence, the unemployment rate falls below the baseline as of the fourth year, falling further to about 0.4 percentage points below the baseline after ten years.

Ex ante[1], the cut in public expenditures is enough to compensate the decrease in tax revenues caused by the 1 percent cut in the social security contribution rate. However, since the automatic fiscal stabilisers are free to operate, the fall in expenditures will be smaller ex post than ex ante programmed. Indeed, as the unemployment rate increases initially, the outlays for unemployment benefits fall by less than programmed. At the same time, the fall in nominal wages and the overall fall in employment cause the nominal wage bill to fall, thereby reducing tax revenues. As a consequence, the public deficit to GDP ratio and the debt to GDP ratio increase by about 0.3 percentage points in the first year. However, in subsequent years, when output and employment increase, revenues increase and outlays decrease, and the deficit to GDP ratio falls below the baseline as of the sixth year. The public debt to GDP ratio starts only to fall below the baseline as of the end of the simulation period, mainly due to the low growth in nominal GDP.

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1. I.e., without taking into account, for instance, the supply side effects of the tax cut.

2. The non-euro EU countries and the rest of the world

In the non-euro EU country (NE) block a similar shock is introduced. Comparing the results for the NE block in Table 2, with the results for the euro area in Table 1, we see that there are some noticeable differences between the two areas which can almost completely be attributed to the different behaviour of the nominal wage rate and the smaller response of the natural rate of unemployment to changes in the tax wedge. In the first year, the nominal wage falls by 0.23 percent in the NE block, compared with 0.75 percent in the euro area, while the take home real wage increases by 0.77 percent in the NE block, compared with 0.24 percent in the euro area. This difference in the nominal wage is largely explained by the fact that on impact the response of the nominal wage rate to a change in the tax rate is much higher in the euro area than in the NE block[1]. The stronger increase in the take home wage in the NE block, gives a stronger initial boost to domestic private demand. For instance, in the first year, private consumption increases by 0.68, compared with 0.32 percent in the euro area. All in all, in the first year, real GDP increases by 0.08 percent, compared with a 0.03 percent drop in the euro area. At the same time, private sector employment increases by 0.06 percent, and public sector employment decreases by 1.69 percent, compared with, respectively, 0.06 and 1.43 percent in the euro area, while the unemployment rate increases by 0.21 percentage points in the first year, compared with 0.17 percentage points in the euro area.

In the second year, the increased gap between the unemployment rate and the natural unemployment rate exerts further downward pressure on the nominal wage of the NE block, and the nominal wage falls to 0.61 percent below the baseline, triggering a further drop in the producer real wage rate. This fall in the producer real wage increases labour demand, thereby pushing the unemployment rate to 0.08 percent below the baseline[2]. In the second year, real GDP is close to its level of the first year, reflecting to a large extent the drop in private consumption caused by fall in the take home real wage. As of the third year, private sector employment rises above its baseline level, giving a further boost to aggregate demand. After ten years, real GDP is up by 0.28 percent, compared with 0.39 percent in euro area. This lower increase is caused by the fact that the unemployment rate decreases by less in the NE block than in the euro area.

In the first year, the deficit to GDP ratio of the NE block increases by 0.21 percentage points, while the debt to GDP ratio increases by 0.18 percentage points. In subsequent years, the debt to GDP ratio starts to fall, and it is above the baseline as of the seventh year. After 10 years, the debt to GDP ratio is still 0.29 percentage points above the baseline but falling, compared with a 0.04 percentage points fall below the baseline in the euro area. This difference is mainly due to the smaller increase in economic activity in the NE block, yielding lower fiscal revenues, smaller decreases in the outlays for the unemployed, and a smaller increase in nominal GDP. The current account to GDP ratio decreases by 0.04 percentage

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1. See parameter wrp_l1 in equation (28) of Appendix A. For the euro area, the point estimate for this parameter is 0.77, while for the NE block the point estimate is 0.22. See Table 8 of Appendix A. The parameter wrp_l1 is related to the relative bargaining power of the household sector in the labour market.
2. Here, it should also be noted that the initial increase in the unemployment rate reduces, with a one year lag, the labour supply, which falls by 0.24 percent in the second year. In the euro area this feedback of the lagged unemployment rate on labour supply is negligible. See Section C of Appendix A.

points in the first year, but improves in subsequent years, mainly due to higher exports caused by higher foreign activity and improved competitiveness.

The spill-over effects to the other country blocks are small and mainly limited to exports. See Table 3. Exports in the US increase by about 0.1, which is mainly due to the increase in the foreign effective output level, and a small appreciation of the effective exchange rate. Exports of Japan fall below the baseline because the appreciation of the effective exchange rate offsets the stimulating effects of the increase in the foreign effective output level. The impact of the shock on the exports of the EC block is also small.

TABLE 1 - **A cut in the social security contribution rate and a cut in public outlays: main macro-economic effects for the euro area[a]**

	1	2	3	4	5	6	7	8	9	10
Demand/supply (in constant prices)										
private consumption	0.32	0.59	0.69	0.78	0.83	0.88	0.91	0.94	0.96	0.98
public consumption	-1.43	-1.54	-1.60	-1.65	-1.70	-1.73	-1.76	-1.77	-1.77	-1.76
gross fixed capital formation	0.20	0.43	0.46	0.47	0.47	0.49	0.51	0.53	0.56	0.58
o/w enterprise sector	0.38	0.63	0.66	0.65	0.63	0.62	0.62	0.62	0.63	0.64
residential buildings	0.57	0.79	0.83	0.85	0.91	0.99	1.08	1.16	1.23	1.29
public sector	-1.45	-1.31	-1.24	-1.20	-1.17	-1.15	-1.13	-1.11	-1.09	-1.07
exports	0.11	0.19	0.25	0.29	0.33	0.37	0.39	0.41	0.42	0.43
imports	0.08	0.14	0.16	0.17	0.19	0.21	0.22	0.24	0.25	0.26
gross domestic product	-0.03	0.14	0.20	0.25	0.29	0.31	0.34	0.36	0.37	0.39
total private supply for final demand	0.13	0.31	0.38	0.43	0.47	0.50	0.53	0.55	0.57	0.58
Prices										
GDP deflator (PGDP)	-0.01	-0.05	-0.10	-0.14	-0.17	-0.19	-0.21	-0.23	-0.24	-0.25
consumption price	0.01	-0.11	-0.19	-0.26	-0.32	-0.37	-0.42	-0.46	-0.50	-0.54
export price (in local currency)	0.02	0.04	0.08	0.11	0.15	0.19	0.22	0.26	0.29	0.32
import price (in local currency)	0.04	0.06	0.05	0.03	0.00	-0.02	-0.05	-0.07	-0.09	-0.10
Labour market										
total employment	-0.19	-0.07	-0.05	0.08	0.18	0.27	0.33	0.37	0.39	0.40
private sector employment	0.06	0.19	0.21	0.36	0.49	0.60	0.67	0.72	0.74	0.75
public sector employment	-1.43	-1.42	-1.41	-1.41	-1.41	-1.41	-1.42	-1.42	-1.42	-1.42
unemployment rate *	0.17	0.06	0.04	-0.08	-0.18	-0.27	-0.32	-0.36	-0.37	-0.38
nominal wage (private sector)	-0.75	-0.82	-0.80	-0.82	-0.79	-0.73	-0.66	-0.59	-0.53	-0.48
take home real wage (private sector)	0.24	0.29	0.39	0.44	0.53	0.64	0.76	0.88	0.98	1.06
producer real wage (private sector)	-0.72	-0.78	-0.71	-0.69	-0.63	-0.56	-0.46	-0.38	-0.30	-0.24
contemporaneous productivity	0.07	0.12	0.17	0.07	-0.01	-0.09	-0.14	-0.17	-0.17	-0.17
participation rate	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
contemporaneous labour supply	-0.00	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
Financial sector										
short-term interest rate *	-0.37	-0.30	-0.28	-0.23	-0.20	-0.18	-0.15	-0.14	-0.13	-0.12
long-term interest rate *	-0.21	-0.17	-0.16	-0.13	-0.11	-0.10	-0.09	-0.08	-0.07	-0.07
nominal effective exchange rate (-:appr.)	0.32	0.54	0.69	0.78	0.84	0.89	0.91	0.93	0.93	0.93
real effective exchange rate (-:appr.)	0.30	0.49	0.60	0.65	0.67	0.67	0.65	0.63	0.60	0.57
nominal money stock	1.83	1.34	1.29	1.12	1.04	0.96	0.88	0.83	0.78	0.74
Public finance										
nominal public revenues	-1.89	-1.88	-1.87	-1.86	-1.84	-1.82	-1.80	-1.77	-1.75	-1.74
nominal public expenditures	-1.19	-1.44	-1.47	-1.61	-1.73	-1.84	-1.93	-2.00	-2.04	-2.08
social security contribution rate*	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00
deficit to GDP ratio * (+:surplus)	-0.28	-0.16	-0.14	-0.08	-0.03	0.03	0.07	0.11	0.14	0.16
debt to GDP ratio *	0.30	0.36	0.48	0.53	0.54	0.50	0.40	0.28	0.13	-0.04
Household sector										
total available means	0.76	0.82	0.87	0.89	0.91	0.93	0.95	0.97	0.99	1.01
o/w real disposable income	0.22	0.40	0.43	0.48	0.53	0.60	0.67	0.74	0.80	0.85
inherited assets (deflated by cons. price)	0.55	0.55	0.61	0.59	0.58	0.58	0.57	0.57	0.57	0.58
expected future real income	0.86	0.94	0.98	1.02	1.05	1.08	1.11	1.14	1.16	1.18
Memo items										
foreign effective output	0.05	0.06	0.07	0.08	0.09	0.10	0.10	0.11	0.11	0.11
foreign effective price level	-0.00	-0.02	-0.02	-0.02	-0.03	-0.03	-0.04	-0.04	-0.04	-0.05
foreign effective interest rate *	-0.05	-0.04	-0.03	-0.03	-0.03	-0.02	-0.02	-0.02	-0.02	-0.01
current account to GDP *	0.00	0.01	0.03	0.05	0.08	0.10	0.11	0.13	0.15	0.16
real public debt	0.41	0.66	0.89	1.02	1.07	1.03	0.92	0.76	0.56	0.33

[a] variables without *: deviation from baseline, in percent; variables with *: deviation from baseline, in differences

TABLE 2 - **A cut in the social security contribution rate and a cut in public outlays: main macro-economic effects for the NE block[a]**

	1	2	3	4	5	6	7	8	9	10
Demand/supply (in constant prices)										
private consumption	0.68	0.59	0.66	0.72	0.79	0.83	0.85	0.86	0.86	0.86
public consumption	-1.69	-1.76	-1.82	-1.90	-1.94	-1.96	-1.94	-1.94	-1.92	-1.90
gross fixed capital formation	0.27	0.11	0.12	0.18	0.23	0.26	0.29	0.32	0.34	0.36
o/w enterprise sector	0.20	0.15	0.15	0.21	0.24	0.26	0.27	0.29	0.30	0.32
residential buildings	2.00	1.23	1.26	1.39	1.45	1.52	1.57	1.61	1.62	1.61
public sector	-1.59	-1.62	-1.59	-1.57	-1.51	-1.45	-1.41	-1.39	-1.36	-1.34
exports	0.08	0.21	0.24	0.27	0.32	0.37	0.40	0.43	0.45	0.47
imports	0.27	0.20	0.23	0.28	0.30	0.32	0.34	0.35	0.35	0.35
gross domestic product	0.08	0.06	0.08	0.10	0.16	0.21	0.23	0.25	0.27	0.28
total private supply for final demand	0.26	0.23	0.27	0.31	0.37	0.41	0.44	0.45	0.46	0.47
Prices										
GDP deflator (PGDP)	-0.01	-0.11	-0.11	-0.14	-0.19	-0.23	-0.26	-0.28	-0.31	-0.34
consumption price	0.01	-0.12	-0.14	-0.20	-0.27	-0.32	-0.36	-0.39	-0.42	-0.45
export price (in local currency)	0.05	0.05	0.05	0.06	0.07	0.07	0.07	0.06	0.04	0.03
import price (in local currency)	0.01	-0.03	-0.07	-0.06	-0.06	-0.08	-0.11	-0.13	-0.14	-0.15
Labour market										
total employment	-0.23	-0.16	0.01	0.05	0.08	0.10	0.12	0.13	0.14	0.14
private sector employment	0.06	0.14	0.34	0.38	0.42	0.45	0.46	0.47	0.48	0.49
public sector employment	-1.69	-1.69	-1.69	-1.70	-1.71	-1.71	-1.70	-1.70	-1.69	-1.69
unemployment rate *	0.21	-0.08	-0.10	-0.11	-0.13	-0.14	-0.15	-0.15	-0.15	-0.16
nominal wage (private sector)	-0.23	-0.61	-0.64	-0.62	-0.61	-0.58	-0.55	-0.52	-0.51	-0.50
take home real wage (private sector)	0.77	0.51	0.50	0.58	0.66	0.74	0.81	0.87	0.91	0.95
producer real wage (private sector)	-0.21	-0.52	-0.54	-0.49	-0.44	-0.38	-0.32	-0.27	-0.24	-0.20
contemporaneous productivity	0.20	0.09	-0.07	-0.07	-0.05	-0.03	-0.03	-0.02	-0.02	-0.02
participation rate	0.06	-0.13	-0.01	0.01	0.02	0.03	0.04	0.04	0.04	0.05
contemporaneous labour supply	-0.00	-0.24	-0.09	-0.06	-0.05	-0.04	-0.03	-0.03	-0.03	-0.02
Financial sector										
short-term interest rate *	-0.17	-0.17	-0.09	-0.14	-0.13	-0.10	-0.08	-0.08	-0.07	-0.07
long-term interest rate *	-0.04	-0.04	-0.02	-0.04	-0.03	-0.03	-0.02	-0.02	-0.02	-0.02
nominal effective exchange rate (-:appr.)	0.14	0.18	0.07	0.22	0.35	0.41	0.43	0.44	0.45	0.46
real effective exchange rate (-:appr.)	0.09	0.12	-0.02	0.12	0.22	0.28	0.30	0.31	0.33	0.36
nominal money stock	1.24	1.44	1.12	1.19	1.11	0.99	0.85	0.79	0.76	0.75
Public finance										
nominal public revenues	-1.83	-2.09	-2.04	-2.03	-2.03	-2.02	-2.00	-2.00	-2.00	-2.00
nominal public expenditures	-1.25	-1.67	-1.80	-1.87	-1.96	-2.01	-2.02	-2.03	-2.04	-2.05
social security contribution rate*	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00
deficit to GDP ratio * (+:surplus)	-0.21	-0.14	-0.08	-0.05	-0.02	0.00	0.01	0.02	0.03	0.03
debt to GDP ratio *	0.18	0.37	0.42	0.46	0.46	0.44	0.40	0.37	0.33	0.29
Household sector										
total available means	0.70	0.73	0.68	0.78	0.80	0.80	0.79	0.80	0.80	0.81
o/w real disposable income	0.66	0.44	0.49	0.54	0.60	0.66	0.72	0.77	0.80	0.84
inherited assets (deflated by cons. price)	0.67	0.69	0.47	0.74	0.75	0.69	0.61	0.62	0.63	0.66
expected future real income	0.71	0.75	0.76	0.79	0.82	0.84	0.85	0.85	0.85	0.85
Memo items										
foreign effective output	0.05	0.13	0.15	0.18	0.19	0.21	0.22	0.22	0.23	0.24
foreign effective price level	-0.00	-0.01	-0.03	-0.04	-0.05	-0.06	-0.07	-0.07	-0.08	-0.08
foreign effective interest rate *	-0.14	-0.12	-0.13	-0.08	-0.07	-0.06	-0.05	-0.04	-0.04	-0.03
current account to GDP *	-0.04	0.02	0.04	0.04	0.05	0.07	0.08	0.09	0.09	0.10
real public debt	0.53	0.96	1.12	1.25	1.32	1.33	1.29	1.23	1.16	1.07

[a] variables without *: deviation from baseline, in percent; variables with *: deviation from baseline, in differences

TABLE 3 - **A cut in the social security contribution rate and a cut in public outlays: main spill-over effects[a]**

	1	2	3	4	5	6	7	8	9	10
United States										
gross domestic product	-0.04	-0.00	-0.01	-0.00	0.00	0.01	0.01	0.01	0.01	0.00
exports	0.07	0.12	0.13	0.14	0.15	0.15	0.14	0.14	0.13	0.12
imports	-0.03	0.03	0.03	0.03	0.01	-0.00	-0.01	-0.02	-0.02	-0.02
GDP deflator (PGDP)	-0.01	-0.02	-0.02	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03
export price (in local currency)	-0.06	-0.11	-0.16	-0.18	-0.19	-0.19	-0.19	-0.19	-0.18	-0.18
import price (in local currency)	-0.03	-0.05	-0.06	-0.04	-0.03	-0.02	-0.01	-0.01	-0.01	-0.01
short-term interest rate *	-0.03	-0.01	-0.01	-0.01	-0.00	-0.00	0.00	0.00	0.00	0.00
long-term interest rate *	-0.01	-0.00	-0.00	-0.00	-0.00	-0.00	0.00	0.00	0.00	0.00
nominal effective exchange rate (-:appr.)	-0.09	-0.17	-0.22	-0.25	-0.26	-0.26	-0.26	-0.25	-0.25	-0.24
Japan										
gross domestic product	-0.02	-0.00	-0.02	-0.03	-0.03	-0.02	-0.01	-0.01	-0.01	-0.01
exports	-0.01	-0.02	-0.08	-0.12	-0.12	-0.10	-0.08	-0.06	-0.05	-0.04
imports	-0.01	0.03	0.04	0.05	0.03	0.01	-0.01	-0.03	-0.03	-0.03
GDP deflator (PGDP)	0.00	-0.01	-0.01	-0.02	-0.03	-0.04	-0.05	-0.06	-0.06	-0.07
export price (in local currency)	-0.04	-0.07	-0.09	-0.11	-0.12	-0.14	-0.14	-0.15	-0.16	-0.16
import price (in local currency)	-0.08	-0.14	-0.17	-0.13	-0.07	-0.02	0.01	0.02	0.01	0.00
short-term interest rate *	-0.01	-0.01	-0.01	-0.03	-0.03	-0.03	-0.02	-0.02	-0.01	-0.01
long-term interest rate *	-0.00	-0.00	-0.00	-0.01	-0.01	-0.01	-0.01	-0.00	-0.00	-0.00
nominal effective exchange rate (-:appr.)	-0.23	-0.36	-0.46	-0.43	-0.39	-0.35	-0.31	-0.29	-0.29	-0.28
EU accession countries										
gross domestic product	0.01	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.02	0.02
exports	0.01	0.04	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
imports	-0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.02
GDP deflator	-0.00	-0.00	-0.00	-0.00	0.00	0.00	0.00	0.01	0.01	0.01
price of exports	0.00	0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
price of imports	-0.00	-0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Rest of the world										
total private supply	0.01	0.03	0.04	0.04	0.05	0.05	0.05	0.05	0.06	0.06
exports	0.08	0.20	0.24	0.28	0.31	0.33	0.35	0.36	0.37	0.37
imports	0.13	0.31	0.37	0.45	0.56	0.64	0.70	0.74	0.76	0.79
price of exports (in euro)	0.03	0.09	0.17	0.26	0.35	0.42	0.48	0.52	0.55	0.57
price of imports (in euro)	0.03	0.10	0.21	0.32	0.46	0.61	0.75	0.89	1.00	1.10

[a] variables without *: deviation from baseline, in percent; variables with *: deviation from baseline, in differences

C. A cut in the social security contribution rate and an increase in the indirect tax rate

In the previous variant, the cut in the social security contribution rate was financed by a cut in the public expenditures. Here, we discuss the variant whereby the cut in the social security contribution rate is financed by an increase in the indirect tax rate. In the previous variant, the cut in public outlays reduced public demand and increased private demand in the long run, and it did not have any supply side effect. In this new variant, the increase in indirect taxes tempers the reduction in the natural rate of unemployment. Indeed, in equilibrium, the producer real wage, defined as the nominal wage rate deflated by the producer price[1], is equal to a weighted average of trend productivity and the reservation wage of the employees. Assuming that trend productivity and the reservation wage do not change, a rise in the indirect tax rate has to be compensated by a fall in the nominal wage rate (or an increase in the general price level[2]) in order to maintain equilibrium. However, the fall in the nominal wage rate (or the increase in the price level) reduces also the take home wage of the employees, so that the employees become less willing to accept employment, thereby tempering the fall in the natural unemployment rate which was induced by the cut in the social security contribution rate.

1. The euro area

Table 4 summarises the simulation results for the euro area. The numbers in this table are, unless indicated otherwise, percentage deviations from a technical baseline.

The indirect taxes are raised by 0.7 percentage points to compensate for the loss in tax revenues caused by the 1 percentage point cut in the social security contribution rate. As a result, the overall tax burden decreases less than in the previous variant, and the natural rate of unemployment falls only by 0.1 percentage points, compared with 0.4 percentage points in the previous variant.

Real GDP of the euro area rises by 0.08 percent in the first year, compared with a 0.03 percent fall in the previous variant, and increases further to 0.12 percent above the baseline after 10 years, compared with 0.39 percent in the previous variant. In the previous variant, the initial fall in public demand triggered the initial fall in GDP. However, there the stronger decrease in the natural rate of unemployment, also allowed for a larger increase in GDP in the long run.

The behaviour of the wages is an important determinant of the adjustment process. In the new variant, the take home real wage in the euro area increases by 0.16 percent in the first year, compared with 0.24 percent in the previous variant, and it increases only to 0.22 percent above the baseline after ten years, compared with 1.06 percent in the previous variant. The smaller increase in the take home real wage is caused by a larger fall in the nominal wage rate and a smaller fall in con-

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1. The producer price is equal to the market price minus indirect taxes. If the market price is kept fixed, an increase in the indirect tax rate reduces the producer price. Since the producer price is used as the deflator in the producer real wage, it follows that the producer real wage will increase when the indirect tax rates increase, ceteris paribus.
2. It depends on monetary policy what will happen: a rise in the general price level or a fall in the wage rate.

sumer prices. The nominal wage rate falls by 0.79 percent in the first year, compared with 0.75 percent in the previous variant, and by 0.80 percent after ten years, compared with 0.48 percent in the previous variant. At the same time, the consumer prices fall by 0.02 percent after ten years, compared with 0.54 percent in the previous variant. Remember that in the previous variant the relative price of private consumption had to fall in order to absorb the excess supply in the goods market which was generated by the fall in public consumption and the increase in output. The fall in prices is now smaller not only because the indirect taxes increase tends to push prices up, but also because the initial excess supply in the goods market is now much smaller than in the previous variant.

Total employment increases by 0.02 percent in the first year, compared with a fall of 0.19 percent in the previous variant. In the previous variant, the initial fall in total employment was caused by the strong fall in public employment, and it took three years before total employment rose above the baseline. After ten years, total employment is now only 0.12 percent above the baseline, compared with 0.40 percent in the previous variant, reflecting the lower reduction in the natural rate of unemployment.

Private consumption increases by 0.20 percent in the first year and by 0.35 percent after ten years. These increases are smaller than in the previous variant, where private consumption increased by 0.32 percent in the first year and by 0.98 percent after ten years. This difference is mainly due to the smaller increase in the take home wage and total employment.

After falling 0.04 percent below the baseline in the first year, total gross fixed capital formation increases to 0.19 percent above the baseline in the tenth year. However, it should be noted that while investment in residential buildings and public investment are above the baseline as of the first year, gross fixed capital formation by the enterprise sector falls immediately. Investments in residential buildings increases by 0.68 percent in the first year and by 0.78 percent after ten years, reflecting to a large extent the rise in (expected) take home wages and employment. Public investment increase immediately by 0.07 percent, and 0.11 percent above the baseline after ten years, reflecting the overall increase in economic activity. Gross fixed capital formation by the enterprise sector decreases initially by 0.34 percent because the indirect tax hike increases the real user cost of enterprise investment[1]. After ten years, gross fixed capital formation by the enterprise sector is back to its baseline level.

Imports rise initially by 0.06 percent as higher output requires more imports. However, as the increase in the price of imports relative to the price of output start to have its effect, imports fall 0.20 percent below the baseline in the second year. As output increases further and the relative price of imports falls, imports rebound and they reach 0.07 percent above the baseline after ten years. Exports fall immediately by 0.01 percent because the growth in foreign effective demand is not strong enough to compensate for the appreciation of the real effective exchange rate.

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1. The real user cost is equal to the nominal user cost divided by the producer price. The indirect taxes increases by assumption immediately, while the market price of output does not jump immediately at the same rate, hence there will be a fall in the producer price. This fall in the producer price increases the real user cost.

The price of private consumption falls 0.02 percent below the baseline after ten years, compared with 0.54 percent in the previous variant. Prices fall less than in the previous variant, because the excess supply in the goods market is now much smaller than in the previous variant, and because the increase in the indirect taxes tends to push prices up. The price of imports, denominated in local currency, decreases initially by 0.21 percent because the euro appreciates and the increase in indirect taxes puts downward pressure on the price of imports. Indeed, in equilibrium the price of intermediary imports deflated by the producer price is equal to trend productivity of the intermediary imports adjusted for a mark-up. Since both trend productivity and mark-up do not change, the rise in indirect taxes requires a fall in import prices in order to maintain equilibrium, and after ten years the price of imports falls 0.74 percent below the baseline. Export prices fall in line with the appreciation of the effective exchange rate, because exporters are price takers who want to maintain their price competitiveness in export markets. All in all, the GDP deflator increases by 0.16 percent in the first year, mainly due to the decrease in import prices. The inflationary pressures lead to a 0.22 percentage points increase in the short term interest rates. Afterwards, when the inflationary pressures temper and demand stays below potential output, the interest rates are cut.

The nominal effective exchange rate appreciates by 0.13 percent in the first year, and by 0.43 percent after ten years, mainly reflecting an appreciation of the equilibrium nominal exchange rate. The equilibrium nominal exchange rate appreciates because the cut in the indirect tax rate reduces the price that the producers are willing to pay for intermediary imports. Given that the value of exports, denominated in foreign currency is (almost) unaffected, the value of imports, denominated in foreign currency, can only be kept in line with the value of exports if the exchange rate appreciates. The real effective exchange rate appreciates by somewhat less because the prices of exports, denominated in local currency, fall by 0.01 percent in the first year and by 0.32 percent after ten years.

The indirect tax hike is calculated in such a way that it keeps the fiscal deficit to GDP ex ante fixed to its baseline level. However, due to endogenous changes in tax bases (including a fall in the nominal wage bill) and outlays (including a fall in outlays for the unemployed), the fiscal deficit to GDP ratio increases by 0.13 percentage points in the first year, compared with 0.28 percentage points in the previous variant. After ten years, the public deficit to GDP ratio settles at 0.04 percentage points below the baseline, compared with 0.16 percentage points above the baseline in the previous variant.

2. The non-euro EU countries and the rest of the world

Table 5 shows the results for the block of the EU countries that did not adopt the euro. Here, we find similar results as in the euro area. The indirect tax rate is increased by 0.8 percentage points, while the natural rate of unemployment falls only by 0.04 percentage points, compared with 0.10 percentage points in the previous variant. Total employment is almost unaffected in the first year, and increases by 0.03 percent after ten years. The fiscal deficit to GDP ratio falls by 0.08 percentage points, compared with 0.21 percentage points in the previous variant.

Table 6 shows the spill-over effects to the other areas. In this variant, the spill over effects to the rest of the world are also small.

TABLE 4 - **A cut in the social security contribution rate and an increase in the indirect tax rate: main macro-economic effects for the euro area**[a]

	1	2	3	4	5	6	7	8	9	10
Demand/supply (in constant prices)										
private consumption	0.20	0.21	0.30	0.29	0.29	0.29	0.30	0.32	0.34	0.35
public consumption	-0.12	-0.03	-0.05	-0.12	-0.19	-0.23	-0.26	-0.27	-0.28	-0.29
gross fixed capital formation	-0.04	0.05	0.13	0.07	0.06	0.08	0.11	0.14	0.16	0.19
o/w enterprise sector	-0.34	-0.29	-0.15	-0.22	-0.22	-0.18	-0.13	-0.09	-0.04	-0.01
residential buildings	0.68	0.92	0.88	0.83	0.81	0.80	0.80	0.80	0.79	0.78
public sector	0.07	0.13	0.16	0.13	0.10	0.09	0.09	0.10	0.10	0.11
exports	-0.01	-0.04	-0.05	-0.06	-0.07	-0.08	-0.09	-0.10	-0.11	-0.12
imports	0.06	-0.20	-0.09	-0.04	-0.00	0.02	0.04	0.06	0.06	0.07
gross domestic product	0.08	0.15	0.19	0.15	0.12	0.11	0.11	0.11	0.12	0.12
total private supply for final demand	0.11	0.10	0.16	0.15	0.14	0.14	0.15	0.16	0.16	0.17
Prices										
GDP deflator (PGDP)	0.16	0.10	0.07	0.07	0.08	0.08	0.08	0.08	0.07	0.06
consumption price	0.05	0.03	0.01	-0.00	-0.01	-0.01	-0.02	-0.02	-0.02	-0.02
export price (in local currency)	-0.01	-0.03	-0.06	-0.09	-0.13	-0.17	-0.20	-0.24	-0.28	-0.32
import price (in local currency)	-0.21	-0.38	-0.51	-0.60	-0.65	-0.68	-0.70	-0.72	-0.73	-0.74
Labour market										
total employment	0.02	0.04	0.05	0.06	0.08	0.09	0.10	0.11	0.12	0.12
private sector employment	0.03	0.05	0.06	0.07	0.09	0.11	0.12	0.13	0.14	0.14
public sector employment	-0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
unemployment rate *	-0.02	-0.04	-0.05	-0.06	-0.07	-0.09	-0.10	-0.11	-0.11	-0.11
nominal wage (private sector)	-0.79	-0.87	-0.86	-0.85	-0.84	-0.83	-0.82	-0.82	-0.81	-0.80
take home real wage (private sector)	0.16	0.10	0.14	0.16	0.17	0.18	0.19	0.21	0.21	0.22
producer real wage (private sector)	-0.13	-0.18	-0.13	-0.11	-0.09	-0.08	-0.06	-0.04	-0.02	-0.00
contemporaneous productivity	0.08	0.06	0.10	0.07	0.05	0.03	0.03	0.02	0.02	0.03
participation rate	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
contemporaneous labour supply	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
Financial sector										
short-term interest rate *	0.22	-0.11	-0.03	-0.00	0.00	-0.00	-0.01	-0.01	-0.00	-0.00
long-term interest rate *	0.12	-0.06	-0.02	-0.00	0.00	-0.00	-0.00	-0.00	-0.00	-0.00
nominal effective exchange rate (-:appr.)	-0.13	-0.16	-0.24	-0.29	-0.33	-0.35	-0.37	-0.39	-0.41	-0.43
real effective exchange rate (-:appr.)	-0.11	-0.14	-0.20	-0.24	-0.25	-0.25	-0.23	-0.22	-0.20	-0.19
nominal money stock	-0.42	0.15	0.13	0.11	0.15	0.20	0.25	0.28	0.30	0.31
Public finance										
nominal public revenues	-0.19	-0.26	-0.25	-0.27	-0.29	-0.29	-0.30	-0.30	-0.30	-0.30
nominal public expenditures	0.08	0.04	-0.12	-0.12	-0.13	-0.15	-0.17	-0.19	-0.20	-0.21
social security contribution rate*	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00
indirect tax rate *	0.73	0.72	0.71	0.70	0.70	0.70	0.70	0.70	0.70	0.70
deficit to GDP ratio * (+:surplus)	-0.13	-0.13	-0.05	-0.06	-0.07	-0.06	-0.06	-0.05	-0.05	-0.04
debt to GDP ratio *	-0.03	0.09	0.13	0.21	0.29	0.35	0.40	0.44	0.47	0.50
Household sector										
total available means	0.28	0.37	0.32	0.29	0.29	0.30	0.32	0.33	0.34	0.35
o/w real disposable income	0.53	0.56	0.57	0.56	0.56	0.57	0.57	0.58	0.58	0.58
inherited assets (deflated by cons. price)	0.05	0.40	0.24	0.16	0.15	0.19	0.26	0.33	0.39	0.45
expected future real income	0.38	0.36	0.36	0.35	0.35	0.35	0.34	0.33	0.32	0.31
Memo items										
foreign effective output	0.02	0.00	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.01
foreign effective price level	0.01	-0.01	-0.03	-0.04	-0.05	-0.06	-0.06	-0.07	-0.07	-0.07
foreign effective interest rate *	0.02	-0.04	-0.04	-0.02	-0.01	-0.01	-0.00	-0.00	-0.00	0.00
current account to GDP *	0.02	0.10	0.10	0.09	0.09	0.08	0.08	0.07	0.06	0.05
real public debt	0.04	0.29	0.38	0.46	0.54	0.62	0.69	0.75	0.81	0.87

[a] variables without *: deviation from baseline, in percent; variables with *: deviation from baseline, in differences

TABLE 5 - **A cut in the social security contribution rate and an increase in the indirect tax rate: main macro-economic effects for the NE block[a]**

	1	2	3	4	5	6	7	8	9	10
Demand/supply (in constant prices)										
private consumption	0.28	0.05	0.16	0.16	0.12	0.06	0.01	-0.04	-0.07	-0.09
public consumption	-0.08	-0.02	-0.12	-0.20	-0.26	-0.29	-0.31	-0.33	-0.35	-0.37
gross fixed capital formation	-0.03	0.08	0.07	0.07	0.06	0.07	0.07	0.09	0.10	0.11
o/w enterprise sector	-0.47	-0.17	-0.16	-0.12	-0.08	-0.03	0.01	0.06	0.10	0.12
residential buildings	1.96	1.38	1.22	0.96	0.71	0.50	0.33	0.22	0.14	0.10
public sector	0.12	-0.00	0.08	0.14	0.15	0.14	0.12	0.10	0.09	0.07
exports	-0.10	-0.22	-0.06	0.06	0.16	0.24	0.29	0.32	0.33	0.32
imports	0.09	-0.07	0.01	-0.03	-0.06	-0.08	-0.10	-0.12	-0.13	-0.15
gross domestic product	0.10	0.00	0.07	0.11	0.12	0.12	0.10	0.09	0.08	0.07
total private supply for final demand	0.11	-0.02	0.07	0.10	0.11	0.11	0.09	0.08	0.07	0.06
Prices										
GDP deflator (PGDP)	0.26	0.14	0.02	-0.07	-0.13	-0.18	-0.22	-0.24	-0.25	-0.25
consumption price	0.02	0.02	0.00	0.01	0.02	0.03	0.05	0.06	0.07	0.08
export price (in local currency)	-0.14	-0.36	-0.60	-0.82	-1.01	-1.14	-1.23	-1.27	-1.29	-1.28
import price (in local currency)	-0.69	-0.83	-0.83	-0.86	-0.91	-0.95	-0.98	-1.00	-1.01	-1.01
Labour market										
total employment	-0.01	-0.01	0.04	0.05	0.04	0.04	0.04	0.03	0.03	0.03
private sector employment	-0.01	-0.01	0.05	0.06	0.05	0.05	0.04	0.04	0.04	0.04
public sector employment	0.00	0.00	-0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
unemployment rate *	0.01	-0.02	-0.05	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04
nominal wage (private sector)	-0.51	-0.96	-1.02	-1.06	-1.09	-1.13	-1.16	-1.18	-1.20	-1.21
take home real wage (private sector)	0.46	0.03	-0.03	-0.07	-0.11	-0.16	-0.21	-0.24	-0.27	-0.29
producer real wage (private sector)	0.24	-0.10	-0.08	-0.04	-0.01	0.00	0.01	0.01	0.00	-0.00
contemporaneous productivity	0.13	-0.01	0.02	0.04	0.06	0.06	0.05	0.04	0.03	0.02
participation rate	0.00	-0.02	-0.01	0.00	0.00	-0.00	-0.00	-0.00	-0.00	-0.00
contemporaneous labour supply	0.00	-0.03	-0.01	0.00	0.00	-0.00	-0.00	-0.00	-0.00	-0.00
Financial sector										
short-term interest rate *	0.43	-0.20	-0.17	-0.11	-0.07	-0.05	-0.03	-0.02	-0.00	-0.00
long-term interest rate *	0.11	-0.05	-0.04	-0.03	-0.02	-0.01	-0.01	-0.00	-0.00	-0.00
nominal effective exchange rate (-:appr.)	-1.06	-0.69	-0.38	-0.23	-0.20	-0.23	-0.30	-0.40	-0.49	-0.57
real effective exchange rate (-:appr.)	-0.90	-0.33	0.21	0.58	0.79	0.89	0.90	0.85	0.76	0.68
nominal money stock	-1.36	-0.33	0.15	0.42	0.49	0.50	0.42	0.34	0.26	0.20
Public finance										
nominal public revenues	-0.09	-0.35	-0.39	-0.43	-0.48	-0.52	-0.56	-0.59	-0.60	-0.61
nominal public expenditures	0.09	-0.05	-0.21	-0.24	-0.25	-0.26	-0.27	-0.27	-0.27	-0.26
social security contribution rate*	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00
indirect tax rate *	0.80	0.79	0.79	0.78	0.78	0.78	0.78	0.78	0.78	0.78
deficit to GDP ratio * (+:surplus)	-0.08	-0.13	-0.08	-0.08	-0.10	-0.11	-0.13	-0.14	-0.15	-0.15
debt to GDP ratio *	-0.06	0.16	0.25	0.34	0.45	0.56	0.68	0.80	0.92	1.04
Household sector										
total available means	-0.08	0.31	0.25	0.14	0.05	-0.01	-0.06	-0.09	-0.11	-0.11
o/w real disposable income	0.78	0.48	0.46	0.41	0.35	0.30	0.25	0.22	0.19	0.18
inherited assets (deflated by cons. price)	-1.04	0.73	0.73	0.55	0.41	0.37	0.31	0.30	0.30	0.34
expected future real income	0.25	0.16	0.08	0.00	-0.07	-0.13	-0.18	-0.22	-0.24	-0.25
Memo items										
foreign effective output	0.04	0.04	0.06	0.06	0.05	0.05	0.06	0.06	0.06	0.07
foreign effective price level	0.03	0.01	-0.01	-0.01	-0.02	-0.02	-0.02	-0.03	-0.03	-0.04
foreign effective interest rate *	0.04	-0.05	-0.02	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	0.00
current account to GDP *	0.10	0.09	0.05	0.04	0.04	0.04	0.04	0.05	0.05	0.06
real public debt	-0.05	0.38	0.67	0.95	1.24	1.56	1.88	2.22	2.56	2.90

[a] variables without *: deviation from baseline, in percent; variables with *: deviation from baseline, in differences

TABLE 6 - **A cut in the social security contribution rate and an increase in the indirect tax rate: main spill-over effects[a]**

	1	2	3	4	5	6	7	8	9	10
United States										
gross domestic product	-0.04	-0.01	-0.00	-0.00	0.00	0.00	0.00	0.00	0.00	0.00
exports	0.04	0.00	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01
imports	-0.05	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.01	-0.01
GDP deflator (PGDP)	-0.00	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
export price (in local currency)	-0.01	-0.02	-0.03	-0.03	-0.03	-0.03	-0.03	-0.02	-0.02	-0.02
import price (in local currency)	0.01	0.01	0.00	0.01	0.01	0.00	0.00	0.00	0.00	-0.00
short-term interest rate *	-0.03	-0.01	-0.01	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	0.00
long-term interest rate *	-0.01	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	0.00
nominal effective exchange rate (-:appr.)	0.03	0.03	0.05	0.07	0.08	0.10	0.11	0.12	0.12	0.13
Japan										
gross domestic product	-0.02	0.00	-0.00	-0.01	-0.01	-0.00	-0.00	0.00	0.00	0.00
exports	0.01	-0.01	-0.02	-0.04	-0.04	-0.03	-0.02	-0.02	-0.01	-0.01
imports	-0.01	-0.01	-0.00	0.00	-0.00	-0.01	-0.01	-0.01	-0.01	-0.01
GDP deflator (PGDP)	-0.00	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
export price (in local currency)	-0.01	-0.01	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02
import price (in local currency)	0.02	0.00	-0.02	-0.01	0.00	0.02	0.02	0.02	0.02	0.01
short-term interest rate *	-0.01	-0.00	0.00	-0.00	-0.01	-0.01	-0.00	-0.00	-0.00	0.00
long-term interest rate *	-0.00	-0.00	0.00	-0.00	-0.00	-0.00	-0.00	-0.00	0.00	0.00
nominal effective exchange rate (-:appr.)	0.07	-0.00	-0.03	-0.00	0.03	0.05	0.07	0.08	0.09	0.09
EU accession countries										
gross domestic product	0.02	0.01	0.02	0.01	0.00	0.00	-0.00	-0.00	-0.01	-0.01
exports	0.04	0.02	0.02	0.01	0.01	0.00	-0.00	-0.00	-0.01	-0.01
imports	-0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GDP deflator	-0.00	-0.00	-0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01
price of exports	0.00	0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
price of imports	-0.00	-0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Rest of the world										
total private supply	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
exports	0.06	0.05	0.09	0.08	0.07	0.07	0.07	0.07	0.07	0.07
imports	0.04	0.14	0.13	0.12	0.11	0.10	0.10	0.10	0.09	0.08
price of exports (in euro)	-0.03	-0.09	-0.15	-0.22	-0.29	-0.35	-0.40	-0.45	-0.48	-0.51
price of imports (in euro)	0.19	0.21	0.14	0.05	-0.04	-0.13	-0.22	-0.29	-0.35	-0.41

[a] variables without *: deviation from baseline, in percent; variables with *: deviation from baseline, in differences

IV An increase in the labour participation rate

A. Introduction

In the European Union, the labour participation rate is low, especially for women, the disabled, and elderly people. A permanent increase in the labour participation rate requires adequate micro-economic policies, including, for instance, the elimination of the incentives for early retirement, and better integration between education and work, and work and private live[1]. However, since the modelling of such measures is beyond the scope of the macro-econometric NIME model, we will limit our analysis to the simulation of an exogenous 1 percentage point increase in the labour participation rate of the euro area and the non-euro EU country block.

Before we discuss the simulation results, we want to make the following remarks. First, the labour participation rate is defined as the total labour force divided by the population of working age. Here, we increase the labour supply of the euro area and the non-euro EU county block in such a way that it increases the labour participation rate by 1 percentage point vis-à-vis a technical baseline[2]. Second, the higher participation rate also affects public sector outlays because the number of people receiving a benefit decreases. In the NIME model, the total population is divided into children, old-age people, the employed, the unemployed, and the "others". The total labour supply is equal to the employed plus the unemployed. The children and old-age people are by assumption prohibited to participate in the labour market. The "others" includes those who opt not to participate in the labour market (e.g. because they want to raise their children, the early retired, etc.), and those who are severely hindered to participate (e.g. the severely disabled). It is clear that an increase in the participation rate (i.e. the labour supply), has to come from the people who opt not to participate at the present. It should also be noted that some of these people may draw a benefit from the government. Hence, when these people start to work there will be a reduction in public outlays. However, detailed data about these outlays are not available in the NIME database. As such, the fall in these expenditures can only be estimated indirectly via a simple regression which relates public transfers to the number of people in each type, to inflation and to real growth[3].

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1. See http://europa.eu.int/comm/lisbon_strategy/reports/index_en.html for a comprehensive overview of the Lisbon Strategy.
2. The population of working age is kept fixed at its baseline level.
3. See section B of Appendix A.

B. The simulation results

1. The euro area

The long-term implications of the shock are as follows. An increase in the labour participation rate increases potential output, yielding a higher income to the household sector and the fiscal authorities. Moreover, since more people work and fewer depend on a government benefit, public outlays decrease[1]. The household sector uses this higher income to finance higher consumption, while the fiscal authorities can use the favourable fiscal developments to reduce the public debt. The capital stock of the enterprise sector rises in order to accommodate the increased employment, while the stock of residential buildings rises in line with income. Imports increase in line with the increase in potential output, while exports increase by less as only potential output in the non-euro EU country block increases[2]. Furthermore, in the long run, the producer real wage and real interest rate do not change as they are not affected by this shock. However, the real take home wage will increase in the long run, because the relative price of private consumption falls. This price fall is caused by the fact that in the long run, there tends to be an excess supply of goods in the domestic market. It is only private consumption which is free to absorb this excess supply, because gross fixed capital formation and net exports are determined by the natural output level, and public consumption increases - by assumption - at the rate of potential output. As a consequence, in order to generate this higher private consumption in the long run, the relative prices of private consumption has to fall.

Table 7 shows for the euro area the first ten years of the adjustment process. The numbers in this table are, unless indicated otherwise, percentage deviations from a technical baseline. In the first year, the participation rate increases by 1 percentage point, implying a 1.4 percent increase in the labour supply. Initially, labour demand is insufficient to absorb this increased labour supply, and the unemployment rate rises by 1.2 percentage points. However, as the real wage falls and aggregate demand starts to pick up in subsequent years, half of the additional labour supply gets employed after five years, and almost all of the additional labour supply is employed after ten years.

In the first year, real GDP increases by 0.50 percent, while the GDP deflator falls by 0.05 percent. This rise in GDP is possible because domestic demand is supported by the expectation of higher future labour income and the 0.54 percentage points cut in the interest rates, while at the same time external demand is stimulated by the depreciation of the effective exchange rate and the increase in foreign effective demand[3]. The nominal effective exchange rate depreciates by 0.46 percent because the equilibrium exchange rate depreciates. Indeed, a higher output increases the imports of the euro area, so that the exchange rate has to depreciate in order to maintain equilibrium in the current account. In the medium-term, this depreciation is intensified by the interest rate cuts. In subsequent years, real GDP increases further reaching 0.91 percent above the baseline after five years and 1.11 percent after ten years, while the GDP deflator falls by, respectively, 0.25 and 0.37

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1. I.e., relative to output. Other outlays, e.g. public investments, will increase in line with the increase in output.
2. It is assumed that no shock occurs in the US, Japan, the EC block, and the rest of the world.
3. Remember that in the NE block a similar shock occurs.

percent. Let us now have a closer look at the different components of aggregate demand.

In the first year, private consumption increases by 0.40 percent, primarily because the households expect a 0.83 percent higher real labour income in the future, because the 0.42 percent increase in contemporaneous real disposable income eases pressures on the liquidity constrained households, and because the short-term interest rate falls by 0.54 basis points. The latter reduces the real interest rate and the user cost of capital, and it increases the financial wealth of the households. The largest increases in private consumption occur during the first two years because during this period the largest adjustments in (expected) income and interest rates occur. In subsequent years, private consumption rises at a slower pace, reaching 0.93 percent above the baseline after five years, and 1.16 percent after 10 years.

Higher overall economic activity and lower interest rates increase total gross fixed capital formation by 0.72 percent in the first year. Gross fixed capital formation by the public sector is up by 0.50 percent, which is in line with GDP growth. Investment in residential buildings increases by 0.98 percent in the first year, primarily because real disposable income and the total available means of the household sector increase. Investments by the enterprise sector increase by 0.67 percent in the first year, and increase further in subsequent years as the lower interest rate cuts start to have their full impact. After five years, total investments are 1 percent above the baseline, and increase only gradually thereafter.

The GDP deflator is below the baseline throughout the simulation. As discussed before, the relative consumer price has to fall in order to clear the goods market in the long run. As a consequence, the consumer price falls by 0.50 percent after five years, compared with a 0.25 percent fall in the GDP deflator. After ten years, the consumer price is 0.85 percent below the baseline, compared with 0.37 percent for the GDP deflator. The exchange rate depreciation puts upward pressure on the prices of exports and imports, which increase, respectively, by 0.26 and 0.05 percent after five years. The increase in the import prices is somewhat tempered by the fall in the domestic prices, and import prices start to fall below the baseline as of the seventh year, when they are 0.03 percent below the baseline, compared with 0.32 percent for the GDP deflator.

Imports increase by 0.30 percent in the first year, primarily due to the 0.51 percent increase in private supply for final demand and the increase in import prices. Exports increase by 0.23 percent in the first year, due to the gain in competitiveness and the 0.13 percent increase in the foreign effective output level. The latter increases mainly because the output of the non-euro EU country block increases by 0.55 percent, as the participation rate in the NE block is also raised. In subsequent years, exports and imports evolve in line with the scale effects and the relative prices. All in all, the current account to GDP ratio of the euro area decreases by 0.02 percentage points in the first year, but rises above the baseline thereafter as exports grow faster than imports, i.e., exports are up by 0.7 percent after five years, while imports increase by 0.4 percent.

In the labour market, the unemployment rate increases immediately by 1.2 percentage points as the inflow of new employees is larger than the demand for additional labour. In the first year, the producer real wage increases by 0.13 percent, mainly because contemporaneous labour productivity increases by 0.42 percent. However, in the second year, when the higher unemployment rate starts

to have its effect on wages, the producer real wage falls to 0.43 percent below the baseline, while at the same time the take home real wage falls to 0.32 percent below the baseline. The difference in the behaviour of the producer real wage and the take home real wage reflects the fact that the consumer price falls by more than the producer price. In the subsequent years, the producer real wage decreases further because the unemployment rate improves only moderately while at the same time labour productivity starts to fall. After five years, the producer real wage reaches a low of almost 1 percent below the baseline. These real wage cuts, together with the increases in aggregate demand, which is supported by the expectation of higher future income, stimulate labour demand, and after five years more than half of the additional labour supply has been absorbed, and after ten years almost all of the additional labour supply is employed.

The public deficit to GDP ratio of the euro area increases by less than 0.2 percentage point in the first year, and it is above the baseline as of the sixth year. The deficit increases initially, primarily because the additional outlays for the unemployed is higher than the additional revenues caused by higher economic activity. In later years, the public finances improve, due to higher economic activity which raises tax revenues, the decline in the outlays for the unemployed and the other dependents, and the fall in interest payments. In line with these deficits and a higher nominal GDP, the debt to GDP ratio falls by 0.13 percentage points in the first year. After ten years, the debt to GDP ratio is 0.63 percentage points below the baseline.

2. The non-euro EU countries and the rest of the world

In the non-euro EU country block, where a similar shock occurs there are similar qualitative effects because the nature of the shock and the transmission mechanisms are similar to the ones in the euro area, see Table 8. In the first year, real GDP and the GDP deflator of the non-euro EU country block increase, respectively, by 0.48 and 0.05 percent compared with, respectively, an increase of 0.50 percent and a decrease of 0.05 percent in the euro area. In the second year, real GDP increases to 0.56 percent above the baseline, while the GDP deflator falls to 0.09 percent below the baseline. The widening output gap and the fall in prices trigger a cut in the short-term interest rate, thereby giving an additional boost to demand. In the labour market, the unemployment rate increases by 1.10 percentage points in the first year, while the producer real wage remains almost unaffected. As of the second year, the effect of the increased unemployment rate starts to have its effect on the wages, and the producer real wage falls 0.91 percent below the baseline, compared with 0.43 percent in the euro area.

In subsequent years, GDP increases further to about 0.92 percent above the baseline after five years, compared with 0.91 percent in the euro area, while the GDP deflator is 0.35 percent below the baseline after five years, compared with 0.25 percent in the euro area. The public deficit to GDP ratio rises to 0.31 percentage points above the baseline in the first year. As the number of unemployed starts to fall, and output expands, the fiscal stance improves and the deficit to GDP ratio starts to fall, reaching the baseline in the fourth year. The current account to GDP ratio of the non-euro EU countries falls 0.05 percentage points in the first year, but recovers thereafter, primarily reflecting higher foreign demand and a depreciating exchange rate.

The spill-over effects to the other country blocks are rather limited, see Table 9. Exports of the other country blocks are stimulated by an increase in the foreign effective output level, but are somewhat tempered by the appreciation of their exchange rate. Exports increase in the US by about 0.3 percent throughout the simulation, and in Japan by about 0.1 percent in the first year, but afterwards exports in Japan fall in line with the strong appreciation of the yen. In the EC block exports increase by about 0.10 percent.

TABLE 7 - **An increase in participation rate: main macro-economic effects for the euro area[a]**

	1	2	3	4	5	6	7	8	9	10
Demand/supply (in constant prices)										
private consumption	0.40	0.57	0.66	0.82	0.93	1.01	1.07	1.11	1.14	1.16
public consumption	0.24	0.32	0.37	0.42	0.45	0.47	0.48	0.50	0.53	0.57
gross fixed capital formation	0.72	0.91	1.00	1.02	1.01	1.02	1.04	1.07	1.10	1.13
o/w enterprise sector	0.67	1.01	1.15	1.17	1.12	1.09	1.07	1.06	1.07	1.08
residential buildings	0.98	0.82	0.76	0.70	0.74	0.84	0.97	1.10	1.22	1.32
public sector	0.50	0.60	0.70	0.82	0.91	0.98	1.03	1.06	1.09	1.11
exports	0.23	0.38	0.48	0.58	0.67	0.74	0.78	0.79	0.80	0.80
imports	0.30	0.30	0.33	0.36	0.39	0.42	0.45	0.47	0.49	0.51
gross domestic product	0.50	0.60	0.70	0.82	0.91	0.98	1.03	1.06	1.09	1.11
total private supply for final demand	0.51	0.60	0.69	0.81	0.88	0.95	1.00	1.03	1.05	1.07
Prices										
GDP deflator (PGDP)	-0.05	-0.06	-0.14	-0.20	-0.25	-0.29	-0.32	-0.34	-0.36	-0.37
consumption price	0.01	-0.14	-0.28	-0.40	-0.50	-0.59	-0.67	-0.73	-0.79	-0.85
export price (in local currency)	0.03	0.07	0.13	0.19	0.26	0.33	0.39	0.45	0.51	0.56
import price (in local currency)	0.06	0.10	0.10	0.08	0.05	0.01	-0.03	-0.06	-0.09	-0.11
Labour market										
total employment	0.07	0.12	0.24	0.55	0.83	1.06	1.22	1.30	1.34	1.34
private sector employment	0.09	0.11	0.22	0.56	0.87	1.13	1.30	1.39	1.42	1.41
public sector employment	-0.00	0.18	0.34	0.48	0.61	0.71	0.80	0.87	0.94	0.99
unemployment rate *	1.21	1.16	1.05	0.77	0.51	0.29	0.14	0.05	0.02	0.01
nominal wage (private sector)	0.10	-0.46	-0.80	-1.06	-1.17	-1.17	-1.09	-0.97	-0.85	-0.75
take home real wage (private sector)	0.09	-0.32	-0.52	-0.66	-0.67	-0.58	-0.42	-0.24	-0.06	0.09
producer real wage (private sector)	0.13	-0.43	-0.70	-0.91	-0.98	-0.94	-0.83	-0.69	-0.55	-0.44
contemporaneous productivity	0.42	0.48	0.47	0.25	0.02	-0.18	-0.30	-0.36	-0.37	-0.34
participation rate	1.00	1.00	0.99	0.99	0.99	0.99	0.98	0.98	0.98	0.98
contemporaneous labour supply	1.40	1.40	1.39	1.39	1.38	1.37	1.37	1.36	1.36	1.35
Financial sector										
short-term interest rate *	-0.54	-0.43	-0.49	-0.40	-0.33	-0.28	-0.23	-0.20	-0.18	-0.17
long-term interest rate *	-0.30	-0.24	-0.27	-0.22	-0.19	-0.16	-0.13	-0.11	-0.10	-0.09
nominal effective exchange rate (-:appr.)	0.46	0.81	1.06	1.25	1.38	1.47	1.52	1.54	1.54	1.54
real effective exchange rate (-:appr.)	0.44	0.73	0.91	1.02	1.07	1.08	1.06	1.02	0.96	0.90
nominal money stock	2.43	1.80	1.95	1.61	1.42	1.22	1.06	0.93	0.84	0.76
Public finance										
nominal public revenues	0.45	0.27	0.16	0.13	0.14	0.17	0.21	0.25	0.29	0.31
nominal public expenditures	0.83	0.63	0.60	0.41	0.24	0.06	-0.08	-0.18	-0.24	-0.28
deficit to GDP ratio * (+:surplus)	-0.17	-0.16	-0.19	-0.12	-0.05	0.04	0.12	0.18	0.23	0.25
debt to GDP ratio *	-0.13	-0.03	0.15	0.23	0.25	0.18	0.04	-0.15	-0.38	-0.63
Household sector										
total available means	0.83	0.91	1.02	1.05	1.08	1.10	1.11	1.13	1.15	1.16
o/w real disposable income	0.42	0.37	0.30	0.31	0.37	0.45	0.56	0.66	0.76	0.83
inherited assets (deflated by cons. price)	0.82	0.77	0.99	0.95	0.92	0.87	0.82	0.78	0.76	0.74
expected future real income	0.83	0.97	1.03	1.10	1.15	1.20	1.24	1.28	1.31	1.34
Memo items										
foreign effective output	0.13	0.15	0.17	0.21	0.24	0.26	0.26	0.26	0.26	0.26
foreign effective price level	0.01	-0.01	-0.03	-0.05	-0.06	-0.06	-0.07	-0.07	-0.07	-0.08
foreign effective interest rate *	-0.06	-0.10	-0.12	-0.07	-0.04	-0.02	-0.01	-0.02	-0.02	-0.02
current account to GDP *	-0.02	0.02	0.04	0.08	0.12	0.16	0.19	0.22	0.24	0.26
real public debt	0.30	0.55	0.92	1.15	1.26	1.24	1.08	0.84	0.52	0.17

[a] variables without *: deviation from baseline, in percent; variables with *: deviation from baseline, in differences

TABLE 8 - **An increase in participation rate: main macro-economic effects for the NE block[a]**

	1	2	3	4	5	6	7	8	9	10
Demand/supply (in constant prices)										
private consumption	0.64	0.61	0.79	0.99	1.18	1.32	1.34	1.30	1.25	1.20
public consumption	0.27	0.34	0.34	0.28	0.27	0.33	0.43	0.53	0.63	0.70
gross fixed capital formation	0.64	0.61	0.56	0.56	0.66	0.78	0.88	0.95	0.98	0.99
o/w enterprise sector	0.38	0.51	0.54	0.55	0.58	0.61	0.64	0.69	0.73	0.75
residential buildings	1.99	1.16	0.53	0.42	0.86	1.49	1.93	2.08	2.07	2.01
public sector	0.48	0.56	0.72	0.83	0.92	1.01	1.05	1.07	1.09	1.11
exports	0.33	0.54	0.76	0.91	0.98	1.00	1.00	1.00	1.02	1.06
imports	0.58	0.54	0.60	0.76	0.93	1.06	1.09	1.05	1.00	0.95
gross domestic product	0.48	0.56	0.72	0.83	0.92	1.01	1.05	1.07	1.09	1.11
total private supply for final demand	0.55	0.60	0.75	0.90	1.03	1.13	1.16	1.15	1.14	1.13
Prices										
GDP deflator (PGDP)	0.05	-0.09	-0.21	-0.29	-0.35	-0.39	-0.42	-0.47	-0.51	-0.57
consumption price	0.02	-0.23	-0.50	-0.71	-0.86	-0.94	-0.98	-1.00	-1.03	-1.06
export price (in local currency)	0.14	0.33	0.49	0.60	0.65	0.63	0.58	0.52	0.44	0.37
import price (in local currency)	0.08	0.15	0.06	-0.06	-0.15	-0.21	-0.23	-0.23	-0.23	-0.24
Labour market										
total employment	0.06	0.25	0.75	1.13	1.28	1.26	1.18	1.13	1.12	1.13
private sector employment	0.08	0.24	0.80	1.22	1.37	1.33	1.22	1.15	1.12	1.13
public sector employment	0.00	0.29	0.52	0.69	0.82	0.91	0.99	1.04	1.08	1.11
unemployment rate *	1.10	0.93	0.46	0.09	-0.05	-0.04	0.03	0.08	0.09	0.08
nominal wage (private sector)	0.03	-0.94	-1.63	-1.80	-1.59	-1.27	-1.03	-0.93	-0.92	-0.93
take home real wage (private sector)	0.01	-0.71	-1.13	-1.09	-0.73	-0.33	-0.05	0.07	0.11	0.13
producer real wage (private sector)	-0.03	-0.91	-1.49	-1.56	-1.29	-0.92	-0.65	-0.52	-0.47	-0.44
contemporaneous productivity	0.47	0.36	-0.05	-0.32	-0.34	-0.20	-0.06	0.01	0.02	-0.01
participation rate	1.00	0.99	0.98	0.97	0.97	0.96	0.96	0.96	0.96	0.96
contemporaneous labour supply	1.23	1.23	1.23	1.23	1.23	1.22	1.22	1.22	1.22	1.21
Financial sector										
short-term interest rate *	-0.27	-0.56	-0.44	-0.30	-0.19	-0.11	-0.08	-0.10	-0.12	-0.13
long-term interest rate *	-0.07	-0.14	-0.11	-0.08	-0.05	-0.03	-0.02	-0.03	-0.03	-0.03
nominal effective exchange rate (-:appr.)	0.39	1.37	1.73	1.88	1.79	1.59	1.40	1.31	1.29	1.30
real effective exchange rate (-:appr.)	0.24	1.04	1.20	1.23	1.07	0.87	0.72	0.69	0.74	0.82
nominal money stock	1.53	2.65	2.40	1.81	1.22	0.82	0.62	0.65	0.73	0.80
Public finance										
nominal public revenues	0.59	0.26	0.06	-0.02	0.04	0.15	0.24	0.26	0.26	0.23
nominal public expenditures	1.34	1.16	0.51	-0.12	-0.44	-0.41	-0.27	-0.16	-0.13	-0.16
deficit to GDP ratio * (+:surplus)	-0.31	-0.38	-0.20	0.03	0.18	0.23	0.20	0.17	0.16	0.16
debt to GDP ratio *	0.10	0.50	0.66	0.60	0.37	0.11	-0.10	-0.26	-0.39	-0.53
Household sector										
total available means	0.74	1.13	1.26	1.24	1.18	1.13	1.09	1.08	1.08	1.07
o/w real disposable income	0.63	0.32	0.15	0.15	0.33	0.59	0.79	0.89	0.93	0.95
inherited assets (deflated by cons. price)	1.00	2.05	2.10	1.72	1.30	1.01	0.84	0.86	0.92	0.96
expected future real income	0.65	0.80	0.95	1.07	1.14	1.17	1.17	1.15	1.12	1.10
Memo items										
foreign effective output	0.21	0.25	0.29	0.33	0.37	0.39	0.41	0.43	0.43	0.44
foreign effective price level	-0.01	-0.01	-0.04	-0.06	-0.08	-0.09	-0.10	-0.11	-0.11	-0.12
foreign effective interest rate *	-0.19	-0.16	-0.22	-0.14	-0.11	-0.09	-0.07	-0.06	-0.05	-0.05
current account to GDP *	-0.05	0.05	0.18	0.24	0.26	0.25	0.23	0.22	0.22	0.23
real public debt	0.74	1.79	2.34	2.29	1.85	1.30	0.78	0.37	0.01	-0.35

[a] variables without *: deviation from baseline, in percent; variables with *: deviation from baseline, in differences

TABLE 9 -   An increase in participation rate: main macro-economic spill-over effects[a]

	1	2	3	4	5	6	7	8	9	10
United States										
gross domestic product	-0.01	0.01	0.00	0.00	0.01	0.02	0.02	0.01	0.01	0.01
exports	0.26	0.29	0.30	0.33	0.34	0.35	0.34	0.32	0.30	0.28
imports	-0.00	0.06	0.07	0.07	0.04	0.01	-0.01	-0.03	-0.03	-0.03
GDP deflator (PGDP)	-0.01	-0.02	-0.03	-0.04	-0.05	-0.05	-0.05	-0.05	-0.05	-0.04
export price (in local currency)	-0.10	-0.22	-0.31	-0.36	-0.38	-0.38	-0.36	-0.35	-0.34	-0.33
import price (in local currency)	-0.05	-0.09	-0.11	-0.09	-0.06	-0.03	-0.02	-0.01	-0.01	-0.01
short-term interest rate *	-0.03	-0.01	-0.01	-0.01	-0.00	0.00	0.00	0.01	0.00	0.00
long-term interest rate *	-0.01	-0.00	-0.00	-0.00	-0.00	0.00	0.00	0.00	0.00	0.00
nominal effective exchange rate (-:appr.)	-0.15	-0.28	-0.41	-0.46	-0.48	-0.48	-0.47	-0.46	-0.45	-0.44
Japan										
gross domestic product	-0.01	-0.00	-0.04	-0.05	-0.04	-0.03	-0.02	-0.01	-0.01	-0.01
exports	0.12	0.03	-0.08	-0.15	-0.14	-0.11	-0.07	-0.04	-0.02	-0.01
imports	-0.00	0.05	0.08	0.10	0.07	0.02	-0.02	-0.05	-0.06	-0.05
GDP deflator (PGDP)	-0.00	-0.00	-0.01	-0.02	-0.05	-0.07	-0.08	-0.09	-0.10	-0.10
export price (in local currency)	-0.07	-0.13	-0.18	-0.21	-0.24	-0.26	-0.27	-0.28	-0.29	-0.30
import price (in local currency)	-0.13	-0.24	-0.31	-0.25	-0.14	-0.04	0.03	0.05	0.04	0.01
short-term interest rate *	-0.00	-0.01	-0.02	-0.05	-0.05	-0.04	-0.03	-0.02	-0.01	-0.01
long-term interest rate *	-0.00	-0.00	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.00	-0.00
nominal effective exchange rate (-:appr.)	-0.34	-0.60	-0.83	-0.79	-0.70	-0.60	-0.53	-0.50	-0.49	-0.48
EU *accession countries*										
gross domestic product	0.06	0.06	0.05	0.06	0.06	0.07	0.07	0.07	0.07	0.06
exports	0.10	0.10	0.08	0.09	0.09	0.09	0.09	0.09	0.09	0.08
imports	-0.00	0.00	0.01	0.01	0.02	0.02	0.03	0.03	0.04	0.04
GDP deflator	-0.01	-0.01	-0.00	-0.00	0.00	0.01	0.01	0.02	0.03	0.04
price of exports	0.00	0.00	0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
price of imports	-0.00	-0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Rest of the world										
total private supply	0.05	0.06	0.07	0.09	0.09	0.10	0.11	0.11	0.11	0.11
exports	0.35	0.42	0.48	0.57	0.63	0.68	0.71	0.72	0.73	0.73
imports	0.47	0.67	0.80	0.98	1.15	1.29	1.38	1.43	1.46	1.48
price of exports (in euro)	0.04	0.14	0.27	0.42	0.57	0.69	0.80	0.88	0.94	0.98
price of imports (in euro)	0.02	0.14	0.36	0.59	0.85	1.11	1.35	1.57	1.76	1.92

[a] variables without *: deviation from baseline, in percent; variables with *: deviation from baseline, in differences

V Appendix A: Modifications to the NIME model

A comprehensive overview of the NIME model can be found in Meyermans and Van Brusselen (2001) and Appendix A of Meyermans (2003). In this appendix, we describe changes to the equations determining the natural rate of unemployment, the labour supply, and the public transfers of the household sector. We also describe briefly the new country block for the EU accession countries, i.e., the EC block.

In the first section of this appendix, we propose a new specification for the natural rate of unemployment. In Meyermans and Van Brusselen (2001), the natural rate of unemployment is calculated by applying a Hodrick-Prescott filter to the unemployment rate series and it is kept constant troughout the simulation of a shock. This approach is not entirely satisfying since it does not allow for a careful analysis of shocks that affect the natural rate of unemployment. In this appendix, we make this variable endogenous by giving more structure to the reservation wage in the labour bargaining process. In the second section, we modify the equation describing public transfers to the household sector by having a more detailed breakdown of the different recipients. In the third section, we modify the labour supply equation by letting labour supply be affected by the deviation of the contemporaneous wage from the equilibrium wage. This approach captures the idea that in the NIME model the income effect and the substitution effect of a permanent wage increase cancel each other out, but that a temporary wage increase (decrease) induces employees to work temporary more (less). In the fourth section, we describe the new EC country block which consists of a limited set of equations for the main macro-economic aggregates of the EC accession countries.

A. The natural rate of unemployment

The natural rate of unemployment is closely linked to the bargaining process in the labour market. Meyermans and Van Brusselen (2001) start from a bargaining process between the household sector and the enterprise sector, and they derive that the equilibrium wage is a function of the reservation wage and labour productivity, whereby it is assumed that the reservation wage is proportional to the after tax real wage. In this paper, we assume that this proportionality between the reservation wage and the after tax real wage varies with the unemployment rate. Indeed, when the unemployment rate increases, the public outlays for unemployment benefits also increase, so that in order to limit its outlays, the public sector will have an incentive to reduce the unemployment benefit. Hence, there exists a negative relationship between the reservation wage and the unemployment rate. Moreover, we also assume that the reservation wage is also determined by the op-

tions which the unemployed have in the informal economy and by their non-labour income, whereby the latter is determined by the real interest rate. Based on these new assumptions regarding the reservation wage, we derive an equation determining the natural rate of unemployment as a function of the tax wedge, the real interest rate and the market power of the enterprises in the goods and labour market. Indeed, when the tax rates are lowered the gap between the reservation wage and the take home wage increases, and the employees become more willing to accept a job offer so that the natural rate of unemployment falls. When the real interest rate increases the non-labour income of the unemployed increases and the unemployed will be more reluctant to accept a job offer so that the natural rate of unemployment increases. When the employers market power in the goods market increases, the output level decreases and the demand for labour will decrease so that the natural rate of unemployment increases. Let us now have a closer look at the analytical results.

1. Wage setting

Our starting point is a sequential bargaining process whereby in a first stage, a profit maximizing enterprise sector and a utility maximizing household sector bargain over the wage[1]. In a second stage, the enterprise sector decides the quantities of labour and the other production factors that it will use in production [2]. As discussed in Meyermans and Van Brusselen (2000), the first stage of the wage bargaining process is defined as:

(1) $\underset{WRP}{MAX}\ OSPU^{q}B^{(1-q)}$

with:

B: the disutility of work by the household sector,
OSPU: profits of the enterprise sector,
WRP: nominal wage in private sector.

a. The enterprise sector

The enterprise sector maximizes its profits. Assuming a Cobb-Douglas production technology with constant returns to scale, profits of the enterprise sector, OSPU, are equal to:

(2) $OSPU = \left(\dfrac{1-asp\_l1}{asp\_l1}\right) WRP\ NP - PCIP\ GIPO - PMP\ MPO,$

with:

GIPO: gross fixed capital formation of the enterprise sector, in constant prices,
MPO: the (intermediary) imports, in constant prices,
NP: total employment in the private sector,
PCIP: the price of the capital stock owned by enterprises,
PMP: the price of (intermediary) imports,
and asp_l1, i.e., the technical coefficient of labour in the Cobb-Douglas production function. See Appendix B of Meyermans and Van Brusselen (2001) for more details.

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1. We repeat here to a large extent Appendix B of Meyermans and Van Brusselen (2001). The main difference is the specification of the reservation wage.
2. See Alogoskoufis and Manning (1991) for a similar sequential bargaining process.

b. The household sector

The household sector bargains for a real wage that maximizes the surplus between the after-tax real wage bill and the real reservation wage bill. The objective function of the household sector is defined as:

$$(3) \quad B = \left(\frac{WRP(1 - DTHR)(1 - SSRTR)}{PCH} - \frac{BEN}{PCH} \right) NP,$$

with:
DTHR: the direct income tax rate,
SSRTR: the social security contribution rate,
BEN: the nominal reservation wage,
PCH: the consumer price index,

whereby it should be noted that the reservation wage is not observed.

2. The equilibrium reservation wage

Here, we assume that the reservation wage is determined by the unemployment benefit, UB, the income earned in the informal economy, BW, and other non-labour income, RNLI, i.e.:

$$(4) \quad \left(\frac{BEN}{PCH} \right) = rb0\_1 \left(\frac{UB}{PCH} \right) + (1\text{-}rb0\_1) \left(\frac{BW}{PCH} \right) + rb0\_2 \, RNLI,$$

with:
BEN: the nominal reservation wage,
BW: the nominal wage in the informal sector,
RNLI: the real non-labour income,
UB: the nominal unemployment benefit,

and where $0 \le rb0\_1 \le 1$ measures the share of the non-employed receiving an unemployment benefit and $(1\text{-}rb0\_1)$ the share of people working in the informal economy.

We assume that the unemployment benefit, UB, is proportional to the after tax wage earned in the private sector, that the wage earned in the informal economy, BW, is linked to labour productivity, and that the real non-labour income, RNLI, is determined by the real interest rate, i.e.:

$$(5) \quad \left(\frac{UB}{PCH} \right) = (ub\_0 \, UR^{ub\_1}) \left(\frac{WRP \, (1\text{-} DTHR) \, (1\text{-}SSRH)}{PCH} \right),$$

$$(6) \quad \left(\frac{BW}{PCH} \right) = bw\_0 \, asp\_l1 \, YNP \, \frac{PASP}{PCH},$$

$$(7) \quad RNLI = rnli\_1 \, RLI$$

with:
RLI: the real interest rate,
UR: the unemployment rate,
YNP: the (average) labour productivity,

and where $ub\_0, bw\_0, rnli\_1 \ge 0$ and $ub\_1 \le 0$.

Equation (5) states that the unemployment benefit is proportional to the net real wage earned in the formal sector of the economy. Here, we assume that this proportionality varies with the unemployment rate. Indeed, when the unemployment rate increases, the public outlays for unemployment benefits also increase, so that in order to limit its outlays, the public sector will have an incentive to reduce the unemployment benefit when unemployment increases. Equation (6) states that the real "wage" earned in the informal economy is proportional to the output value deflated by the consumer price index. Finally, equation (7) states that the real non labour income is function of the real interest rate.

Inserting equations (5), (6) and (7) into equation (4), yields:

(8) $\quad \left(\dfrac{\text{BEN}}{\text{PCH}}\right) = \text{rb0\_1 Z} \left(\dfrac{\text{WRP}}{\text{PCH}}\right) + (1\text{-rb0\_1}) \, \text{bw\_0 asp\_l1 YNP} \dfrac{\text{PASP}}{\text{PCH}}$

$\quad\quad\quad\quad\quad + \text{rb0\_2 rnli\_1 RLI}$

with Z defined as:

(9) $\quad Z = (\text{ub\_0 UR}^{\text{ub\_1}}) \; (1\text{- DTHR}) (1\text{-SSRTR}) \,.$

Inserting equation (8) into equation (3), yields for the disutility of the household sector:

(10) $\quad B = \left\{ \left(\dfrac{(1-\text{DTHR})(1-\text{SSRTR}) - \text{rb0\_1 Z}}{\text{PCH}}\right) \text{WRP} \right.$

$\quad\quad\quad\quad - (1\text{-rb0\_1}) \, \text{bw\_0 asp\_l1 YNP} \dfrac{\text{PASP}}{\text{PCH}} - \left. \text{rb0\_2 mli\_1 RLI} \right\} \text{NP}$

3. The equilibrium private sector wage

In a first stage the household sector and the enterprise sector negotiate the wage. Inserting equation (2), i.e. the profits of the enterprises, and equation (10), i.e. the disutility of the household sector, into equation (1), i.e. the wage bargaining process, yields:

(11) $\quad \underset{\text{WRP}}{\text{MAX}} \left(\dfrac{1-\text{asp\_l1}}{\text{asp\_l1}} \text{WRP NP} - \text{PCIP GIPO} - \text{PMP MPO}\right)^{q}$

$\quad\quad\quad \left\{ \left\{ \left(\dfrac{(1-\text{DTHR})(1-\text{SSRTR}) - \text{rb0\_1 Z}}{\text{PCH}}\right) \text{WRP} \right.\right.$

$\quad\quad\quad\quad - (1\text{-rb0\_1}) \, \text{bw\_0 asp\_l1 YNP} \dfrac{\text{PASP}}{\text{PCH}} - \left.\left. \text{rb0\_2mli\_1RLI} \right\} \text{NP} \right\}^{(1\text{-q})}$

The equilibrium wage derived from this optimization problem read as[1]:

(12.a) $\quad \ln\left(\dfrac{\text{WRP}}{(1-\text{NITR})\text{PASP}}\right) = \text{wrp\_l1} \ln\left(\left(\dfrac{\text{BEN}}{\text{PCH}}\right)\dfrac{1}{\text{TAXWP}}\right)$

$\quad\quad\quad\quad + (1\text{-wrp\_l1}) \ln(\text{asp\_l1 YNP}),$

with the tax wedge, TAXWP, defined as:

(12.b) $\quad \text{TAXWP} = (1-\text{DTHR})(1-\text{SSRTR})(1-\text{NITR}) \dfrac{\text{PASP}}{\text{PCH}},$

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1. See sub-section A.7 of this appendix.

and labour productivity, YNP, as:

(12.c) $YNP = \dfrac{ASPO}{NP}$,

and where $0 \le wrp\_l1 \le 1$.

Note that equation (12.a) can be rewritten in terms of the real take home wage as:

(13) $\ln\left(\dfrac{WRP(1\text{-}DTHR)\,(1\text{-}SSRH)}{PCH}\right) = wrp\_l1\,\ln\left(\dfrac{BEN}{PCH}\right)$

$$+ (1\text{-}wrp\_l1)\,\ln(asp\_l1\ YNP\ TAXWP).$$

Equation (13) states that in equilibrium the take home real wage is a weighted average of labour productivity and the reservation wage.

4. The natural rate of unemployment

In this section, we calculate the natural rate of unemployment. For the sake of mathematical convenience, we use a log-linearised approximation of equation (8), i.e.:

(14) $\ln\left(\dfrac{BEN}{PCH}\right) = b\_0 + b\_1\,\ln\left(\left(\dfrac{WRP}{PCH}\right)Z\right)$

$$+ (1\text{-}b\_1)\,\ln\left[bw\_0\ asp\_l1\ YNP\dfrac{PASP}{PCH}\right]$$

$$+ b\_2\,\ln(1+RLI)$$

with $0 \le b\_1 \le 1$, and $b\_2 \ge 0$.

On using equation (9), which defines Z, and equation (12.b), which defines the tax wedge, equation (14) can also be written as:

(15) $\ln\left(\dfrac{BEN}{PCH}\right) = b\_0 + b\_1\,\ln\left(\dfrac{WRP}{(1-NITR)PASP}\right)$

$$+ b\_1\,\ln\left(ub\_0\ UR^{ub\_1}\right)$$

$$+ b\_1\,\ln(TAXWP)$$

$$+ (1\text{-}b\_1)\,\ln\left[bw\_0\ asp\_l1\ YNP\dfrac{PASP}{PCH}\right]$$

$$+ b\_2\,\ln(1+RLI).$$

Inserting the equation determining the equilibrium reservation wage, i.e. equation (15), in the long run wage equation, i.e. equation (12.a), we get:

$$\ln\left(\dfrac{WRP}{(1-NITR)PASP}\right) = wrp\_l1\ b\_0$$

$$+ wrp\_l1\ b\_1\,\ln\left(\dfrac{WRP}{(1-NITR)PASP}\right)$$

$$+ wrp\_l1\ b\_1\,\ln\left(ub\_0\ UR^{ub\_1}\right)$$

$$+ wrp\_l1\ b\_1\,\ln(TAXWP)$$

$$+ \text{wrp\_l1} (1\text{-}b\_1) \ln\left[\text{bw\_0 asp\_l1 YNP}\frac{\text{PASP}}{\text{PCH}} \right]$$

$$+ \text{wrp\_l1 b\_2} \ln(1+\text{RLI})$$

$$- \text{wrp\_l1} \ln(\text{TAXWP})$$

$$+ (1\text{-wrp\_l1}) \ln(\text{asp\_l1 YNP}).$$

On rearranging terms, and using the definition of TAXWP in (12.b), we get:

(16) $0 = (\text{wrp\_l1 b\_1 - 1}) [\ln \left(\dfrac{\text{WRP}}{(1 - \text{NITR})\text{PASP}} \right) - \ln(\text{asp\_l1 YNP})]$

$\quad\quad + \text{wrp\_l1 ub\_1 b\_1} \ln(\text{ub\_0 UR})$

$\quad\quad + \text{wrp\_l1 (b\_1-1)} \ln[(1\text{-DTHR}) (1\text{-SSRTR}) (1\text{-NITR})]$

$\quad\quad + \text{wrp\_l1 b\_2} \ln(1+\text{RLI})$

$\quad\quad + \text{wrp\_l1 b\_1} \ln(\text{ub\_0}) + \text{wrp\_l1}(1\text{- b\_1}) \ln(\text{bw\_0}) + \text{wrp\_l1 b\_0}.$

Here, it should be noted that in the goods market, prices are set by:

(17) $\ln [\text{PASP} (1\text{-NITR})] = \ln \left(\dfrac{\text{WRP}}{\text{asp\_l1 YNP}} \right) + \text{TR\_MP}$

with TR_MP(≥ 0) the market power of the price setter. Equation (17) states that the producer price is equal to the unit wage cost plus a mark-up. Note that TR_MP = 0 in the case of perfect competition.

Rewriting the previous equation we get:

(18) $\ln \left(\dfrac{\text{WRP}}{(1 - \text{NITR})\text{PASP}} \right) - \ln(\text{asp\_l1 YNP}) = - \text{TR\_MP}.$

Using the latter result in equation (16), equation (16) solves for the natural rate of unemployment as:

(19.a) $\ln(\text{UR}) = \text{ur\_0} + \text{ur\_1} \ln[(1\text{-DTHR}) (1\text{-SSRTR})(1\text{-NITR})] + \text{ur\_2} \ln(1+\text{RLI})$
$\quad\quad\quad + \text{ur\_3 TR\_MP}$

with the parameters defined as:

(19.b) $\text{ur\_0} = \dfrac{\text{-b\_1} \ln(\text{ub\_0}) \text{-b\_0-} (1\text{-b\_1}) \ln (\text{bw\_0})}{\text{b\_1 ub\_1}}$,

(19.c) $\text{ur\_1} = \dfrac{1\text{-b\_1}}{\text{ub\_1 b\_1}} \leq 0$,

(19.d) $\text{ur\_2} = - \dfrac{\text{b\_2}}{\text{b\_1 ub\_1}} \geq 0$,

(19.e) $\text{ur\_3} = \dfrac{\text{wrp\_l1 b\_1 - 1}}{\text{wrp\_l1 b\_1 ub\_1}} \geq 0$

Equation (19) shows how the natural rate of unemployment is determined by the tax wedge, the real interest rate, and the market power of the employers in the goods market. When the tax rates are lowered the gap between the reservation wage and the take home wage increases, and the employees become more willing to accept a job offer so that the natural rate of unemployment falls. When the real interest rate increases the non-labour income increases and the unemployed will

become more reluctant to accept a job offer so that the natural rate of unemployment increases. When the market power of the employers in the goods market increases, the output level decreases and the demand for labour will decrease so that the natural rate of unemployment increases. It should also be noted that equations (12.a) and (19) describe long run equilibrium conditions, and that these conditions are not immediately attained, because the household sector revises its reservation wage only gradually.

5. The wage dynamics

a. The short run dynamics of the reservation wage

The equilibrium reservation wage, RBEN, is defined in equation (15). Here, we assume that the household sector revises its contemporaneous reservation wage only gradually according to the following scheme:

$$\Delta\ln\left(\frac{BEN_t}{PCH_t}\right) = (ben\_1 - 1)\left\{\ln\left(\frac{BEN_{t-1}}{PCH_{t-1}}\right) - \ln\left(\frac{RBEN_{t-1}}{PCH_{t-1}}\right)\right\}$$

or, on rewriting terms:

$$(20.a) \quad 1\ln\left(\frac{BEN_t}{PCH_t}\right) = ben\_1 \ln\left(\frac{BEN_{t-1}}{PCH_{t-1}}\right) + (1 - ben\_1)\ln\left(\frac{RBEN_{t-1}}{PCH_{t-1}}\right)$$

with $0 \le ben\_1 \le 1$, and with the equilibrium reservation wage, RBEN:

$$(20.b) \quad \ln\left(\frac{RBEN_t}{PCH_t}\right) = b\_0 + b\_1 \ln\left(\frac{WRP_t}{(1 - NITR_t)PASP_t}\right)$$

$$+ b\_1 \ln\left[\left(ub\_0\, UR_t^{ub\_1}\right)\right]$$

$$+ b\_1 \ln(TAXWP_t)$$

$$+ (1-b\_1)\ln\left(bw\_0\, asp\_l1\, YNP_t\frac{PASP_t}{PCH_t}\right)$$

$$+ b\_2 \ln(1+RLI_t),$$

see equation (15). Note that we use time subscripts to indicate the period in time.

b. The short run dynamics of the private sector wage equation

Using the previous results, we will now derive a dynamic wage setting equation.

Note that for the period *t-1*, equation (12.a) can be rewritten as:

$$(21) \quad \ln(BEN_{t-1}/PCH_{t-1}) = (1/wrp\_l1) \ln[WRP_{t-1}/((1-NITPR_{t-1})\, PASP_{t-1})]$$
$$- ((1-wrp\_l1)/wrp\_l1) \ln(asp\_l1\, YNP_{t-1}).$$
$$+ \ln(TAXWP_{t-1})$$

On inserting equation (21) into equation (20.a), we obtain for the reservation wage in period t:

(22) $\ln(BEN_t/PCH_t) = ben\_1 \{(1/wrp\_l1) \ln(WRP_{t-1}/((1-NITR_{t-1}) PASP_{t-1})$
$- ((1-wrp\_l1)/wrp\_l1) \ln(asp\_l1\ YNP_{t-1}) + \ln(TAXWP_{t-1})\}$
$+ (1-ben\_1) \ln(RBEN_{t-1}/PCH_{t-1}).$

Inserting equation (22) into equation (12.a), yields:

$\ln(WRP_t/((1-NITR_t) PASP_t)) = ben\_1 \ln(WRP_{t-1}/((1-NITR_{t-1}) PASP_{t-1})$
$- ben\_1 (1-wrp\_l1) \ln(asp\_l1\ YNP_{t-1})$
$+ wrp\_l1\ ben\_1 \ln(TAXWP_{t-1})$
$+ wrp\_l1 (1-ben\_1) \ln(RBEN_{t-1}/PCH_{t-1})$
$- wrp\_l1 \ln(TAXWP_t),$
$+ (1-wrp\_l1) \ln(asp\_l1\ YNP_t)$

or, on subtracting $\ln(WRP_{t-1}/((1-NITR_{t-1}) PASP_{t-1}))$ from both sides and rearranging terms:

(23) $\Delta \ln(WRP_t/((1-NITR_t) PASP_t)) =$
$(ben\_1-1)[\ln(WRP_{t-1}/((1-NITR_{t-1})PASP_{t-1})$
$- (1-wrp\_l1) \ln(asp\_l1\ YNP_{t-1})$
$+ wrp\_l1 \ln(TAXWP_{t-1}) - wrp\_l1 \ln(RBEN_{t-1}/PCH_{t-1})]$
$+ (1-wrp\_l1) \Delta \ln(asp\_l1\ YNP_t) - wrp\_l1\ \Delta \ln(TAXWP_t).$

Inserting equation (20.b) into equation (23) to eliminate the unobserved equilibrium reservation wage, yields:

(24) $\Delta \ln(WRP_t/((1-NITR_t) PASP_t)) =$
$(ben\_1-1)\{\ln(WRP_{t-1}/((1-NITR_{t-1}) PASP_{t-1})$
$- (1-wrp\_l1) \ln(asp\_l1\ YNP_{t-1})$
$+ wrp\_l1 \ln(TAXWP_{t-1})$
$- wrp\_l1 \{b\_0 + b\_1 \ln \left(\dfrac{WRP_{t-1}}{(1-NITR_{t-1})PASP_{t-1}} \right)$
$+ b\_1 \ln (ub\_0\ UR_{t-1}^{ub\_1})$
$+ b\_1 \ln(TAXWP_{t-1})$
$+ (1-b\_1) \ln\left(bw\_0\ asp\_l1\ YNP_{t-1} \dfrac{PASP_{t-1}}{PCH_{t-1}} \right)$
$+ b\_2 \ln(1+RLI_{t-1})\}\}$
$+ (1-wrp\_l1) \Delta \ln(asp\_l1\ YNP_t)$
$- wrp\_l1\ \Delta \ln(TAXWP_t),$

and after adding and subtracting (ben_1-1) (1-b_1 wrp_l1) TR_MP, we find on rearranging terms:

(25.a) $\Delta \ln[WRP_t/((1-NITR_t) PASP_t)] =$
$(ben\_1-1)(1-b\_1 wrp\_l1)$
$[\ln(WRP_{t-1}/((1-NITR_{t-1})PASP_{t-1})-\ln(asp\_l1 YNP_{t-1})-TR\_MP_{t-1}]$
$+ (ben\_1-1)\ b\_1\ wrp\_l1\{(b\_1-1)/b\_1 \ln((1-DTHR_{t-1}) (1-SSRTR_{t-1}) (1-NITR_{t-1}))$
$+ (b\_2/b\_1) \ln(1+RLI) - wrp\_l0 - (b\_1\ wrp\_l1-1)/(b\_1\ wrp\_l1)\ TR\_MP_{t-1}$
$+ ub\_1 \ln(UR_{t-1})\} + (1-wrp\_l1) \Delta \ln(asp\_l1\ YNP_t) - wrp\_l1\ \Delta \ln(TAXWP_t),$

with:
(25.b) $wrp\_l0 = -[b\_1 \ln(ub\_0) + b\_0 + (1-b\_1) \ln(bw\_0)].$

Finally, taking into account that (according to equation (19.a)) the natural rate of unemployment, HP_UR, is determined by:

(26) $\ln(\text{HP\_UR}) = \text{ur\_0} + \text{ur\_1} \ln((1\text{-DTHR})\,(1\text{-SSRTR})\,(1\text{-NITR}))$
$\qquad\qquad\quad + \text{ur\_2} \ln(1\text{+RLI}) + \text{ur\_3 TR\_MP},$

with the parameters defined in (19.b) - (19.e), we can rewrite equation (25.a) as:

(27) $\Delta \ln[\text{WRP}_t / ((1\text{-NITR}_t)\,\text{PASP}_t)] =$
$\qquad\qquad [(\text{ben\_1-1})(1\text{-b\_1wrp\_l1})]$
$\qquad\qquad [\ln(\text{WRP}_{t\text{-}1} / (\text{PASP}_{t\text{-}1}\,(1\text{-NITR}_{t\text{-}1})))\text{-}\ln(\text{asp\_l1 YNP}_{t\text{-}1})\text{-TR\_MP}]$
$\qquad\qquad - [(\text{ben\_1-1})\,\text{b\_1 wrp\_l1 ub\_1}]\,[\ln(\text{UR}_{t\text{-}1}) - \ln(\text{HP\_UR}_{t\text{-}1})]$
$\qquad\qquad + (1\text{-wrp\_l1})\,\Delta\ln(\text{asp\_l1 YNP}_t) - \text{wrp\_l1}\,\Delta\ln(\text{TAXWP}_t).$

Note that:
$\qquad -1 \leq (\text{ben\_1-1})\,(1\text{-b\_1 wrpl\_1}) \leq 0,$
$\qquad - (\text{ben\_1-1})\,\text{b\_1 wrpl\_1 ub\_1} \leq 0.$

Equation (27) explains the change in the real wage by the deviation of the lagged real wage from trend productivity plus the mark-up in the goods market, the deviation of the lagged unemployment rate from the natural unemployment rate, the change in labour productivity, and the change in the tax wedge.

6. Some empirical results

Equations (27) and (19) present the main results of our calculations. Equation (27) explains the change in the real wage by the deviation of the lagged wage from trend productivity plus the mark-up in the goods market, the deviation of the lagged unemployment rate from the natural unemployment rate, the change in labour productivity, and the change in the tax wedge. Equation (19) describes how the natural rate of unemployment is determined by the tax wedge, the real interest rate, and the mark-up in the goods market. In this section we will estimate these equations, i.e., we estimate the following version of the error correction mechanism (27):

(28.a) $\Delta\ln(\text{WRP}_t) =$
$\text{wrp\_swpasp}\,\Delta\ln\,[(1\text{-NITR}_t)\,\text{PASP}_t] + (1\text{-wrp\_swpasp})\,\Delta\ln\,[(1\text{-NITR}_{t\text{-}1})\,\text{PASP}_{t\text{-}1}]$
$+(1\text{-wrp\_l1})[\text{wrp\_swynp}\,\Delta\ln(\text{asp\_l1 YNP}_t)+(1\text{-wrp\_swynp})\,\Delta\ln(\text{asp\_l1 YNP}_{t\text{-}1})]$
$- \text{wrp\_l1}\,\Delta\ln(\text{TAXWP}_t) + \text{wrp\_sl1 U\_WRP}_{t\text{-}1} + \text{wrp\_sl2 U\_UR}_{t\text{-}1}$

with the error correction terms, U_WRP and U_UR, defined as:

(28.b) $\text{U\_WRP}_t = [\ln(\text{WRP}_t / (\text{PASP}_t\,(1\text{-NITR}_t)) - \ln(\text{asp\_l1 YNP}_t)\text{- TR\_MP}_t],$

(28.c) $\text{U\_UR}_t = \ln(\text{UR}_t) - [\text{ur\_0} + \text{ur\_1} \ln((1\text{-DTHR})\,(1\text{-SSRTR})(1\text{-NITR}))$
$\qquad\qquad\quad + \text{ur\_2} \ln(1\text{+RLI}) + \text{ur\_3 TR\_MP}],$

and with:
$\qquad -1 \leq \text{wrp\_sl1}\,[= (\text{ben\_1-1})\,(1\text{-b\_1 wrp\_l1})] \leq 0,$
$\qquad \text{wrp\_sl2}\,[= - (\text{ben\_1-1})\,\text{b\_1 wrp\_l1 ub\_1}] \leq 0,$
$\qquad 0 \leq \text{wrp\_swynp, wrp\_swpasp} \leq 1.$

Note that in equation (28), we allowed for a richer dynamic structure than derived in equation (27) by taking a weighted average of the lagged and contemporaneous price change, and by having productivity be a weighted average of trend productivity and contemporaneous productivity[1].

Estimates of a co-integrating vector for equation (28.c) are shown in Table 10 for the main country blocks of the NIME model[2]. The sample period ranges from 1970 until 2002. The first rows show the point estimates, while the last rows show some diagnostic statistics. For all country blocks, we could reject the hypothesis of no cointegration at a fairly high level of confidence. All point estimates have the expected sign, except for the EU block where the parameter associated with market power in the goods market TR_MP had the wrong sign, and for the JP block where the parameter associated with the tax variables had the wrong sign. In both cases the parameters with the wrong sign were restricted to zero. The semi-elasticities in Table 10 show for example that in the euro area, a 1 percentage point fall in taxes induces a 0.4 percentage point fall in the natural rate of unemployment, while a similar tax cut reduces the natural rate of unemployment in the NE and US by, respectively, 0.25 and 0.46 percentage points.

Once we have estimated the co-integrating vectors, we can estimate in a second step the short term wage equation (28.a). Table 11 shows estimation results for this short term wage equation. All the parameters have the expected sign and the diagnostic statistics are fairly good. The line 'semi-elasticity unemployment rate' shows the semi-elasticity of the lagged unemployment rate, i.e., it shows by how much (in percent) the wage will increase when the unemployment rate deviates by 1 percentage point from the natural rate of unemployment. In the euro area, the nominal wage will fall with a lag of 1 year by 0.5 percent if the unemployment rate increases (relative to the natural rate of unemployment) by 1 percentage point.

Finally, the point estimates of Table 10 can be used in equation (28.c) to estimate the natural rate of unemployment, HP_UR. These estimates are plotted in figures 1 until 4 of the main text. These figures show that in the non-euro EU country block and the US the natural rate of unemployment rose from the early seventies until the mid-eighties when it started to fall. In the euro area, the natural rate of unemployment rose until the early nineties, and fell only gradually thereafter. In Japan, there has been a gradual increase in the natural rate of unemployment throughout the sample.

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1. See also equation (A.12) of Appendix A of Meyermans (2003) on the latter. No lag on the tax wedge because no parameter estimate within the 0.1 interval was obtained.
2. Remember that he main country blocks are the euro area (EURO), the non-euro EU countries (NE), the United States (US), and Japan (JP). In the empirical part, market power TR_MP is measured by the openness of the economy, i.e. a Hodrick-Prescott filtered series of the sum of imports and exports divided by GDP.

TABLE 10 - **Estimates of the co-integration vector for the natural rate of unemployment (equation 26)**

	EURO	NE	US	JP
ur_0	-5.53	-2.04	-3.99	-0.36
ur_1	-5.58	-4.11	-7.82	0.00[b]
ur_2	10.52	24.24	9.76	4.29
ur_3	0.00[b]	-6.05	-8.55	-16.33
semi-elasticities[a]				
tax wedge	-0.39	-0.25	-0.46	0.00
real long term interest rate	0.73	1.46	0.57	0.10
Diagnostic statistics				
Dickey Fuller	-2.01	-2.50	-2.31	-2.03
Augmented Dickey Fuller	-1.98	-2.46	-2.25	-2.00

[a] i.e. the corresponding point estimate multiplied by the average unemployment rate.
[b] parameter restricted to zero; free estimation gives a wrong sign.

TABLE 11 - **Estimates for the short run wage equation (28.a)[a]**

	EURO	NE	US	JP
wrp_swpasp	0.89	0.62	0.78	0.85
	(0.08)	(0.16)	(0.19)	(0.07)
wrp_l1	0.77	0.22	0.30	0.40
	(0.10)	(0.12)	(0.14)	(0.11)
wrp_swynp[b]	0.00	1.00	0.28	0.00
	-.-	-.-	(0.26)	-.-
wrp_sl1	-0.37	-0.25	-0.15	-0.20
	(0.09)	(0.14)	(0.15)	(0.09)
wrp_sl2	-0.04	-0.05	-0.02	-0.02
	(0.01)	(0.02)	(0.01)	(0.02)
semi-elasticitiy				
unemployment rate[c]	-0.51	-0.75	-0.33	-0.93
Diagnostic statistics				
Adj. R2	0.98	0.89	0.84	0.97
Durbin Watson	2.31	1.49	1.56	1.51

[a] standard error between brackets, some dummies were added.
[b] when the free estimation is beyond the 0,1 interval, parameter is restricted to closest boundary.
[c] i.e. parameter wrp_sl2 divided by the average unemployment rate

7. Derivation of the wage equation (12.a)

Equation (12.a) is derived from equation (11) as follows.

The first order condition for an optimum is:

$$q \, OSPU^{(q-1)} \, \frac{1 - asp\_l1}{asp\_l1} \, NP \, B^{(1-q)}$$
$$+ \, OSPU^q \, (1-q) \, B^{(-q)} \, \frac{(1\text{-}DTHR) \, (1\text{-}SSRTR) - rb0\_1 \, Z}{PCH} \, NP = 0,$$

with OSPU and B defined in equations (2) and (10), respectively.

On rearranging terms, we find that the first order condition can be rewritten as:

$$q \, \frac{1 - asp\_l1}{asp\_l1} \, B + OSPU \, (1\text{-}q) \, \frac{(1\text{-}DTHR) \; (1\text{-}SSRTR)\text{-} rb0\_1 Z}{PCH} = 0.$$

Inserting equation (3) into the previous result and rearranging terms, we get:

$$(29) \quad \frac{WRP(1 - DTHR)(1 - SSRHR)}{PCH} \, NP$$
$$= \left(\frac{BEN}{PCH}\right) \, NP$$
$$- OSPU \, \frac{1 - q}{q} \, \frac{asp\_l1}{1 - asp\_l1} \, \frac{(1\text{-}DTHR) \; (1\text{-}SSRH)\text{-} rb0\_1 \, Z}{PCH} \, .$$

Profits are defined as:

$$OSPU \; = \; PASP \, (1 - NITR) \, ASPO - NP \, WRP - GIPO \, PCIP - MPO \, PMP$$

while the demand for imports is, according to equation (A.3.c) of Appendix A of Meyermans and Van Brusselen (2000):

$$MPO \, PMP = asp\_l3 \, PASP \, (1\text{-}NITR) \, ASPO.$$

Furthermore, note that in equilibrium [1]:

$$PCIP \, GIPO = USERIP \, CIPO = asp\_l2 \, PASP \, (1\text{-}NITR) \, ASPO,$$

Using the previous two equations, and assuming constant returns to scale, i.e.:

$$asp\_l1 = (1\text{-}asp\_l2\text{-}asp\_l3),$$

we rewrite profits as:

$$OSPU = asp\_l1 \, PASP \, (1\text{-}NITR) \, ASPO - WRP \, NP.$$

Inserting this result into equation (29) dividing both sides of the expression by, $(1 - DTHR)(1 - SSRHR)(1 - NITR) \, \dfrac{PASP}{PCH} \, NP$, we obtain:

$$\frac{WRP}{(1 - NITR)PASP} = \left(\frac{BEN}{PCH}\right) \, \frac{1}{TAXWP}$$
$$- [asp\_l1 \, YNP - \frac{WRP}{(1 - NITR)PASP}] \frac{1 - q}{q} \, \frac{asp\_l1}{1 - asp\_l1} \, G.$$

with:

$$YNP = \frac{ASPO}{NP} \, ,$$
$$TAXWP \; = \; (1 - DTHR)(1 - SSRTR)(1 - NITR) \, \frac{PASP}{PCH}$$
$$G = 1 \text{-} rb0\_1 \, ub\_0 \, UR^{ub\_1} \, .$$

---

1. See equations (A.3.b), (A.5) and (A.12.b) of Appendix A of Meyermans and Van Brusselen (2000).

Solving for $\dfrac{WRP}{(1-NITR)PASP}$, we get:

$$\frac{WRP}{(1-NITR)PASP} = \left(\frac{BEN}{PCH}\right) \frac{1}{TAXWP} \frac{q\,(1-asp\_l1\,)}{q\,(1-asp\_l1\,)-(1-q)asp\_l1\ \ G}$$
$$+ asp\_l1\ YNP\ \frac{asp\_l1(1-q)}{q\,(1-asp\_l1\,)-(1-q)asp\_l1\ \ G}\ G$$

or:

$$(30) \quad \frac{WRP}{(1-NITR)PASP} = \left(\frac{BEN}{PCH}\right) \frac{1}{TAXWP}\ w0 + asp\_l1\ YNP\ (1-w0)$$

with w0 defined as:

$$0 \le w0 = \frac{q\,(1-asp\_l1\,)}{q\,(1-asp\_l1\,)-(1-q)asp\_l1\ \ G} \le 1.$$

A log-linearised version would then read as:

$$\ln\left(\frac{WRP}{(1-NITR)PASP}\right) = wrp\_l1\ \ln\left(\left(\frac{BEN}{PCH}\right)\frac{1}{TAXWP}\right) + (1-wrp\_l1)\ \ln(asp\_l1\ YNP),$$

with $0 \le wrp\_l1 \le 1$, which yields equation (12.a) of the previous sub-section 3.

B. Public transfers to the household sector

In the NIME model, transfers to the household sector are function of the level of the benefits and the number of recipients per category, i.e.:

$$(31) \quad TRANSH_t = WC_t\ NPOC_t + WO_t\ NPOO_t + UB_t\ UR_t\ LS_t + TRANSH\_0,$$

with:
LS: labour supply,
NPOC: number of children,
NPOO: number of old-age pensioners,
TRANSH_0: other public transfers to the household sector,
UB: benefit accruing to the unemployed,
UR: unemployment rate,
WC: benefit accruing to children,
WO: benefit accruing to old-age pensioners.

See section A.1d.i. of Chapter V of Meyermans and Van Brusselen (2001).

Here, we refine equation (31) by giving more structure to TRANSH_0, i.e.:

$$(32) \quad TRANSH\_0 = WOD\ OTDEPEN + TRANSH\_1$$

with:
OTDEPEN: other dependents,
TRANSH_1: other public transfers to the household sector,
WOD: benefit accruing to other dependents.

Equation (32) makes explicit some of the dependents that were implicitly present in the previous specification. This refinement is needed for the variant with the increased participation rate because a higher participation rate implies that peo-

ple who may previously have been drawing a benefit are now in the work force, thereby affecting the level and composition of the public outlays.

We now have that in terms of heads:

(33)   NPO = NPOC + NPOO + NP + NG+ LS UR + OTDEPEN

with:
LS: total labour supply,
NG: total employment in the public sector,
NP: total employment in the enterprise sector,
NPO: total population,
NPOC: number of children,
NPOO: number of aged people (65+),
UR: the unemployment rate.

For our exercise it may be useful to point out that NPOC and NPOO are two types which are set by institutional conditions and can not be used to expand the labour supply. A higher labour supply will be induced by a higher participation rate of the people in the type OTDEPEN.

Inserting equation (32) into equation (31), we get:

(34) $\text{TRANSH}_t = \text{WC}_t \, \text{NPOC}_t + \text{WO}_t \, \text{NPOO}_t + \text{UB}_t \, \text{UR}_t \, \text{LS}_t$
$\qquad\qquad\qquad + \text{WOD OTDEPEN} + \text{TRANSH\_1}.$

After the proper manipulations, we obtain that equation (34) can be written in first differences as [1]:

(35) $\Delta \ln\left(\dfrac{\text{TRANSH}_t}{\text{PCH}_t}\right) = \text{G\_YNP}_{t-1}$
$\qquad\qquad\qquad + \text{trh\_s2} \, \Delta\ln(\text{NPOC}_t) + \text{trh\_s3} \, \Delta\ln(\text{NPOO}_t)$
$\qquad\qquad\qquad + \text{trh\_s4} \, \Delta\ln(\text{UR}_t \, \text{LS}_t) + \text{trh\_s5} \, \Delta\ln(\text{OTDEPEN}_t).$

Table 12 shows empirical results for equation (35).

---

1. Differentiating both sides of equation (34), dividing both sides by TRANSH, and noting that for small changes

   $\Delta \ln X = \Delta X / X$, equation (34) can be rewritten as:

   $\Delta\ln(\text{TRANSH}_t) = \text{trh\_s2} \, \Delta\ln(\text{NPOC}_t) + \text{trh\_s2} \, \Delta\ln(\text{WC}_t)$

   $+ \text{trh\_s3} \, \Delta\ln(\text{NPOO}_t) + \text{trh\_s3} \, \Delta\ln(\text{WO}_t)$

   $+ \text{trh\_s4} \, \Delta\ln(\text{UR}_t \, \text{LS}_t) + \text{trh\_s4} \, \Delta\ln(\text{UB}_t)$

   $+ \text{trh\_s5} \, \Delta\ln(\text{OTDEPEN}_t) + \text{trh\_s5} \, \Delta\ln(\text{WOD}_t)$

   $+ \text{trh\_s6} \, \Delta\ln(\text{TRANSH\_1}_t).$

   Noting that the shares, trh, add up to one, i.e. :
   trh_s2 + trh_s3 + trh_s4 + trh_s5 + trh_s6= 1,
   and assuming that real benefits are indexed to lagged productivity growth, i.e.:

   $\Delta\ln\left(\dfrac{\text{WC}_t}{\text{PCH}_t}\right) = \Delta\ln\left(\dfrac{\text{WO}_t}{\text{PCH}_t}\right) = \Delta\ln\left(\dfrac{\text{UB}_t}{\text{PCH}_t}\right) = \Delta\ln\left(\dfrac{\text{WOD}_t}{\text{PCH}_t}\right) = \text{G\_YNP}_{t-1},$

   and that other transfers, TRANSH_1, increase by:

   $\Delta\ln\left(\dfrac{\text{TRANSH\_1}_t}{\text{PCH}_t}\right) = \text{G\_YNP}_{t-1},$

   we obtain equation (35).

TABLE 12 - **Transfers to the household sector by the public sector[a]**

	EURO	NE	US	JP
trh_s2	0.47	1.07	0.20	1.42
	(0.18)	(0.45)	(0.34)	(0.29)
trh_s3	0.79	1.36	1.49	1.21
	(0.14)	(0.52)	(0.23)	(0.17)
trh_s4	0.15	0.21	0.18	0.18
	(0.04)	(0.03)	(0.04)	(0.05)
trh_s5	0.15	0.27	0.22	0.52
	(0.31)	(0.20)	(0.22)	(0.18)
Diagnostic statistics				
Adjusted R²	0.74	0.89	0.73	0.74
Durbin - Watson	2.04	1.74	1.03	1.76

[a] standard error between brackets

C. Labour supply

In the NIME model, the steady state labour supply is determined outside the model and is estimated applying a Hodrick-Prescott filter to the labour supply series. In the medium run, the labour supply is determined by a partial adjustment mechanism whereby the contemporaneous labour supply changes as a function of the gap between the lagged labour supply and the steady state labour supply, the lagged deviation of the unemployment rate from the natural rate of unemployment, and of the deviation of the contemporaneous wage rate from the equilibrium real wage rate, i.e.:

$$(36) \quad \ln(LS_t) = ls\_sl \ln(HP\_LS_t) + (1-ls\_sl) \ln(LS_{t-1}) + ls\_s1 \ln(UR_{t-1}/HP\_UR_{t-1})$$
$$+ ls\_s4 [\ln(WRP_t) - \ln(asp\_l1\ HP\_YNP_t\ PASP_t\ (1-NITR_t)) - TR\_MP_t],$$

with: $0 \leq ls\_sl \leq 1$, ls_s1, $ls\_s2 \leq 0$, and $ls\_l4 \geq 0$,

and where:
HP_LS: steady state labour supply,
HP_UR: steady state unemployment rate,
HP_YNP: steady stage labour productivity,
LS: contemporaneous labour supply,
NITR: indirect tax rate.
PASP: producer price,
WRP: nominal wag rate,
UR: unemployment rate.

The last term of equation (36) captures the idea that the income effect and the substitution effect of a permanent wage increase cancel each other out, but that a temporary wage increase (decrease) induces people to work more (less).

Point estimates for equation (36) are shown in Table 13. We note that for all country blocks the response of labour supply to a temporary deviation of the contemporaneous wage from the equilibrium wage is small (i.e. low ls_s4).

TABLE 13 -   Estimates for the labour supply[a]

	EURO	NE	US	JP
ls_sl	0.21	0.87	0.65	0.54
	(0.05)	(0.17)	(0.14)	(0.11)
ls_s1	-0.00	-0.59	-0.29	-0.58
	(0.07)	(0.15)	(0.13)	(0.22)
ls_s4 * 100	0.51	0.07	0.63	0.36
	(0.07)	(0.12)	(0.26)	(0.11)
Diagnostic statistics				
R2-adjusted	1.00	0.99	1.00	1.00
Durbin Watson	1.41	0.83	0.80	1.59

a standard error between brackets, some dummies were added.

D. The EU accession countries block

A new block consisting of 12 EU accession and candidate countries has been added to the NIME model. This new Eastern European (EC) block includes Bulgaria, Cyprus, the Czech republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Romania, Slovakia, and Slovenia. These twelve countries were previously included in the Rest of the World (RW) block of the NIME model.

Data availability for the countries of the EC block remains limited, as most of the countries of the EC block are countries that experienced in recent years a transition from a centrally planned economy to a market economy. The AMECO database of the European Commission[1] provides the standard Eurostat-defined data series for some EC block countries as of 1992, but data generally remain fragmentary up until 1995. Moreover, the data for the EC block are limited to a small set of aggregates, consisting of population, employment, GDP, private consumption, government consumption, total gross fixed capital formation, imports and exports. As a consequence, only a limited number of observations are available to estimate behavioural relations under a market economy. Moreover, in most of these countries, transition is a slow and ongoing process, affecting the stability of the parameters. Therefore, we adopted a rather pragmatic strategy.

1. The specification and estimation of the EC block

a. The components of final demand

The different components of final demand are:

CPO: private consumption, in constant prices,
FGCO: public consumption, in constant prices,
GIO: gross fixed capital formation, in constant prices,
MTO: imports of goods and services, in constant prices,
XTO: exports of goods and services, in constant prices,

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1.   See   http://europa.eu.int/comm/economy_finance/indicators/annual_macro_economic_data base/ameco_en.htm

and:

PCH: the price of private consumption,
PFCG: the price of public consumption,
PGI: the price of gross fixed capital formation,
PMT: the price of imports,
PXT: the price of exports,
with all prices denominated in a composite currency.

For the series in current prices, it holds that:

> CPU = CPO PCH,
> FCGU = FCGO PFCG,
> MTU = MTO PMT,
> XTU = XTO PXT,
> GIU = GIO PGI.

Real GDP, GDPO, is equal to:

(37.a) GDPO = CPO + FGCO + GIO + (XTO - MTO)

while GDP in current prices, GDPU, is equal to:

(37.b) GDPU = CPU + FGCU + GIU + (XTU - MTU),

and the GDP deflator, PGDP, is defined as:

(37.c) PGDP = GDPU/GDPO.

The different components of final demand are specified as follows.The domestic components of demand are determined by total activity, the relative price, and a trend, TIME. In order to save on the degrees of freedom, we impose a unit elasticity for total activity and relative prices, i.e.:

(38)   ln (XO) = x_l0 + ln(GDPO) - ln(PX/PGDP) + x_l1 ln(TIME)

with X = CP, FCG, GI and MT, and x = cp, fcg, gi and mt.

An error correction mechanism captures sluggish adjustment in expenditures, i.e.:

(39)   d ln(XO) =x_sl{ln(XO)-[x_l0+ln(GDPO)-ln(PX/PGDP)+x_l1 ln(TIME)]}[-1]

for X = CP, FCG, GI and MT and with $-1 \leq x\_sl \leq 0$.

Exports, XTO, are related to foreign activity, competitiveness, and a trend, i.e.:

(40)   ln(XTO) = xto_l0+ln(EFASPO)-ln [(PXT/(EFEX EFPASP)]+xto_l1 ln(TIME)

with:
EFASPO: the foreign effective output level, in constant prices,
EFPASP: the foreign effective price level, denominated in the foreign effective currency unit,

EFEX: the nominal effective exchange rate of the EC block, number of local currency per unit of the foreign currency[1].

An error correction mechanism captures sluggish adjustment, i.e.:

(41) $d \ln(XTO) = xto\_sl \{\ln(XTO) - [xto\_l0 + \ln(EFASPO)$
$\qquad\qquad - \ln[(PXT/(EFEX\ EFPASP)] + xto\_l2 \ln(TIME)]\}[-1]$

with $-1 \leq xto\_sl \leq 0$.

The sample period ranges from 1993 until 2002. The estimation results are shown in Table 14. Given the limited number of observations, the necessary caution should be used interpreting these results.

TABLE 14 - Point estimates for the different components of demand in EC block

	CPO	FCGO	GIO	MTO	XTO
l0	0.93	1.33	5.93	-0.43	-12.93
l1	-0.39	-0.95	-2.13	0.08	4.99
sl	-0.10[a]	-0.10[a]	-0.10[a]	-0.10[a]	-0.10[a]

[a] a priori restriction.

b. The prices

Prices are sticky but they adjust in such a way that in the long run they close the output gap along a predetermined steady state inflation rate.

Applying the same modelling strategy for the short term adjustment of prices as outlined in section III.C of Meyermans and Van Brusselen (2001), we estimate for the price of good X:

(42) $d \ln(PX) = (px\_sl-1) [\ln(PX_{-1}) - \ln(PXR_{-1})] + (1-px\_sl)\ d \ln(PXR)$
$\qquad\qquad - (1-px\_sl)\ px\_sw\ [\ln(PXR) - \ln(PX_{-1})] + (1-px\_sl)\ px\_sw\ d \ln(PX_{-1})$

for all, and with the parameters $0 \leq px\_sl, px\_sw \leq 1$, and where PXR is the rational reset price (or equilibrium price). Remember that px_sl is the fraction of the composite good for which the price is kept at its old price, and px_sw is the fraction of the prices that is revised according to a rule of thumb.

The rational reset prices, i.e. the equilibrium prices which are set when all information is available and there are no menu costs, are set by

(43.a) $\ln(PXR) = px\_s0 + \ln(PGDP)$,

for X = FCG, GI and MT, and for exports as:

(43.b) $\ln(PXTR) = \ln(EFPASP\ EFEX) + pxt\_l0$,

i.e., the EC block is (in the long run) a price taker for exports.

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1. The "local" currency is a synthetic currency calculated on the basis of a basket of currencies of the EC country block.

Applying the same adjustment strategy for the price of private consumption as outlined in section III.C.3 Meyermans and Van Brusselen (2001), we estimated for the price of private consumption:

(44)   d ln(PCH) = (1-pch_sl) (pch_sw-1) pch_s1 ln(GDPO/HP_GDPO)
        -(1-pch_sl) (pch_sw-1) G_PCH+(1-pch_sl) pch_sw d ln(PCH$_{-1}$)

where HP_GDPO is trend real GDP, where the latter is obtained applying a Hodrick Prescott filter to the GDP series.

The estimation results for prices are summarized in Table15.

TABLE 15 -   Point estimates of price equations in EC block

	CPO	FCGO	GIO	MTO	XTO
sl	0.00	0.04	0.00	0.11	0.12
sw	0.19	0.00	0.10	0.14	0.17

A low value for px_sl indicates that only a small fraction of the prices is kept at its old price, while a low value for px_sw indicates that only a small fraction of the prices that are revised, are revised according to a backward looking rule of thumb.

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