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# Monetary policy in the euro area

Simulations with the NIME model

Eric Meyermans

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# Federal Planning Bureau

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In this paper, we investigate with an econometric world model how monetary policy rules affect economic activity in the euro area. For this purpose, we apply three different shocks to the NIME model. A temporary real demand shock allows us to analyse to what extent money targeting, when compared with a Taylor rule, tempers inflationary pressures that arise in the real sector. A permanent productivity shock and a money velocity shock allow us to examine to what extent money targeting compromises price stability when money growth targets are not immediately revised in the face of these shocks.

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# I  Introduction

In this paper[1], we investigate with a macroeconometric world model how monetary policy rules affect economic activity in the euro area[2]. In the economic literature, there is a general consensus that a credible monetary policy rule is to be preferred to discretionary interventions by central banks because monetary surprises can increase expected inflation and worsen economic performance (Kydland and Prescott (1977)). Several monetary policy rules have been proposed, for example, money targeting (Friedman (1956)), inflation targeting (Bernanke et al. (1999)), nominal income targeting (Hall and Mankiw (1994), Frankel and Chinn (1995)), and an interest rate rule that targets inflation and output relative to a reference value (Taylor (1993)). Although the theoretical merits of these rules have been thoroughly discussed in the literature, the empirical investigation of the implications of these rules has only recently commenced (Bryant et al. (1993)).

This paper provides some additional empirical evidence on the effects of monetary policy rules in the euro area. More particularly, we investigate with the NIME model[3] the responses of the main macroeconomic variables to diverse shocks under money targeting and a Taylor rule. Under money targeting, the monetary authorities target the money supply in every period. Under a Taylor rule, the monetary authorities set the short-term interest rate by weighing inflation and output relative to a reference value[4]. The shocks we investigate are a temporary increase in real demand, a permanent increase in the velocity of money, and a permanent drop in labour productivity. The temporary real demand shock allows us to analyse to what extent money targeting, when compared with a Taylor rule, tempers inflationary pressures that arise in the real sector. The productivity shock and the money velocity shock allow us to examine to what extent money targeting may compromise price stability when money growth targets are not immediately revised in the face of these shocks.

In the second section of this paper, we briefly describe the NIME model. The NIME model is a macroeconometric world model that covers the euro area, the other countries of the European Union, the United States, Japan, and the rest of the world. In this model, money is neutral in the long run. However, in the short run, money is not neutral because of imperfect competition and imperfect information.

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1. Working Paper presented at the International Conference on Policy Modelling (EcoMod2002), Brussels, 4-6 July 2002. Comments can be mailed to em@plan.be.
2. Monetary policy rules are part of a monetary policy strategy. A monetary policy strategy refers to the whole framework and procedures that central banks use to translate relevant information into monetary policy decisions, see Issing et al. (2001).
3. The NIME model is a macroeconometric world model developed at he Belgian Federal Planning Bureau. See the next section for a brief summary of the model. See also Meyermans and Van Brusselen (2001) for more details.
4. See Taylor (1993).

In the third section, we briefly highlight some differences and similarities between money targeting and a Taylor rule. Under money targeting the short-term interest rate is determined by the conditions in the money market, while under a Taylor rule, the short-term interest rate is determined by the conditions in the goods market. Both rules require a specific information-set. Under money targeting, the monetary authorities require knowledge about potential output (growth), the velocity of money, and the contemporaneous money supply. Under a Taylor rule, the monetary authorities need knowledge about potential output (growth), the output gap, and the equilibrium interest rate.

From the fourth section until the seventh section, we present simulation results for the euro area. These simulation results give a detailed description of the effects of shocks under money targeting and a Taylor rule. The case of a temporary demand shock is straightforward to implement. However, in the case of a permanent shock one also has to make assumptions on how the monetary authorities revise their reference values and their targets. Here, we distinguish two sub-variants. In a first sub-variant, the monetary authorities revise immediately the reference value for output or the money target. In the other sub-variant, the monetary authorities do not change the reference value or the money target. In these sections, we also compare the simulation results for the euro area with the simulation results for similar policy rules and shocks in the United States (U.S.).

In the last section, we draw some conclusions. First, in the case of a temporary demand shock, we find that money targeting causes the smallest deviation from trend for private supply in the first year. This is because the induced changes in the interest rate are larger under money targeting than under a Taylor rule in the first year. However, as time progresses and the conditions in the money market and the goods market evolve differently, we find that after the first year money targeting loses its potency to provide more output stability than a Taylor rule. Therefore, we also investigate the implications of a two-pillar strategy that sets the short-term interest rate by weighing the conditions in the money market against the conditions in the goods market. We find that such a policy rule provides more output stability than money targeting or a Taylor rule. However, it should also be noted that this higher output stability is gained at the expense of lower stability of the financial variables. Second, in the case of a permanent shock to the velocity of money, we find that important short run deviations from trend may occur if the monetary authorities do not immediately adjust the money supply. Third, in the case of a permanent drop in labour productivity, we find that money targeting tempers the initial decline in output, especially if money targets are not revised. However, it should also be stressed that such loose monetary policy only delays adjustment towards the new steady state, and that it compromises price stability in the long run if money targets are not revised in due course.

## II    The NIME model

The NIME model is a macroeconometric world model developed at the Belgian Federal Planning Bureau. This model is built to make medium-term forecasts of the Belgian international economic environment and to study the transmission of the effects of economic policies and exogenous shocks on the Belgian and European economy. A detailed discussion of the NIME model can be found in Meyermans and Van Brusselen (2001)[1]. Since this paper deals with monetary policy, we outline for ease of reference the demand for money equations in Appendix A. Technical details regarding the monetary policy rules will be provided in the next section.

The current version of the NIME model divides the world into six separate country blocks: Belgium (BE), the euro area (minus Belgium), the NE block consisting of the countries of the European Union that did not adopt the euro, 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. The EU, NE, US and JP block have the same structure. In each of these country blocks, we distinguish a household sector, an enterprise sector, a public sector, and a monetary sector. For each sector we postulate the existence of a single representative agent, so that we do not consider issues of heterogeneity. 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. The NIME model uses annual data from 1970 until 2000.

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 where 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, the natural rate of unemployment, secular inflation, the real interest rate, the 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.

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1.  This paper is available on the world wide web at www.plan.be click Language, click Working Papers, or at www.plan.be/nl/pub/wp/detail_wp.stm?pub=WP0103. Since this paper was published, the NIME model has been updated with data covering the period 1970-2000. A paper describing these updates will follow. The simulations shown in this paper are made with the updated version of the NIME model. It should be noted that the structure of the model and the point estimates of the behavioural equations of the updated version are similar to the ones reported in Meyermans and Van Brusselen (2001).

The NIME model distinguishes four sectors per country block. First, 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. This scale variable consists of the assets inherited from the past, plus asset income, plus current and expected future labour income. In the short run, the household sector is liquidity constrained so that a fraction of total private consumption must be financed by disposable income. Error correction mechanisms and partial adjustment schemes are used to capture sluggish adjustment in the expenditure plans of the household sector.

Second, the enterprise sector maximizes its profits by hiring production factors and selling goods and services to the final users. There are three production factors, i.e., labour, capital and intermediary imports. The production technology is a Cobb-Douglas production function with constant returns to scale. Error correction mechanisms and partial adjustment schemes are used to model short run factor demand. In these schemes the long run factor demand equations are derived from the Cobb-Douglas production function. Price adjustment occurs sluggishly because of menu costs and incomplete information.

Third, public sector receipts are determined by endogenous tax bases and predetermined tax rates[1], 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 through the unemployment benefits and interest payments on public debt, and on the revenue side through direct labour income taxes, profit taxes, social security contributions, and indirect taxes. See also Meyermans (2002).

Fourth, in the default version of the model, the monetary authorities set the short-term interest rate in such a way that it deviates from the steady state interest rate to the extent that inflation and output deviate from their target value. The long-term interest rate is determined by the short-term interest rate and the steady state interest rate. In the short run, the exchange rate is free to clear the foreign exchange market, while in the long run the exchange rate stabilises the foreign debt to GDP ratio.

In the NIME model, money is neutral in the long run. However, in the short run, prices adjust sluggishly because of 'menu costs' and imperfect information. As a consequence, changes in nominal demand cause changes in quantities, the interest rates, the exchange rate, the user cost of capital, and the expectations. As time passes, prices adjust and the real effects diminish.

Finally, the expectations of the agents are partly forward-looking, and partly backward-looking, i.e., chartists. 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.

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1. In the default version of the NIME model, the public debt to GDP ratio stabilises at a rate determined outside the model. It is the direct labour income tax rate which adjusts to reach this target.

# III  Money targeting and a Taylor rule

In this paper, we use the NIME model to study to what extent money targeting in the euro area, when compared with a Taylor rule, disciplines inflationary pressures in the short run, and to what extent it can achieve a predetermined (medium run) inflation target. It is beyond the scope of this paper to give an elaborated theoretical discussion of these rules, however, before we proceed with the analysis of our simulation results, it may be useful to make some comments on these two policy rules.

Under money targeting, the monetary authorities keep the nominal money supply fixed at a predetermined level, and the interest rate adjusts to equilibrate the money market immediately[1]. In practice, a strict application of money targeting is not often found. For example, under the monetary strategy of the European Central Bank[2], the reference value for money growth, that is consistent with price stability, has been set at 4.5 percent in the medium run. This reference value reflects an inflation target that is below 2 percent, a 2.0 à 2.5 percent trend-growth in output, and a 0.5 à 1.0 percent trend-decline in money velocity[3]. However, the existence of such a reference value does not imply a commitment to mechanistically correct deviations over the short run. Deviations of current monetary growth from the reference value will be weighed against a broadly based assessment of the outlook for price developments and the risks to price stability.

Money targeting has several advantages, of which we mention the following. First, under normal circumstances, money targeting can have a stabilising feedback on the real sector of the economy. Indeed, if the nominal money stock is kept at its target level then the inflationary pressures arising in the real sector will reduce the supply of real money balances. This reduction will trigger an increase in the interest rates, thereby disciplining the inflationary pressures and keeping the economy close to its trend growth path. Second, money targeting has the advantage that it is transparent and easy to communicate to the general public. However, money targeting also has some disadvantages, of which we mention the following. First, it requires that the velocity of money be predictable, i.e., that there exists a stable money demand function with few arguments. Second, it also requires that the (permanent) changes in potential output be known, and be acted

1. Technically speaking, such an interest rate reaction function is obtained in our simulations by solving the short run money demand function, i.e., equation (A.2) of Appendix A, for the short-term interest rate, and evaluating this function for the target level of the money supply.
2. See European Central Bank (1998.a, 1998.b, and 1999).
3. Remember that MV = PT, where M is the money stock, V is the velocity of money, P is the price level, and T is the transaction volume. Rewriting the latter equation in growth terms we have that:d ln(M) + d ln(V) = d ln(P) + d ln(T). If we assume a 2 percent target for d ln(P), and that d ln(T) and d ln(V) are in the medium run independent of monetary policy, we get that money growth should be set according to d ln(M) = d ln(P) + d ln(T) - d ln(V).

upon. Indeed, if money targets are not revised when the velocity of money or potential output change, then the inflation rate will also change.

Under the Taylor rule, the short-term interest rate is set by the monetary authorities in such a way that the short-term interest rate deviates from the steady state interest rate to the extent that (expected future) inflation and output deviate from their reference value. In this paper, we specify the reaction function for the short-term interest rate as:

$$(1) \qquad SI_t = HP\_RLI_t + G\_PCH_t + si\_s1(INFL_t - G\_PCH_t) + si\_s2 \ln(ASPO_t/HP\_ASPO_t)$$

where ASPO is the contemporaneous private supply for final demand, in constant prices, G_PCH is the steady state growth of general price level, (i.e., "reference value for inflation"), HP_ASPO is the steady state private supply for final demand, in constant prices, (i.e., "reference value for potential output"), HP_RLI is the steady state real interest rate, INFL is the contemporaneous inflation, SI is the short-term interest rate, and where the parameter values are such that $1 \leq si\_s1$, and $0 \leq si\_s2$. Note that si_s1 is larger than 1. Indeed, if si_s1 is smaller than 1, we get that the real interest rate drops when inflation increases, thereby reinforcing the inflationary pressures. See, for example, Clarida et al. (1998).

In this paper, potential output is derived from a Cobb-Douglas production function, trend productivity, and the natural level of employment[1]. Instead of estimating equation (1), we selected values for the parameters si_s1 and si_s2 based on research done by others. We propose the following values: si_s1 = 1.5 and si_s2 = 0.5[2]. Moreover, the equilibrium real interest rate is calculated on the basis of an ex-post trend value[3].

Here, it should also be noted that in the NIME model, the output gap is a leading indicator of future inflation[4]. As a consequence, equation (1) can also be interpreted as a rule targeting contemporaneous and future inflation.

An important disadvantage of the Taylor rule is that it requires timely knowledge about the trend deviation of output and inflation, and the equilibrium interest rate. If, for example, under a Taylor rule the reference value for output is not revised after a shock, and one continues to evaluate contemporaneous output vis-à-vis the 'old' reference value, then monetary policy can be too loose or too tight. It is argued in the literature that it is easier to obtain timely information about (narrow) money supply (growth) than about inflation and output gaps, (McCallum (1999)), and that such considerations should also be taken into account when evaluating policy rules.

Finally, note some of the similarities between money targeting and a Taylor rule. First, there is the similarity in the behaviour of the interest rates. Under money

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1. See Section II.G of Meyermans and Van Brusselen (2000.b).
2. These are the values proposed by Taylor (1993) for the Fed, and they are in line with what, for example, Clarida et al. (1998) find for the Bundesbank.
3. Taylor (1993) used a real interest rate equal to 2 percent.
4. See equation (III.24) of Meyermans and Van Brusselen (2001).

targeting, the short-term interest rate responds to the conditions in the money market. The short-term interest rate falls if the demand for money is smaller than the predetermined supply of money, and it rises if the demand for money is larger than the supply of money. Under a Taylor rule, the short-term interest rate is set in response to the conditions in the goods market. The short-term interest rate increases if output and inflation are above their natural level, and it falls if output and inflation are below their natural level. If prices and output move in opposite directions - as it may be in the case of a supply shock - the interest rate response is less clear-cut. It should be noted that to the extent that the conditions in the money market and goods market are the same, the movements in the short-term interest rate will also be the same, only the timing and order of magnitude of changes in the short-term interest rate will differ between the two rules. Second, there is a similarity in the information needed to implement these policy rules successfully. Both rules require to identify shocks to potential output. If, for example, under money targeting the growth rate of money is not reduced in the face of a decline in the trend growth of potential output, inflation will be higher in the long run. A similar problem arises when, under a Taylor rule, the reference value for output is not revised and one continues to evaluate the contemporaneous output vis-à-vis the 'old' reference value. However, as mentioned above, there are also differences. Under money targeting the monetary authorities need to have a clear understanding of shocks to the velocity of money, while under a "Taylor rule" - as specified in this paper - they need to have a clear understanding of the equilibrium interest rate and the output gap.

# IV Diverse shocks under alternative monetary policy rules

In the following three sections, we examine the responses of the main macroeconomic variables of the euro area to diverse shocks under money targeting and a Taylor rule. The shocks we investigate are a temporary increase in real demand, a permanent increase in the velocity of money, and a permanent drop in trend labour productivity. The temporary real demand shock allows us to analyse to what extent money targeting tempers inflationary pressures that may arise in the real sector. The permanent productivity shock and the permanent money velocity shock allow us to examine to what extent money targeting compromises price stability when money growth targets are not revised in the face of these shocks.

The case of a temporary demand shock is straightforward to implement. However, in the case of a permanent shock one also has to make assumptions regarding the way in which the monetary authorities revise their reference values and their targets. Here, we distinguish two sub-variants. In a first sub-variant, the monetary authorities revise immediately the reference value for output or the money target. In the other sub-variant, the monetary authorities do not change the reference value for output or the money target.

In each of the following exercises, we start from a baseline[1] to which we apply a shock, and we simulate the model until it reaches a steady state. Although our analysis focuses primarily on the adjustment process during the first 5 years, a discussion of the steady state will also be provided because a clear understanding of the changes in the steady state is necessary to understand the short run dynamics.

Finally, note that the shocks discussed in the following sections are country-specific, i.e., they only occur in one country.

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1. We perform the shocks on a technical baseline that has been obtained simulating the model for a prolonged time until it has reached a steady state. The year in which the shock is introduced is the first year of the steady state. This implies, for example, that the equilibrium direct income tax rate is set at the level that is compatible with the fiscal targets, in particular, the debt to GDP ratio. The latter is determined outside the model at 0.60. See Chapter VI of Meyermans and Van Brusselen (2001).

# V    A temporary real demand shock

Here, we assume that, during the first three years, the household sector of the euro area expects an increase in its future income[1]. As a result, the household sector reallocates its expenditures, thereby inducing in the first year an increase in private consumption by 1 percent vis-à-vis the baseline. In the fourth year, the household sector revises its expectations and the expected future income stream is again equal to its baseline level.

We will discuss two policy responses to this temporary increase in private demand. In the first variant, the monetary authorities of the euro area adjust the short-term interest rate according to a Taylor rule, as described in equation (1). In the second variant, the monetary authorities of the euro area keep the supply of money fixed to its baseline level. The simulation results for these two variants are summarised in Table 1. The first 6 columns refer to the variant with the Taylor rule, while the last 6 columns refer to the variant with money targeting. For comparison, results for a similar shock in the U.S. are shown in Table 2.

## A. Adjustment under a Taylor rule

The simulation results for the euro area are shown in Table 1. The first 3 columns show the first 3 years of the adjustment process as percentage deviations from the baseline. The fourth column shows the fifth year. The fifth column, labelled sq, shows the standard deviation for the first 5 years[2], while the sixth column, labelled ss, shows the new steady state that is obtained simulating the model for a prolonged period. In the next section, these results will be compared with the results under money targeting.

The steady state equilibrium is not affected by this temporary real demand shock, as is shown in column 6 of Table 1.

In the first year, the household sector increases its consumption of goods and services by 1 percent. The monetary authorities react to these demand pressures with an interest rate increase of 58 basis points. This interest rate hike increases the long-term interest rate by 43 basis points, and it induces a 0.14 percent appreciation of the effective nominal exchange rate. These changes in the financial variables temper demand via an increase in the opportunity cost of money, a substitution of contemporaneous consumption for future consumption, an increase

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1. We calculated this increase in future income in such a way that it induces a 1 percent increase in private consumption in the first year. It is only the household sector that changes its expectations.
2. I.e., the square root of the sum of squared deviations from baseline.

in the user cost of capital, and a loss of international competitiveness. Taking all effects into account, we see that total private supply for final demand increases by 0.65 percent, while the price level remains almost unaffected. The prices do not change much in the first year for three reasons. First, in the long run, the shock does not affect the general price level, so that price setters do not have an incentive to change their prices in response to changing long run conditions. Second, it is only with a one-year lag that prices change to accommodate the output gap[1]. Third, most of the increased demand is met by increased imports, which rise by 1.85 percent.

After the first year, the demand pressures continue to exist and inflation starts to pick up. We see that private supply for final demand is about 0.7 percent above its baseline level in second and third year, while the GDP deflator climbs in the second and third year to, respectively, 0.28 and 0.55 percent above the baseline level. To temper these deviations from trend, the monetary authorities increase the short-term interest rate by an additional 53 basis points in the second year, and an additional 24 basis points in the third year. In the fourth year, when the shock reverses, household demand falls and the monetary authorities react with an interest rate cut. Following this reversal of the shock, the economy gradually converges to its baseline level. However, note also that during this adjustment process, prices adjust only sluggishly, i.e., in the fifth year the GDP deflator is still 0.88 percent above its baseline level.

Private sector employment increases by about 0.1 percent in the first three years, while real wages do not change much. This rather small increase in private employment reflects the low short run output elasticity of the demand for labour. When in the fourth year the shock reverses, private sector employment drops initially 0.1 percent below the baseline, and it subsequently converges gradually to its baseline level.

Public revenues in constant prices increase by 0.18 percent in the first year, mainly because of a rise in indirect tax receipts. Public expenditures in constant prices fall by 0.13 percent, reflecting a drop in the outlays for unemployment benefits and a fall in the real value of interest payments. The fiscal deficit to GDP ratio decreases by 0.13 percentage points, while the debt to GDP ratio falls by 0.39 percentage points. However, it should be noted that when the interest rates increase, interest payments on public debt also increase. Nevertheless, during the first three years, the public sector runs a surplus, and the debt to GDP ratio continues to fall. Once the shock reverses, the public sector starts to run a deficit until the economy is again in its steady state.

The spill-over effects to the other country blocks are summarised in the last rows of Table 1[2]. Activity in the other country blocks is stimulated by increased exports, which rise to meet the higher imports of the euro area. In the first year, private supply for final demand increases, on average, by about 0.10 percent in the other country blocks, while prices remain almost unchanged. Foreign short-term interest rates increase, on average, by 9 basis points. After this initial jump in output, output starts to fall, partly due to an additional interest rate hike of 7

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1. See equation (III.24) of Meyermans and Van Brusselen (2001).
2. The effective foreign variables are a weighted average of the corresponding variables in the other country blocks. The weights are shares in export markets.

basis points. These higher interest rates are triggered by the emerging inflationary pressures in the other country blocks[1].

The first four columns of Table 2 show the responses for a similar shock in the U.S.. Here we see that the initial responses are larger than in the euro area. Of particular interest are the responses in the U.S. labour market where employment in the private sector increases by 0.39 percent, compared with 0.13 percent in the euro area. This reflects to a large extent the relative high short run output elasticity of labour demand in the U.S.. In the U.S., the public sector runs a surplus equal to 0.17 percent of GDP, reflecting the strong decrease in outlays for unemployment benefits. Finally, note that the spill-over effects to the rest of the world are now somewhat smaller, i.e., foreign private supply for final demand increases, on average, by 0.07 percent, compared with 0.10 for a similar shock in the euro area.

## B. Adjustment under money targeting

In the previous variant, the authorities reacted to the demand shock with an interest rate increase of 58 basis points in the first year, an additional hike of 53 basis points in the second year, and a hike of 24 basis points in the third year. At the same time, the supply of money was adjusted to maintain money market equilibrium, e.g., the nominal money supply increased by 1.26 percent in the first year.

In this variant, the monetary authorities keep the nominal supply of money fixed at its baseline level, and the short-term interest rate adjusts to maintain money market equilibrium. The simulation results of this variant are shown in the columns 7 until 12 of Table 1.

Let us now start with a discussion of the behaviour of the short-term interest rate.

In the first year, the money supply is fixed at its baseline level and prices do not change much, hence the supply of real money balances remains almost unaffected. However, the demand for money increases as higher economic activity increases the need for more transaction balances. In other words, there tends to be an excess demand in the money market. In order to keep money demand in line with money supply, the nominal short-term interest rate increases by 124 basis points, - which is 66 basis points more than in the previous variant. As a result of this interest rate hike, total demand for goods rises less than in the previous variant, and private supply for final demand is now only 0.49 percent above its baseline level, compared with 0.65 percent in the previous variant.

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1. The default interest rate reaction function in the other country blocks is a Taylor rule.

**TABLE 1 -**    **A temporary real demand shock in the euro area**

| | Taylor rule | | | | | | Money targeting | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 01 | 02 | 03 | 05 | sq | ss | 01 | 02 | 03 | 05 | sq | ss |
| short-term interest rate * | 0.58 | 1.11 | 1.35 | 0.25 | 0.91 | -0.00 | 1.24 | 0.79 | 0.87 | 0.25 | 0.78 | -0.00 |
| real GDP | 0.35 | 0.41 | 0.41 | -0.01 | 0.30 | -0.00 | 0.23 | 0.47 | 0.48 | -0.01 | 0.34 | 0.00 |
| GDP deflator (PGDP) | 0.08 | 0.28 | 0.55 | 0.88 | 0.59 | -0.00 | 0.05 | 0.26 | 0.52 | 0.93 | 0.61 | -0.00 |
| private supply for final demand | 0.65 | 0.75 | 0.69 | -0.18 | 0.55 | -0.00 | 0.49 | 0.85 | 0.78 | -0.19 | 0.58 | 0.00 |
| | | | | | | | | | | | | |
| *Demand* (in constant prices) | | | | | | | | | | | | |
| private consumption | 1.00 | 1.25 | 1.21 | -0.20 | 0.90 | 0.00 | 0.90 | 1.25 | 1.27 | -0.10 | 0.91 | -0.00 |
| public consumption | -0.00 | 0.04 | 0.07 | 0.07 | 0.07 | 0.00 | -0.00 | 0.03 | 0.07 | 0.09 | 0.07 | -0.00 |
| gross capital formation | -0.02 | -0.09 | -0.13 | -0.06 | 0.09 | -0.00 | -0.49 | 0.38 | 0.11 | -0.43 | 0.41 | 0.00 |
| exports | 0.08 | -0.04 | -0.10 | -0.08 | 0.11 | -0.00 | -0.01 | 0.03 | -0.06 | -0.12 | 0.07 | 0.00 |
| imports | 1.85 | 2.12 | 1.85 | -0.89 | 1.56 | -0.00 | 1.57 | 2.31 | 1.94 | -0.92 | 1.58 | 0.00 |
| | | | | | | | | | | | | |
| *Prices* | | | | | | | | | | | | |
| GDP deflator (PGDP) | 0.08 | 0.28 | 0.55 | 0.88 | 0.59 | -0.00 | 0.05 | 0.26 | 0.52 | 0.93 | 0.61 | -0.00 |
| consumption price/PGDP | -0.08 | -0.06 | 0.02 | 0.30 | 0.17 | 0.00 | -0.05 | -0.09 | 0.01 | 0.33 | 0.17 | 0.00 |
| export price/PGDP | -0.09 | -0.31 | -0.61 | -1.00 | 0.67 | -0.00 | -0.07 | -0.30 | -0.59 | -1.04 | 0.68 | -0.00 |
| import price/producer price | -0.02 | -0.17 | -0.34 | -0.38 | 0.31 | 0.00 | -0.01 | -0.18 | -0.30 | -0.40 | 0.31 | -0.00 |
| | | | | | | | | | | | | |
| *Labour market* | | | | | | | | | | | | |
| total employment | 0.11 | 0.11 | 0.08 | -0.09 | 0.06 | 0.00 | 0.10 | 0.12 | 0.08 | -0.10 | 0.06 | -0.00 |
| private sector employment | 0.13 | 0.14 | 0.10 | -0.11 | 0.11 | 0.00 | 0.12 | 0.15 | 0.10 | -0.12 | 0.11 | -0.00 |
| take home real wage | 0.03 | 0.02 | -0.03 | -0.17 | 0.09 | -0.00 | 0.02 | 0.03 | -0.02 | -0.18 | 0.09 | -0.00 |
| producer real wage | 0.00 | 0.03 | 0.08 | 0.17 | 0.10 | 0.00 | 0.01 | 0.01 | 0.07 | 0.18 | 0.10 | -0.00 |
| | | | | | | | | | | | | |
| *Monetary sector* | | | | | | | | | | | | |
| short-term interest rate * | 0.58 | 1.11 | 1.35 | 0.25 | 0.91 | -0.00 | 1.24 | 0.79 | 0.87 | 0.25 | 0.78 | -0.00 |
| long-term interest rate * | 0.43 | 0.79 | 0.94 | 0.15 | 0.63 | -0.00 | 0.77 | 0.61 | 0.69 | 0.17 | 0.54 | -0.00 |
| eff. nom. exchange rate (-:appr.) | -0.14 | -0.33 | -0.47 | -0.23 | 0.34 | -0.00 | -0.31 | -0.31 | -0.35 | -0.11 | 0.26 | 0.00 |
| eff. real exchange rate (-:appr.) | -0.14 | -0.29 | -0.37 | -0.00 | 0.24 | -0.00 | -0.29 | -0.26 | -0.24 | 0.06 | 0.21 | 0.00 |
| nominal money stock | 1.26 | -0.08 | -0.88 | -1.10 | 1.42 | -0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -0.00 |
| real money stock | 1.26 | -0.30 | -1.46 | -2.27 | 2.07 | 0.00 | -0.00 | -0.16 | -0.53 | -1.26 | 0.75 | 0.00 |
| error correction term money | 0.85 | 1.04 | 0.70 | -0.39 | -0.95 | 0.00 | 1.68 | 0.14 | 0.18 | 0.08 | 1.01 | 0.00 |
| | | | | | | | | | | | | |
| *Public sector* | | | | | | | | | | | | |
| nominal public revenues | 0.26 | 0.48 | 0.73 | 0.83 | 0.65 | -0.00 | 0.19 | 0.47 | 0.73 | 0.89 | 0.68 | -0.00 |
| real public revenues | 0.18 | 0.20 | 0.18 | -0.05 | 0.15 | 0.00 | 0.14 | 0.22 | 0.21 | -0.04 | 0.15 | 0.00 |
| nominal public expenditures | -0.05 | 0.29 | 0.75 | 1.31 | 0.88 | -0.00 | -0.06 | 0.36 | 0.65 | 1.19 | 0.81 | -0.00 |
| real public expenditures | -0.13 | 0.01 | 0.20 | 0.43 | 0.31 | 0.00 | -0.11 | 0.10 | 0.13 | 0.26 | 0.21 | 0.00 |
| deficit to GDP ratio * (+:surplus) | 0.13 | 0.09 | 0.01 | -0.18 | 0.14 | 0.00 | 0.11 | 0.06 | 0.05 | -0.11 | 0.09 | -0.00 |
| debt to GDP ratio * | -0.39 | -0.63 | -0.79 | -0.37 | 0.57 | 0.00 | -0.27 | -0.60 | -0.80 | -0.54 | 0.61 | -0.00 |
| | | | | | | | | | | | | |
| *Household sector* | | | | | | | | | | | | |
| total available means | 2.36 | 2.28 | 2.14 | -0.44 | 1.77 | 0.00 | 2.36 | 2.29 | 2.16 | -0.47 | 1.78 | -0.00 |
| real disposable income | 0.05 | 0.24 | 0.15 | -0.28 | 0.18 | -0.00 | 0.04 | 0.26 | 0.17 | -0.31 | 0.20 | 0.00 |
| savings as % of disp. inc * | -0.96 | -1.01 | -1.06 | -0.08 | 0.79 | -0.00 | -0.86 | -1.00 | -1.11 | -0.21 | 0.79 | 0.00 |
| | | | | | | | | | | | | |
| *Spill-over effects* | | | | | | | | | | | | |
| effec. foreign output | 0.10 | 0.07 | 0.05 | -0.01 | 0.06 | -0.00 | 0.08 | 0.10 | 0.05 | -0.06 | 0.07 | 0.00 |
| effec. foreign price level | -0.01 | 0.01 | 0.04 | 0.10 | 0.07 | -0.00 | 0.00 | 0.02 | 0.04 | 0.06 | 0.04 | -0.00 |
| effec. foreign interest rate * | 0.09 | 0.16 | 0.18 | 0.06 | 0.13 | -0.00 | 0.14 | 0.16 | 0.14 | 0.00 | 0.11 | 0.00 |
| | | | | | | | | | | | | |
| *Memo items* | | | | | | | | | | | | |
| current account to GDP * | -0.26 | -0.32 | -0.31 | 0.03 | 0.23 | -0.00 | -0.23 | -0.33 | -0.32 | 0.02 | 0.23 | -0.00 |
| total stock of real assets | -0.00 | -0.01 | -0.01 | -0.02 | 0.01 | -0.00 | -0.02 | -0.00 | 0.00 | 0.00 | 0.02 | 0.00 |

variables without * : deviation from baseline, in percent;  variables with * : deviation from baseline, in differences; ss: steady state;

sq : standard deviation of first 5 years.

**TABLE 2 -      A temporary real demand shock in the u.s.**

| | Taylor rule | | | | | | Money targeting | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 01 | 02 | 03 | 05 | sq | ss | 01 | 02 | 03 | 05 | sq | ss |
| short-term interest rate * | 0.59 | 0.89 | 1.00 | 0.09 | 0.68 | 0.00 | 1.10 | 0.99 | 0.97 | 0.07 | 0.79 | -0.00 |
| real GDP | 0.58 | 0.57 | 0.48 | -0.19 | 0.44 | 0.00 | 0.46 | 0.54 | 0.47 | -0.18 | 0.39 | 0.00 |
| GDP deflator (PGDP) | 0.03 | 0.14 | 0.31 | 0.57 | 0.37 | -0.03 | 0.01 | 0.11 | 0.25 | 0.53 | 0.32 | -0.00 |
| private supply for final demand | 0.82 | 0.79 | 0.63 | -0.33 | 0.62 | 0.00 | 0.63 | 0.75 | 0.62 | -0.32 | 0.54 | 0.00 |
| | | | | | | | | | | | | |
| *Demand* (in constant prices) | | | | | | | | | | | | |
| private consumption | 1.00 | 1.10 | 0.96 | -0.34 | 0.81 | 0.00 | 0.82 | 1.02 | 0.93 | -0.30 | 0.73 | -0.00 |
| public consumption | -0.00 | 0.03 | 0.08 | 0.06 | 0.06 | 0.00 | -0.00 | 0.03 | 0.07 | 0.06 | 0.06 | 0.00 |
| gross capital formation | 0.27 | 0.05 | -0.20 | -0.38 | 0.35 | 0.00 | -0.03 | 0.11 | -0.11 | -0.45 | 0.24 | 0.00 |
| exports | 0.12 | -0.05 | -0.11 | -0.01 | 0.12 | 0.00 | 0.06 | -0.06 | -0.12 | 0.00 | 0.10 | 0.00 |
| imports | 1.93 | 1.80 | 1.31 | -1.00 | 1.46 | 0.00 | 1.36 | 1.77 | 1.35 | -1.01 | 1.26 | 0.00 |
| | | | | | | | | | | | | |
| *Prices* | | | | | | | | | | | | |
| GDP deflator (PGDP) | 0.03 | 0.14 | 0.31 | 0.57 | 0.37 | -0.03 | 0.01 | 0.11 | 0.25 | 0.53 | 0.32 | -0.00 |
| consumption price/PGDP | -0.03 | 0.00 | 0.08 | 0.24 | 0.15 | -0.00 | -0.01 | -0.00 | 0.08 | 0.23 | 0.13 | -0.00 |
| export price/PGDP | -0.09 | -0.31 | -0.59 | -0.83 | 0.59 | 0.02 | -0.13 | -0.37 | -0.62 | -0.73 | 0.57 | 0.00 |
| import price/producer price | -0.00 | -0.10 | -0.14 | -0.03 | 0.10 | -0.00 | 0.01 | -0.13 | -0.10 | 0.02 | 0.09 | -0.00 |
| | | | | | | | | | | | | |
| *Labour market* | | | | | | | | | | | | |
| total employment | 0.33 | 0.32 | 0.19 | -0.30 | 0.18 | 0.00 | 0.25 | 0.30 | 0.20 | -0.28 | 0.15 | 0.00 |
| private sector employment | 0.39 | 0.37 | 0.22 | -0.36 | 0.33 | 0.00 | 0.30 | 0.35 | 0.23 | -0.33 | 0.29 | -0.00 |
| take home real wage | 0.05 | 0.01 | -0.05 | -0.18 | 0.12 | 0.01 | 0.03 | 0.01 | -0.05 | -0.17 | 0.10 | 0.00 |
| producer real wage | 0.05 | 0.04 | 0.05 | 0.03 | 0.04 | 0.00 | 0.04 | 0.04 | 0.05 | 0.02 | 0.04 | 0.00 |
| | | | | | | | | | | | | |
| *Monetary sector* | | | | | | | | | | | | |
| short-term interest rate * | 0.59 | 0.89 | 1.00 | 0.09 | 0.68 | 0.00 | 1.10 | 0.99 | 0.97 | 0.07 | 0.79 | -0.00 |
| long-term interest rate * | 0.28 | 0.43 | 0.48 | 0.05 | 0.33 | 0.00 | 0.39 | 0.43 | 0.46 | 0.06 | 0.34 | -0.00 |
| eff. nom. exchange rate (-:appr.) | -0.16 | -0.31 | -0.40 | -0.15 | 0.28 | -0.00 | -0.34 | -0.43 | -0.45 | -0.07 | 0.33 | 0.00 |
| eff. real exchange rate (-:appr.) | -0.11 | -0.14 | -0.11 | 0.15 | 0.12 | 0.00 | -0.23 | -0.16 | -0.06 | 0.17 | 0.18 | -0.00 |
| nominal money stock | 1.25 | 0.38 | 0.09 | -0.12 | 0.80 | -0.03 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -0.00 |
| real money stock | 1.25 | 0.23 | -0.30 | -0.94 | 1.11 | -0.00 | 0.00 | -0.11 | -0.32 | -0.76 | 0.45 | 0.00 |
| error correction term money | 0.48 | 0.51 | 0.38 | -0.21 | -0.39 | 0.00 | 0.80 | 0.42 | 0.26 | -0.28 | 0.52 | 0.00 |
| | | | | | | | | | | | | |
| *Public sector* | | | | | | | | | | | | |
| nominal public revenues | 0.34 | 0.44 | 0.51 | 0.33 | 0.39 | -0.03 | 0.25 | 0.39 | 0.46 | 0.31 | 0.35 | -0.00 |
| real public revenues | 0.30 | 0.30 | 0.20 | -0.24 | 0.25 | -0.00 | 0.24 | 0.28 | 0.21 | -0.22 | 0.22 | -0.00 |
| nominal public expenditures | -0.33 | 0.06 | 0.42 | 1.01 | 0.71 | -0.03 | -0.26 | 0.09 | 0.35 | 0.88 | 0.60 | -0.00 |
| real public expenditures | -0.36 | -0.08 | 0.11 | 0.43 | 0.38 | 0.00 | -0.26 | -0.02 | 0.10 | 0.35 | 0.30 | -0.00 |
| deficit to GDP ratio * (+:surplus) | 0.17 | 0.09 | 0.02 | -0.18 | 0.15 | -0.00 | 0.13 | 0.07 | 0.02 | -0.15 | 0.12 | -0.00 |
| debt to GDP ratio * | -0.53 | -0.69 | -0.74 | -0.11 | 0.52 | -0.00 | -0.41 | -0.58 | -0.64 | -0.12 | 0.45 | 0.00 |
| | | | | | | | | | | | | |
| *Household sector* | | | | | | | | | | | | |
| total available means | 2.81 | 2.76 | 2.69 | -0.22 | 2.14 | 0.01 | 2.81 | 2.77 | 2.71 | -0.20 | 2.14 | -0.00 |
| real disposable income | 0.16 | 0.41 | 0.32 | -0.21 | 0.26 | 0.01 | 0.12 | 0.39 | 0.33 | -0.19 | 0.26 | 0.00 |
| savings as % of disp. inc * | -0.84 | -0.69 | -0.64 | 0.13 | 0.58 | 0.01 | -0.70 | -0.64 | -0.61 | 0.11 | 0.51 | 0.00 |
| | | | | | | | | | | | | |
| *Spill-over effects* | | | | | | | | | | | | |
| effec. foreign output | 0.07 | 0.01 | 0.01 | 0.01 | 0.04 | 0.00 | 0.06 | 0.02 | 0.01 | -0.01 | 0.04 | 0.00 |
| effec. foreign price level | -0.01 | 0.01 | 0.02 | 0.04 | 0.03 | -0.00 | -0.00 | 0.01 | 0.02 | 0.04 | 0.03 | -0.00 |
| effec. foreign interest rate * | 0.12 | 0.19 | 0.21 | 0.03 | 0.14 | 0.00 | 0.09 | 0.17 | 0.20 | 0.04 | 0.13 | 0.00 |
| | | | | | | | | | | | | |
| *Memo items* | | | | | | | | | | | | |
| current account to GDP * | -0.19 | -0.21 | -0.19 | 0.00 | 0.15 | 0.00 | -0.14 | -0.21 | -0.21 | 0.01 | 0.15 | 0.00 |
| total stock of real assets | 0.01 | 0.01 | 0.00 | -0.04 | 0.03 | 0.00 | -0.00 | 0.00 | -0.00 | -0.04 | 0.02 | 0.00 |

Variables without * : deviation from baseline, in percent;  variables with * : deviation from baseline, in differences;  ss: steady state;

sq : standard deviation of first 5 years.

In the second year, inflation starts to pick up and the supply of real money balances falls by 0.16 percent. A priori, it is not clear how money demand evolves because the different variables that determine short run money demand point in a different direction. Indeed, remember that the short run demand for money is determined by the available means of the household sector, the nominal interest rate, the expected inflation, and the lagged error correction term[1], see Appendix A. Looking at the evidence in Table 1, we note the following. First, in column 8 of Table 1, we see that the total available means are in the second year very much the same as in the first year, so that, given the falling supply of real money balances, they will add some pressure to increase the interest rate. Second, in the same table, we also see that in the second year the lagged error correction term of money demand is larger than zero, i.e., that "equilibrium" money demand was below the predetermined money supply in the first year. This disequilibrium requires a fall in the short-term interest rate. The evidence in Table 1 shows that the net result of the earlier mentioned effects is that, in the second year, the short-term interest rate falls to a level that is 79 basis points above the baseline, compared with 124 basis points in the first year. In other words, in the second year under money targeting, the short-term interest rate is 45 basis points lower than in the first year, and it is also 32 basis points lower than under the Taylor rule in the second year.

This particular path of the short-term interest rate under money targeting is not without implications for the path of the components of demand, private supply for final demand, and GDP. Indeed, we see that the deviation from trend of private supply in the first year is smaller under money targeting than under a Taylor rule, i.e., 0.49 percent compared with 0.65 percent. However, in the second and third year, this deviation is larger under money targeting than under a Taylor rule, i.e., 0.85 percent compared with 0.75 percent in the second year, and 0.78 percent compared with 0.69 percent in the third year.

Before we have a more detailed look at the differences between the two policy rules, we want to present first the results for the U.S. of Table 2. Having the previous results in mind, it is important to note that during the first three years the deviation from baseline of private supply is in the U.S. always smaller under money targeting than under a Taylor rule, reflecting a higher short-term interest rate under money targeting than under a Taylor rule. However, it is also important to note that in the second and third year, the short-term interest rate starts to fall under money targeting, while it increases under a Taylor rule, and that this increase is stronger, in absolute terms, than the fall under money targeting.

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1.  The lagged error correction term measures the conditions in the money market one period earlier. The error correction term is defined as ln(M/ML), with M the money supply and ML the "equilibrium" money demand as described in equation (A.1) of Appendix A. M is predetermined and ML is determined, i.e., by the short-tem interest rate. A rise in the short-term interest rate lowers ML, while a drop in the short-term interest rate increases ML. An error correction term larger than zero puts downward pressure on the short-term interest rate, because a positive error correction term indicates that ML is smaller than the predetermined money supply M. Hence, it is only an interest rate cut that can raise ML to the predetermined level of M.

## C. The degree of stabilisation under money targeting

Table 3 and 4 give a measure for the degree of stabilisation under money targeting when compared with a Taylor rule[1]. Table 3 shows results for the euro area, while Table 4 refers to the U.S..

In the first year, we find for the euro area that the deviation from trend of private supply is about 25 percent lower under money targeting than under a Taylor rule, due to the fact that under money targeting the short-term interest rate is 66 basis points higher than under a Taylor rule. A similar result can be found for the U.S., where output deviations form trend are about 23 percent lower under money targeting than under a Taylor rule, and the short-term interest rate is 52 basis points higher under money targeting than under a Taylor rule.

As of the second year, we see that in the euro area the deviations from trend of private supply are about 13 percent higher under money targeting than under a Taylor rule, reflecting the higher interest rates under the Taylor rule. By contrast, we find that in the U.S. these deviations are lower under money targeting than under a Taylor rule. This difference between the two country blocks is partly due to the behaviour of the interest rate. Indeed, remember that under money targeting, there is a sharp interest rate hike in both country blocks in the first year, i.e., a hike equal to 124 basis points in the euro area and a hike of 110 basis points in the U.S.. However, after the first year, money market equilibrium is maintained by reducing the interest rate[2]. Since money demand is more elastic in the U.S. than in the euro area, a smaller rate cut is needed in the U.S. than in the euro area, i.e., a rate cut of 45 basis points in the euro area, compared with a rate cut of 11 basis points in the U.S.. These rate cuts stimulate demand for goods. Clearly, in the euro area the overall stimulus is larger than in the U.S., and it is even large enough to overshoot the level reached under a Taylor rule.

The numbers in column 4 of Table 3 and Table 4 summarise the overall relative short run variability of the main macroeconomic variables in, respectively, the euro area and the U.S.[3]. For the euro area, we see that GDP variability under money targeting is 1.11 times GDP variability under a Taylor rule. However, we note also that interest rate variability and exchange rate variability under money targeting are, respectively, 0.85 and 0.76 times their variability under a Taylor rule. For the U.S., we see that GDP variability under money targeting is 0.89 times GDP variability under a Taylor rule, and that interest rate variability and exchange rate variability under money targeting are, respectively, 1.16 and 1.17 times their variability under a Taylor rule.

We draw the following conclusions from the simulation results of this section. First, in the first year, money targeting, if compared with a Taylor rule, generates smaller output deviations in the euro area and the U.S.. Second, as of the second

---

1. Degree of stabilisation is defined as (deviation from baseline under a Taylor rule -deviation from baseline under money targeting)/deviation from baseline under a Taylor rule. Interpreting these results, one should of course take into account that a very small denominator can yield large numbers.
2. See the discussion in the previous sub-section.
3. The numbers in column 4 of Table 3 show the ratio of the variability shown in column 11 and 5 of Table 1. The numbers in column 4 of Table 4 show a similar ratio of the variability shown in column 11 and 5 of Table 2.

year, money targeting loses in the euro area its potency to stabilise output more than a Taylor rule. This is primarily because the interest rate hikes needed to clear the money market are smaller than the hikes needed to temper the inflationary pressures arising in the goods market. By contrast, in the U.S., money targeting generates smaller deviations from trend for output, but larger deviations from trend for the financial variables.

In view of this mixed evidence on the potency of the two policy rules to stabilise output, it may be worthwhile to investigate what the merits are of a two-pillar strategy that sets the short-term interest rate by weighing the conditions in the money market against the conditions in the goods market. This will be done in the next sub-section.

**TABLE 3 - Degree of stabilisation under a temporary real demand shock and money targeting in the euro area**

|  | 01 | 02 | 03 | var |
|---|---|---|---|---|
| short-term interest rate * | -0.66 | 0.33 | 0.47 | 0.85 |
| private supply for final demand | 24.64 | -12.78 | -12.51 | 1.05 |
| real GDP | 33.56 | -15.29 | -18.07 | 1.11 |
| GDP deflator | 34.28 | 7.79 | 5.65 | 1.03 |
| nominal exchange rate | -124.37 | 4.96 | 26.83 | 0.76 |

**TABLE 4 - Degree of stabilisation under a temporary real demand shock and money targeting in the U.S.**

|  | 01 | 02 | 03 | var |
|---|---|---|---|---|
| short-term interest rate * | -0.52 | -0.09 | 0.02 | 1.16 |
| private supply for final demand | 23.27 | 4.82 | 0.11 | 0.88 |
| real GDP | 20.52 | 6.30 | 1.68 | 0.89 |
| GDP deflator | 72.24 | 25.87 | 20.40 | 0.88 |
| nominal exchange rate | -115.66 | -38.50 | -12.20 | 1.17 |

A value smaller than zero if deviation from trend is larger under money targeting than under a Taylor rule. A value greater than zero if deviation from trend is smaller under money targeting than under a Taylor rule. var: relative variability, i.e., standard deviation of first five years under money targeting divided by standard deviation of first five years under a Taylor rule, see columns 11 and 5 of tables 1 and 2, respectively. Variable with * is in differences.

## D. Adjustment under a two-pillar strategy

In this section, we summarise the simulation results for a two-pillar strategy under which the short-term interest rate is set in accordance with the conditions in the money market and the conditions in the goods market[1].

The results of this rule for the euro area are summarised in Table 5[2]. On impact, the euro short-term interest is under the two-pillar strategy 53 basis points higher than under the Taylor rule, yielding in the first year a dampening impact on output of about 20 percent. Looking at the first five years, we see that, on average, the variability of output and prices is smaller under the two-pillar strategy than under the Taylor rule. See column 4 of Table 5. However, we note also that the var-

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1. Under the two-pillar strategy the monetary authorities target the money supply in the medium term but they allow for deviations from this target in the short run in order to limit deviations of output and inflation from their reference value.
2. See Table 17 of Appendix B for details about this variant.

iability of the interest rate and the variability of the effective exchange rate increase under the two-pillar strategy.

For the U.S., we find similar qualitative results, however, here the order of magnitude is larger. See Table 6.

**TABLE 5 -**      **Degree of stabilisation under a temporary real demand shock and a two-pillar strategy in the euro area**

|  | 01 | 02 | 03 | var |
|---|---|---|---|---|
| short-term interest rate * | -0.53 | 0.08 | -0.02 | 1.08 |
| private supply for final demand | 19.75 | -4.48 | 3.12 | 0.98 |
| real GDP | 26.90 | -4.60 | 2.25 | 0.97 |
| GDP deflator | 27.50 | 8.87 | 9.12 | 0.93 |
| nominal exchange rate | -99.67 | -10.01 | -3.87 | 1.07 |

**TABLE 6 -**      **Degree of stabilisation under a temporary real demand shock and a two-pillar strategy in the U.S.**

|  | 01 | 02 | 03 | var |
|---|---|---|---|---|
| short-term interest rate * | -0.43 | -0.18 | -0.22 | 1.29 |
| private supply for final demand | 19.55 | 8.90 | 14.16 | 0.88 |
| real GDP | 17.24 | 9.45 | 13.43 | 0.89 |
| GDP deflator | 60.55 | 25.12 | 22.92 | 0.80 |
| nominal exchange rate | -96.78 | -44.32 | -35.83 | 1.39 |

A value smaller than zero if deviation from trend is larger under money targeting than under a Taylor rule. A value greater than zero if deviation from trend is smaller under a two-pillar strategy than under a Taylor rule. var: relative variability, i.e., standard deviation of first five years under a two-pillar strategy by standard deviation of first five years under a Taylor rule. Variable with * is in differences.

# VI A permanent increase in the velocity of money

In this section, we discuss the results for the case where there is an autonomous drop of 1 percent in the demand for money, and where the household sector reduces its money balances by holding more interest bearing financial assets instead. In a first variant, the monetary authorities accommodate the shock by reducing immediately the supply of money by the same amount as the drop in the demand for money. In the second variant, the monetary authorities keep the money stock fixed at its baseline level. We will now investigate the implications of both variants.

## A. Adjustment under a Taylor rule

When the demand for money falls, the monetary authorities reduce the supply of money by the same amount. Since money is created out of nothing, no further adjustments are necessary to keep the economy in equilibrium[1].

## B. Adjustment under money targeting without revision of the money target

Table 7 shows the results for the variant with money targeting in the euro area[2]. The steady state results are shown in column 6 of Table 7, labelled ss. Here, we see that in the long run the general price level increases by 1 percent, while the real variables are at their baseline level. This 1 percent increase in the general price level is necessary to clear the money market in the long run[3].

In the first year, the short-term interest rate falls by 28 basis points, while the general price level increases by 0.38 percent and the effective nominal exchange rate depreciates by 0.63 percent. As a consequence, all components of final demand get a boost, and GDP in constant prices increases by 0.12 percent, while GDP in current prices increases by 0.49 percent. Furthermore, we note that private consumption increases by 0.04 percent, while gross fixed capital formation in-

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1. Note that the shift from money to interest bearing assets generates an adjustment path induced by changes in interest earnings. However, these effects are too small to be reported.
2. Note that if the monetary authorities reduce their money target immediately by 1 percent, we get the same results as described in the previous section.
3. Remember that in the short run the short-term interest rate clears the money market. However, in the steady state, the interest rates are equal to the steady state interest rate, and the steady state interest rate balances the total supply of savings and investments. Note also that the effective nominal exchange rate depreciates by 1 percent, keeping the real exchange rate unchanged vis-à-vis the baseline.

creases by 0.40 percent. The export volume increases by 0.28 percent, while imports increase by 0.34 percent.

In the second year, the price level increases further and the supply of real money balances declines. As the conditions in the money market tighten, the short-term interest rate rises by 18 basis points and final demand starts to fall. This feedback between interest rates, demand and prices continues until the real variables are back to their baseline level and the nominal variables have increased by 1 percent.

Looking at the other sectors of the economy, we note that in the labour market the real producer wage and private sector employment are almost unaffected. This low response of labour demand is due to the fact that the output increase is offset by the fall in the user cost of capital and the fall in the price of intermediary imports. In the current account, there is a deficit equal to 0.02 percent of GDP in the first year. The fiscal stance is affected via the automatic fiscal stabilisers. The public sector runs a surplus equal to 0.05 percent of GDP, while the debt to GDP ratio drops by 0.35 percentage points in the first year. As time progresses, these deviations from trend start to decline and the real variables return to their baseline level.

The spill-over effects to the other country blocks are small. Private supply for final demand in the other country blocks increases, on average, by 0.02 percent in the first year, compared with 0.15 percent in the euro area. The foreign price effects are also negligible. The latter result is primarily due to the fact that we assume a flexible exchange rate regime.

Table 8 shows simulation results for a similar shock in the U.S.. Summarising these results, we note that, in the first year, real GDP and nominal GDP increase in the U.S. by 0.11 percent and 0.34 percent, respectively, compared with, respectively, 0.12 percent and 0.49 percent in the euro area.

The simulation results of this section indicate that an autonomous increase in the velocity of money leads to important short run deviations from trend, if the money supply target is not immediately adjusted. In the euro area, a 1 percent drop in the money demand increases the output gap by 0.15 percent in the first year, and 0.03 percent in the second year. Prices increase by 0.38 percent in the first year, and continue to rise until they have reached their new steady state level, which is 1 percent above baseline. Similar results are found for the U.S., although here we see that the output gap closes at a slower pace.

**TABLE 7 -        A permanent money demand shock in the euro area**

|  | 01 | 02 | 03 | 05 | sq | ss |
|---|---|---|---|---|---|---|
| short-term interest rate * | -0.28 | -0.10 | -0.08 | -0.06 | 0.14 | -0.00 |
| real GDP | 0.12 | 0.05 | 0.03 | -0.01 | 0.06 | 0.00 |
| GDP deflator (PGDP) | 0.38 | 0.54 | 0.67 | 0.80 | 0.64 | 1.00 |
| private supply for final demand | 0.15 | 0.03 | 0.03 | 0.00 | 0.07 | 0.00 |
| | | | | | | |
| *Demand* (in constant prices) | | | | | | |
| private consumption | 0.04 | -0.04 | -0.07 | -0.12 | 0.08 | -0.00 |
| public consumption | 0.11 | 0.09 | 0.06 | 0.04 | 0.07 | -0.00 |
| gross capital formation | 0.40 | -0.03 | -0.00 | -0.02 | 0.18 | 0.00 |
| exports | 0.28 | 0.30 | 0.36 | 0.39 | 0.35 | 0.00 |
| imports | 0.34 | -0.02 | 0.06 | 0.08 | 0.16 | 0.00 |
| | | | | | | |
| *Prices* | | | | | | |
| GDP deflator (PGDP) | 0.38 | 0.54 | 0.67 | 0.80 | 0.64 | 1.00 |
| consumption price/PGDP | 0.06 | 0.18 | 0.18 | 0.18 | 0.16 | 0.00 |
| export price/PGDP | -0.35 | -0.45 | -0.50 | -0.42 | 0.44 | -0.01 |
| import price/producer price | -0.27 | -0.23 | -0.30 | -0.27 | 0.27 | -0.00 |
| | | | | | | |
| *Labour market* | | | | | | |
| total employment | 0.01 | -0.01 | -0.01 | -0.01 | 0.01 | -0.00 |
| private sector employment | 0.01 | -0.02 | -0.01 | -0.01 | 0.01 | -0.00 |
| take home real wage | -0.04 | -0.09 | -0.11 | -0.12 | 0.10 | -0.00 |
| producer real wage | 0.05 | 0.11 | 0.12 | 0.11 | 0.10 | -0.00 |
| | | | | | | |
| *Monetary sector* | | | | | | |
| short-term interest rate * | -0.28 | -0.10 | -0.08 | -0.06 | 0.14 | -0.00 |
| long-term interest rate * | -0.03 | 0.01 | -0.01 | -0.02 | 0.02 | -0.00 |
| eff. nom. exchange rate (-:appr.) | 0.63 | 0.85 | 0.95 | 1.01 | 0.90 | 1.00 |
| eff. real exchange rate (-:appr.) | 0.57 | 0.73 | 0.74 | 0.60 | 0.67 | 0.00 |
| nominal money stock | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| real money stock | -0.44 | -0.71 | -0.85 | -0.98 | 0.81 | -1.00 |
| | | | | | | |
| *Public sector* | | | | | | |
| nominal public revenues | 0.48 | 0.63 | 0.74 | 0.85 | 0.71 | 1.00 |
| real public revenues | 0.11 | 0.09 | 0.07 | 0.05 | 0.08 | 0.00 |
| nominal public expenditures | 0.35 | 0.61 | 0.77 | 0.88 | 0.72 | 1.00 |
| real public expenditures | -0.03 | 0.07 | 0.10 | 0.09 | 0.08 | 0.00 |
| deficit to GDP ratio * (+:surplus) | 0.05 | 0.01 | -0.01 | -0.02 | 0.03 | -0.00 |
| debt to GDP ratio * | -0.35 | -0.42 | -0.47 | -0.50 | 0.45 | 0.00 |
| | | | | | | |
| *Household sector* | | | | | | |
| total available means | -0.11 | -0.18 | -0.21 | -0.22 | 0.19 | -0.00 |
| real disposable income | 0.05 | -0.01 | -0.03 | -0.06 | 0.04 | 0.00 |
| savings as % of disp. inc * | 0.01 | 0.03 | 0.05 | 0.06 | 0.04 | 0.00 |
| | | | | | | |
| *Spill-over effects* | | | | | | |
| effec. foreign output | 0.02 | -0.02 | -0.01 | -0.00 | 0.01 | 0.00 |
| effec. foreign price level | -0.02 | -0.03 | -0.03 | -0.03 | 0.03 | -0.01 |
| effec. foreign interest rate * | -0.03 | -0.03 | -0.01 | -0.01 | 0.02 | -0.00 |
| | | | | | | |
| *Memo items* | | | | | | |
| current account to GDP * | -0.02 | 0.02 | 0.02 | 0.03 | 0.02 | -0.00 |
| total stock of real assets | 0.02 | 0.02 | 0.02 | 0.01 | 0.02 | 0.00 |

variables without * : deviation from baseline, in percent;  variables with * : deviation from baseline, in differences;  ss: steady state;
sq : standard deviation of first 5 years.

**TABLE 8 -      A permanent money demand shock in the U.S.**

| | 01 | 02 | 03 | 05 | sq | ss |
|---|---|---|---|---|---|---|
| short-term interest rate * | -0.31 | -0.22 | -0.16 | -0.08 | 0.20 | -0.00 |
| real GDP | 0.11 | 0.11 | 0.09 | 0.03 | 0.09 | 0.00 |
| GDP deflator (PGDP) | 0.23 | 0.39 | 0.55 | 0.78 | 0.56 | 1.00 |
| private supply for final demand | 0.17 | 0.14 | 0.11 | 0.05 | 0.12 | 0.00 |
| | | | | | | |
| *Demand* (in constant prices) | | | | | | |
| private consumption | 0.14 | 0.12 | 0.10 | 0.05 | 0.10 | -0.00 |
| public consumption | 0.09 | 0.09 | 0.05 | -0.02 | 0.06 | 0.00 |
| gross capital formation | 0.32 | 0.14 | 0.07 | -0.02 | 0.16 | 0.00 |
| exports | 0.13 | 0.22 | 0.27 | 0.14 | 0.20 | 0.00 |
| imports | 0.58 | 0.29 | 0.27 | 0.12 | 0.33 | 0.00 |
| | | | | | | |
| *Prices* | | | | | | |
| GDP deflator (PGDP) | 0.23 | 0.39 | 0.55 | 0.78 | 0.56 | 1.00 |
| consumption price/PGDP | 0.01 | 0.05 | 0.04 | 0.05 | 0.04 | 0.00 |
| export price/PGDP | 0.01 | 0.19 | 0.32 | 0.36 | 0.28 | -0.00 |
| import price/producer price | -0.12 | 0.04 | -0.08 | -0.13 | 0.11 | -0.00 |
| | | | | | | |
| *Labour market* | | | | | | |
| total employment | 0.07 | 0.05 | 0.03 | -0.01 | 0.03 | -0.00 |
| private sector employment | 0.08 | 0.06 | 0.03 | -0.01 | 0.05 | -0.00 |
| take home real wage | 0.00 | -0.02 | -0.03 | -0.04 | 0.03 | -0.00 |
| producer real wage | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.00 |
| | | | | | | |
| *Monetary sector* | | | | | | |
| short-term interest rate * | -0.31 | -0.22 | -0.16 | -0.08 | 0.20 | -0.00 |
| long-term interest rate * | 0.06 | 0.06 | 0.05 | 0.04 | 0.05 | -0.00 |
| eff. nom. exchange rate (-:appr.) | 0.70 | 0.98 | 1.07 | 1.08 | 1.00 | 1.00 |
| eff. real exchange rate (-:appr.) | 0.46 | 0.40 | 0.20 | -0.05 | 0.29 | 0.00 |
| nominal money stock | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| real money stock | -0.23 | -0.44 | -0.60 | -0.83 | 0.60 | -1.00 |
| | | | | | | |
| *Public sector* | | | | | | |
| nominal public revenues | 0.44 | 0.58 | 0.69 | 0.83 | 0.68 | 1.00 |
| real public revenues | 0.21 | 0.19 | 0.13 | 0.05 | 0.15 | 0.00 |
| nominal public expenditures | 0.12 | 0.36 | 0.54 | 0.82 | 0.56 | 1.00 |
| real public expenditures | -0.11 | -0.03 | -0.01 | 0.04 | 0.05 | 0.00 |
| deficit to GDP ratio * (+:surplus) | 0.09 | 0.07 | 0.05 | 0.01 | 0.06 | -0.00 |
| debt to GDP ratio * | -0.30 | -0.46 | -0.59 | -0.74 | 0.58 | 0.00 |
| | | | | | | |
| *Household sector* | | | | | | |
| total available means | -0.03 | -0.06 | -0.07 | -0.09 | 0.07 | -0.01 |
| real disposable income | 0.11 | 0.12 | 0.12 | 0.10 | 0.11 | 0.00 |
| savings as % of disp. inc * | -0.03 | -0.00 | 0.02 | 0.04 | 0.03 | 0.00 |
| | | | | | | |
| *Spill-over effects* | | | | | | |
| effec. foreign output | 0.01 | -0.01 | -0.00 | -0.00 | 0.01 | 0.00 |
| effec. foreign price level | -0.00 | -0.00 | -0.00 | 0.00 | 0.00 | -0.00 |
| effec. foreign interest rate * | 0.12 | 0.11 | 0.08 | 0.05 | 0.09 | 0.00 |
| | | | | | | |
| *Memo items* | | | | | | |
| current account to GDP * | -0.03 | 0.00 | 0.04 | 0.05 | 0.04 | -0.00 |
| total stock of real assets | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.00 |

variables without * : deviation from baseline, in percent;  variables with * : deviation from baseline, in differences;  ss: steady state;

sq : standard deviation of first 5 years.

# VII A permanent supply shock

In this section, we assume that trend labour productivity falls by 1 percent in the euro area[1]. First, we start with a discussion of the variant in which the monetary authorities follow a Taylor rule. Here, we distinguish two sub-variants. In a first sub-variant, we assume that the monetary authorities reduce immediately the reference value for output in equation (1) by 1 percent. In the second sub-variant, we assume that the monetary authorities do not revise the reference value for output. Failure to do so may be due to the lack of the necessary information to identify changes in potential output. Next, we investigate the variant in which the monetary authorities target the money supply. Here, we distinguish also two sub-variants. In the first sub-variant, the monetary authorities stick to their old money target. In the second sub-variant, the monetary authorities revise immediately their money target to a level that is consistent with long run price stability. Finally, we compare the different sub-variants with each other.

## A. Adjustment under a Taylor rule with immediate revision of the output reference value

The simulation results of this sub-variant are shown in the first six columns of Table 9.

The steady state results can be found in the sixth column of Table 9. Here, we see that if trend labour productivity in the euro area decreases by 1 percent, then the total supply for final demand and real GDP of the euro area decreases also by 1 percent in the long run[2].

Let us now investigate how this decreased supply is absorbed in the new steady state. First, when labour productivity decreases permanently by 1 percent, the (future) real wage must also decrease by 1 percent, and the household sector will feel poorer. This wealth effect will lower private consumption and demand for residential buildings by 1 percent. Second, a permanent decrease in the total supply requires a proportional permanent decrease in the capital stock of the enterprise sector, thereby lowering the enterprise sector's gross fixed capital formation by 1 percent. Third, while the domestic components of demand decrease, the export volume does not decrease because, in the steady state, total domestic demand and supply in the other blocks remain unchanged, so that they need the same volume of intermediary imports. Fourth, taking the previous effects into account, the remaining excess demand is eliminated by a 0.3 percent increase in the

---

1. Trend labour productivity in the other county blocks is not affected.
2. Since a similar shock does not occur in the other blocks, the steady state output in the other blocks remains unchanged.

relative price of private consumption[1]. As a consequence, private consumption decreases by an additional 0.3 percent, and long run equilibrium between demand and supply is restored[2]. Finally, note also that the total available means of the household sector fall by 1.3 percent, which is the sum of two effects. Indeed, the productivity shock has as a direct result that contemporaneous and future nominal labour income fall by 1 percent, while it also causes the private consumer price index to increase by 0.3 percent[3].

In the money market, we see that in the steady state the demand for real money balances falls by 1.3 percent, reflecting the 1.3 percent drop in total available means of the household sector. A corresponding drop in the supply of real money balances is generated by a 1 percent drop in the supply of money and a 0.3 percent increase in the consumer price deflator[4]. In the foreign exchange market, the effective nominal exchange rate appreciates by 1 percent. This appreciation is necessary to maintain current account equilibrium in the long run[5].

In the first year, the real wage falls by about 0.4 percent. This wage drop, together with the expected future real wage decline, causes a major drop in household demand. Looking at the different components of demand, we see that the drop in private consumption is strongest, i.e., 0.63 percent in the first year. Moreover, in anticipation of the fact that the stock of capital has to fall by 1 percent in the long run, contemporaneous gross fixed capital formation falls by 0.5 percent. As a consequence, real GDP and private supply for final demand fall by 0.52 percent and 0.56 percent, respectively. Nevertheless, in spite of this fall, private supply is still 0.44 percent above its new equilibrium level, so that the short-term interest rate increases by 39 basis points.

In the foreign exchange market, the effective nominal exchange rate appreciates by 0.66 percent, reflecting the interest rate hike and the expectation that in the steady state the equilibrium nominal exchange rate will appreciate by 1 percent[6]. As prices do not change much in the first year, the effective real exchange rate appreciates by 0.60 percent, causing exports to fall by 0.39 percent. Imports fall by 0.56 percent, reflecting the strong drop in domestic demand.

Looking at the other sectors of the economy, we see that in the labour market, private sector employment is only moderately affected. This is because, while output is about 0.4 percent above its new equilibrium level, the real wage is still

---

1. The price of private consumption adjusts to clear the goods market in the long run. See equation (III.24) of MVB.
2. See Meyermans (2002) for a discussion of the steady state implications of this variant for the fiscal sector.
3. The consumer price is used to deflate the nominal assets and income of the household sector.
4. The consumer price index is the deflator of the nominal money balances.
5. In the current account, the import volume decreases by 1 percent, and the export volume does not change, reflecting the absence of a similar productivity shock in the other country blocks. Moreover, the productivity of the intermediary imports does not change, so that its price, measured in local currency, does not change. Hence, in order to maintain current account equilibrium, measured in local currency, the price of exports, measured in local currency, must decrease by 1 percent. Next, the exports are used as intermediary imports in the other countries. However, the productivity of these intermediary imports does not change, so that the price of exports, denominated in foreign currency, must remain at its initial level. Given the 1 percent decrease of the price of exports denominated in local currency, the price denominated in foreign currency can only be kept constant if the exchange rate appreciates by 1 percent.
6. The exchange rate undershoots its long run equilibrium because backward-looking chartists are operating in the foreign exchange market.

about 0.6 percent above its new equilibrium level. Both effects cancel each other out. Next, we see that the public sector runs a deficit equal to 0.14 percent of GDP, reflecting primarily a decline in tax receipts.

After the first year, the real wage continues to fall and the prices start to increase, reaching in the fifth year a level of 0.25 percent above the baseline. In the meantime, the short-term interest rate stays above its baseline level, and the real exchange rate continues to appreciate. These developments depress demand even further, and output falls 0.91 percent below the baseline in the fifth year. This adjustment will continue until the components of demand have fallen sufficiently to restore steady state equilibrium between the demand for and supply of goods.

The first six columns of Table 18 of Appendix B show the simulation results for a similar supply shock in the U.S.. Here we see that private supply for final demand falls by 0.79 percent in the first year and 0.97 percent in the second year, compared with 0.56 percent and 0.84 percent, respectively, in the euro area.

## B. Adjustment under a Taylor rule without revision of the output reference value

Here we assume that the monetary authorities do not revise the reference value for potential output. A summary of the short run simulation results is shown in the last 4 columns of Table 9.

The most important result is that private supply falls by 0.45 percent in the first year, compared with 0.56 percent in the previous sub-variant. This lower output reduction is caused by the loose monetary policy. Indeed, in the first year and the following years, the short-term interest rate hovers around its baseline level, compared with a hike of 40 basis points in the previous sub-variant. We also note that after the second year inflation starts to pick up, and the price level is 0.32 percent above its baseline level in the fifth year, compared with 0.25 percent in the previous sub-variant.

The simulation results of this section show that failure on the part of the monetary authorities to revise its reference value causes a delay in the adjustment process, and it creates additional inflation in the short run. Moreover, such a policy is unsustainable since it creates a permanent wedge between the short-term interest rate and the steady state interest rate.

**TABLE 9 -** **A permanent supply shock in the euro area under a Taylor rule**

| | with revision of reference value | | | | | | without revision of reference value | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 01 | 02 | 03 | 05 | sq | ss | 01 | 02 | 03 | 05 |
| short-term interest rate * | 0.39 | 0.43 | 0.38 | 0.27 | 0.36 | 0.00 | -0.04 | 0.05 | 0.02 | -0.07 |
| real GDP | -0.52 | -0.71 | -0.72 | -0.77 | 0.70 | -1.00 | -0.45 | -0.64 | -0.66 | -0.71 |
| GDP deflator (PGDP) | -0.02 | 0.07 | 0.14 | 0.25 | 0.16 | 0.01 | -0.00 | 0.11 | 0.22 | 0.41 |
| private supply for final demand | -0.56 | -0.84 | -0.86 | -0.91 | 0.82 | -1.00 | -0.45 | -0.76 | -0.78 | -0.83 |
| | | | | | | | | | | |
| *Demand* (in constant prices) | | | | | | | | | | |
| private consumption | -0.63 | -0.93 | -0.99 | -1.09 | 0.95 | -1.31 | -0.55 | -0.84 | -0.89 | -1.00 |
| public consumption | -0.21 | -0.64 | -0.65 | -0.67 | 0.59 | -1.00 | -0.21 | -0.64 | -0.64 | -0.66 |
| gross capital formation | -0.51 | -0.56 | -0.52 | -0.52 | 0.53 | -1.10 | -0.20 | -0.45 | -0.42 | -0.44 |
| exports | -0.39 | -0.46 | -0.44 | -0.45 | 0.44 | 0.00 | -0.33 | -0.42 | -0.40 | -0.41 |
| imports | -0.56 | -1.18 | -1.21 | -1.26 | 1.13 | -1.00 | -0.38 | -1.06 | -1.05 | -1.11 |
| | | | | | | | | | | |
| *Prices* | | | | | | | | | | |
| GDP deflator (PGDP) | -0.02 | 0.07 | 0.14 | 0.25 | 0.16 | 0.01 | -0.00 | 0.11 | 0.22 | 0.41 |
| consumption price/PGDP | 0.02 | 0.06 | 0.12 | 0.21 | 0.14 | 0.33 | 0.00 | 0.06 | 0.12 | 0.23 |
| export price/PGDP | -0.01 | -0.17 | -0.33 | -0.66 | 0.41 | -1.00 | -0.02 | -0.20 | -0.38 | -0.77 |
| import price/producer price | 0.01 | -0.15 | -0.13 | -0.10 | 0.11 | -0.00 | 0.00 | -0.16 | -0.17 | -0.18 |
| | | | | | | | | | | |
| *Labour market* | | | | | | | | | | |
| total employment | -0.01 | -0.05 | -0.05 | -0.04 | 0.04 | 0.00 | -0.01 | -0.05 | -0.04 | -0.04 |
| private sector employment | -0.02 | -0.07 | -0.06 | -0.05 | 0.05 | 0.00 | -0.01 | -0.06 | -0.06 | -0.05 |
| take home real wage | -0.43 | -0.49 | -0.54 | -0.64 | 0.55 | -1.39 | -0.42 | -0.49 | -0.55 | -0.66 |
| producer real wage | -0.41 | -0.42 | -0.42 | -0.43 | 0.42 | -1.00 | -0.42 | -0.42 | -0.41 | -0.41 |
| | | | | | | | | | | |
| *Monetary sector* | | | | | | | | | | |
| short-term interest rate * | 0.39 | 0.43 | 0.38 | 0.27 | 0.36 | 0.00 | -0.04 | 0.05 | 0.02 | -0.07 |
| long-term interest rate * | 0.29 | 0.29 | 0.26 | 0.19 | 0.25 | 0.00 | 0.07 | 0.11 | 0.08 | 0.02 |
| eff. nom. exchange rate (-:appr.) | -0.66 | -0.96 | -1.07 | -1.11 | 1.00 | -1.00 | -0.55 | -0.82 | -0.93 | -0.97 |
| eff. real exchange rate (-:appr.) | -0.60 | -0.81 | -0.82 | -0.62 | 0.72 | 0.00 | -0.51 | -0.71 | -0.72 | -0.56 |
| nominal money stock | -1.48 | -1.85 | -1.87 | -1.55 | 1.70 | -0.96 | -0.58 | -0.69 | -0.61 | -0.23 |
| real money stock | -1.48 | -1.99 | -2.13 | -2.01 | 1.96 | -1.31 | -0.58 | -0.86 | -0.96 | -0.87 |
| | | | | | | | | | | |
| *Public sector* | | | | | | | | | | |
| nominal public revenues | -0.46 | -0.60 | -0.54 | -0.44 | 0.51 | -0.85 | -0.42 | -0.54 | -0.44 | -0.27 |
| real public revenues | -0.44 | -0.68 | -0.68 | -0.69 | 0.64 | -0.87 | -0.42 | -0.66 | -0.66 | -0.68 |
| nominal public expenditures | -0.12 | -0.52 | -0.43 | -0.29 | 0.37 | -0.84 | -0.12 | -0.56 | -0.42 | -0.18 |
| real public expenditures | -0.10 | -0.60 | -0.57 | -0.55 | 0.51 | -0.86 | -0.12 | -0.68 | -0.64 | -0.59 |
| deficit to GDP ratio * (+:surplus) | -0.14 | -0.04 | -0.05 | -0.07 | 0.08 | -0.00 | -0.12 | 0.00 | -0.01 | -0.04 |
| debt to GDP ratio * | 0.47 | 0.56 | 0.58 | 0.66 | 0.58 | -0.00 | 0.39 | 0.44 | 0.40 | 0.38 |
| | | | | | | | | | | |
| *Household sector* | | | | | | | | | | |
| total available means | -0.72 | -0.79 | -0.86 | -0.95 | 0.85 | -1.30 | -0.71 | -0.81 | -0.89 | -1.04 |
| real disposable income | -0.43 | -0.75 | -0.79 | -0.88 | 0.75 | -1.31 | -0.43 | -0.75 | -0.81 | -0.91 |
| savings as % of disp. inc * | 0.19 | 0.18 | 0.20 | 0.22 | 0.20 | 0.00 | 0.13 | 0.08 | 0.09 | 0.08 |
| | | | | | | | | | | |
| *Spill-over effects* | | | | | | | | | | |
| effec. foreign output | -0.08 | -0.06 | -0.02 | -0.03 | 0.05 | 0.00 | -0.07 | -0.07 | -0.03 | -0.03 |
| effec. foreign price level | 0.03 | 0.06 | 0.07 | 0.08 | 0.07 | 0.01 | 0.02 | 0.03 | 0.04 | 0.05 |
| effec. foreign interest rate * | 0.02 | 0.04 | 0.05 | 0.05 | 0.04 | 0.00 | -0.02 | -0.02 | -0.00 | -0.01 |
| | | | | | | | | | | |
| *Memo items* | | | | | | | | | | |
| current account to GDP * | 0.02 | 0.10 | 0.08 | 0.04 | 0.07 | -0.00 | 0.00 | 0.09 | 0.06 | 0.02 |
| total stock of real assets | -0.02 | -0.05 | -0.07 | -0.12 | 0.08 | -1.10 | -0.01 | -0.03 | -0.05 | -0.09 |

variables without * : deviation from baseline, in percent; variables with * : deviation from baseline, in differences; ss: steady state;

sq : standard deviation of first 5 years; no steady state available for the sub-variant without revision of the reference value.

**TABLE 10 -      A permanent supply shock in the euro area under money targeting**

| | without revision of money target | | | | | | with revision of money target | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 01 | 02 | 03 | 05 | sq | ss | 01 | 02 | 03 | 05 | sq | ss |
| short-term interest rate * | -0.15 | -0.04 | -0.00 | 0.05 | 0.08 | 0.02 | 0.16 | 0.12 | 0.14 | 0.17 | 0.15 | 0.02 |
| real GDP | -0.37 | -0.62 | -0.68 | -0.79 | 0.66 | -1.00 | -0.48 | -0.65 | -0.68 | -0.75 | 0.66 | -1.00 |
| GDP deflator (PGDP) | 0.37 | 0.63 | 0.84 | 1.09 | 0.82 | 1.04 | -0.01 | 0.10 | 0.19 | 0.35 | 0.22 | 0.05 |
| private supply for final demand | -0.36 | -0.78 | -0.83 | -0.93 | 0.79 | -1.00 | -0.50 | -0.77 | -0.81 | -0.89 | 0.78 | -1.00 |
| | | | | | | | | | | | | |
| *Demand* (in constant prices) | | | | | | | | | | | | |
| private consumption | -0.57 | -0.96 | -1.08 | -1.25 | 1.03 | -1.31 | -0.59 | -0.86 | -0.92 | -1.05 | 0.90 | -1.31 |
| public consumption | -0.10 | -0.55 | -0.59 | -0.63 | 0.54 | -1.00 | -0.21 | -0.64 | -0.64 | -0.66 | 0.59 | -1.00 |
| gross capital formation | 0.08 | -0.45 | -0.48 | -0.56 | 0.45 | -1.10 | -0.35 | -0.42 | -0.47 | -0.54 | 0.46 | -1.10 |
| exports | -0.07 | -0.12 | -0.05 | -0.04 | 0.07 | -0.00 | -0.36 | -0.42 | -0.42 | -0.43 | 0.41 | -0.00 |
| imports | -0.16 | -1.20 | -1.20 | -1.23 | 1.09 | -1.00 | -0.46 | -1.07 | -1.12 | -1.21 | 1.04 | -1.00 |
| | | | | | | | | | | | | |
| *Prices* | | | | | | | | | | | | |
| GDP deflator (PGDP) | 0.37 | 0.63 | 0.84 | 1.09 | 0.82 | 1.04 | -0.01 | 0.10 | 0.19 | 0.35 | 0.22 | 0.05 |
| consumption price/PGDP | 0.08 | 0.24 | 0.31 | 0.40 | 0.30 | 0.33 | 0.01 | 0.06 | 0.12 | 0.23 | 0.14 | 0.33 |
| export price/PGDP | -0.36 | -0.62 | -0.83 | -1.08 | 0.82 | -0.98 | -0.02 | -0.19 | -0.36 | -0.73 | 0.45 | -0.98 |
| import price/producer price | -0.26 | -0.39 | -0.43 | -0.38 | 0.38 | 0.00 | 0.01 | -0.16 | -0.15 | -0.15 | 0.14 | 0.00 |
| | | | | | | | | | | | | |
| *Labour market* | | | | | | | | | | | | |
| total employment | -0.01 | -0.07 | -0.06 | -0.05 | 0.05 | 0.00 | -0.01 | -0.05 | -0.04 | -0.04 | 0.04 | 0.00 |
| private sector employment | -0.01 | -0.09 | -0.08 | -0.06 | 0.07 | 0.00 | -0.02 | -0.06 | -0.06 | -0.05 | 0.05 | 0.00 |
| take home real wage | -0.46 | -0.58 | -0.65 | -0.77 | 0.64 | -1.39 | -0.43 | -0.49 | -0.55 | -0.65 | 0.55 | -1.38 |
| producer real wage | -0.36 | -0.31 | -0.30 | -0.32 | 0.32 | -1.00 | -0.42 | -0.42 | -0.42 | -0.42 | 0.42 | -1.00 |
| | | | | | | | | | | | | |
| *Monetary sector* | | | | | | | | | | | | |
| short-term interest rate * | -0.15 | -0.04 | -0.00 | 0.05 | 0.08 | 0.02 | 0.16 | 0.12 | 0.14 | 0.17 | 0.15 | 0.02 |
| long-term interest rate * | 0.11 | 0.11 | 0.09 | 0.07 | 0.09 | 0.01 | 0.17 | 0.14 | 0.14 | 0.14 | 0.15 | 0.01 |
| eff. nom. exchange rate (-:appr.) | 0.03 | 0.01 | 0.00 | -0.02 | 0.02 | -0.01 | -0.60 | -0.86 | -0.97 | -1.05 | 0.92 | -1.01 |
| eff. real exchange rate (-:appr.) | 0.03 | 0.02 | 0.01 | 0.01 | 0.02 | -0.00 | -0.55 | -0.73 | -0.75 | -0.61 | 0.67 | -0.00 |
| nominal money stock | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -1.00 | -1.00 | -1.00 | -1.00 | 1.00 | -1.00 |
| real money stock | -0.44 | -0.87 | -1.15 | -1.48 | 1.12 | -1.37 | -1.00 | -1.16 | -1.32 | -1.59 | 1.32 | -1.38 |
| | | | | | | | | | | | | |
| *Public sector* | | | | | | | | | | | | |
| nominal public revenues | 0.04 | 0.05 | 0.23 | 0.43 | 0.27 | 0.17 | -0.44 | -0.56 | -0.47 | -0.34 | 0.45 | -0.82 |
| real public revenues | -0.33 | -0.57 | -0.61 | -0.65 | 0.57 | -0.87 | -0.43 | -0.66 | -0.66 | -0.69 | 0.63 | -0.87 |
| nominal public expenditures | 0.23 | 0.05 | 0.31 | 0.59 | 0.38 | 0.18 | -0.12 | -0.54 | -0.43 | -0.21 | 0.36 | -0.81 |
| real public expenditures | -0.13 | -0.57 | -0.53 | -0.50 | 0.48 | -0.86 | -0.11 | -0.64 | -0.62 | -0.56 | 0.54 | -0.86 |
| deficit to GDP ratio * (+:surplus) | -0.08 | -0.01 | -0.04 | -0.07 | 0.06 | 0.00 | -0.13 | -0.01 | -0.02 | -0.06 | 0.07 | 0.00 |
| debt to GDP ratio * | 0.08 | 0.08 | 0.03 | 0.07 | 0.06 | 0.00 | 0.43 | 0.47 | 0.46 | 0.50 | 0.47 | 0.00 |
| | | | | | | | | | | | | |
| *Household sector* | | | | | | | | | | | | |
| total available means | -0.89 | -1.11 | -1.23 | -1.34 | 1.19 | -1.29 | -0.71 | -0.80 | -0.88 | -1.01 | 0.88 | -1.29 |
| real disposable income | -0.38 | -0.77 | -0.85 | -0.96 | 0.80 | -1.31 | -0.43 | -0.75 | -0.80 | -0.90 | 0.77 | -1.31 |
| savings as % of disp. inc * | 0.19 | 0.19 | 0.23 | 0.28 | 0.24 | -0.00 | 0.16 | 0.11 | 0.12 | 0.15 | 0.14 | -0.00 |
| | | | | | | | | | | | | |
| *Spill-over effects* | | | | | | | | | | | | |
| effec. foreign output | -0.06 | -0.09 | -0.04 | -0.04 | 0.06 | -0.00 | -0.07 | -0.06 | -0.03 | -0.03 | 0.05 | -0.00 |
| effec. foreign price level | -0.00 | 0.01 | 0.02 | 0.03 | 0.02 | 0.01 | 0.02 | 0.04 | 0.05 | 0.06 | 0.05 | 0.01 |
| effec. foreign interest rate * | -0.04 | -0.04 | -0.01 | 0.00 | 0.03 | 0.00 | -0.00 | -0.00 | 0.01 | 0.02 | 0.02 | 0.00 |
| | | | | | | | | | | | | |
| *Memo items* | | | | | | | | | | | | |
| current account to GDP * | 0.00 | 0.12 | 0.11 | 0.08 | 0.09 | 0.00 | 0.01 | 0.09 | 0.07 | 0.03 | 0.06 | 0.00 |
| total stock of real assets | 0.00 | -0.02 | -0.04 | -0.09 | 0.05 | -1.10 | -0.02 | -0.04 | -0.06 | -0.10 | 0.07 | -1.10 |

variables without * : deviation from baseline, in percent;  variables with * : deviation from baseline, in differences; ss: steady state;

sq : standard deviation of first 5 years.

## C. Adjustment under money targeting without revision of the money target

Now, we distinguish two sub-variants of money targeting. In the first sub-variant, the monetary authorities keep in each period the money supply fixed at its baseline level. In the second sub-variant, the monetary authorities reduce the money supply immediately by 1 percent, and they keep it fixed at that level for the rest of the simulation period. Let us start with a discussion of the simulation results of the first sub-variant, which are presented in the first 6 columns of Table 10.

In the new steady state, see column 6 of Table 10, the nominal money stock is at its baseline level, the absolute price level increased by 1 percent, the effective nominal exchange rate is at its baseline level, and the real variables, including the relative prices, are at the same level as described in the previous variant.

In the first year, private supply for final demand falls by 0.36 percent, compared with 0.56 percent under a Taylor rule. The price level increases by 0.37 percent, compared with a 0.02 percent fall under a Taylor rule. This strong initial jump in the prices reflects the fact that the economic agents expect that now prices will increase by 1 percent in the long run, compared with 0 percent under a Taylor rule. Also of some interest is to note that the short-term interest rate falls by 15 basis points in the first year, compared with an increase of 39 basis points under the Taylor rule. This rate cut is needed to restore money market equilibrium. Indeed, while the supply of real money balances falls by 0.44 percent, the demand for money tends to fall even further because the total available means of the households falls by 0.89 percent.

In the foreign exchange market, the effective nominal exchange rate depreciates by 0.03 percent in the first year, reflecting the moderate interest rate fall and the expectation that in the steady state the nominal exchange rate will be at its baseline level. Remember that under the Taylor rule, the effective nominal exchange rate appreciated by 0.66 percent in the first year, reflecting a 1 percent appreciation in the long run.

After the first year, the economy gradually adjusts to its new steady state equilibrium. As prices increase, the supply of real money balances falls and the short-term interest rate increases. Moreover, the higher inflation implies also that the real take home wage falls faster than in the previous variants, i.e. 0.77 percent in the fifth year under money targeting, compared with 0.64 percent in the fifth year under a Taylor rule.

The simulation results for a similar shock in the U.S. are shown in the first six columns of table 19 of Appendix B. Here, real GDP falls by 0.60 percent in the first year, compared with 0.36 percent in the euro area.

Table 11 summarises the short run results for the euro area by comparing the deviations from trend under monetary targeting with the deviations from trend under a Taylor rule[1]. We note that the short-term interest rate is 54 basis points

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1. A Taylor rule under which the reference value for output is immediately revised.

lower under money targeting than under a Taylor rule, reflecting the fact that under monetary targeting the short-term interest rate has to be cut to reduce the excess supply of real money balances. This interest cut increases domestic demand, so that in the first years the decline in output is less strong under money targeting than under the Taylor rule. However, it should be stressed that this smaller output fall reflects only a delay of full adjustment, and that in the long run output will shrink by 1 percent. Finally, note also that in this scenario the price level will be 1 percent higher than in the baseline. Similar results are found for the U.S. in Table 12.

**TABLE 11 -** **Degree of stabilisation under a permanent supply shock without revision of the money target in the euro area**

|  | 01 | 02 | 03 | var |
|---|---|---|---|---|
| short-term interest rate  * | 0.54 | 0.47 | 0.38 | 0.22 |
| private supply for final demand | 35.04 | 7.12 | 3.18 | 0.96 |
| real GDP | 29.17 | 12.03 | 5.29 | 0.94 |
| nominal exchange rate | 105.00 | 101.51 | 100.33 | 0.02 |

**TABLE 12 -** **Degree of stabilisation under a permanent supply shock without revision of the money target in the U.S.**

|  | 01 | 02 | 03 | var |
|---|---|---|---|---|
| short-term interest rate  * | 0.41 | 0.26 | 0.21 | 1.89 |
| private supply for final demand | 26.27 | 14.42 | 12.41 | 0.88 |
| real GDP | 18.27 | 13.06 | 10.39 | 0.90 |
| nominal exchange rate | 123.27 | 119.51 | 115.70 | 0.15 |

Money targeting without revision of money target compared with a Taylor rule with revision of the output reference value.

See also note of Table 6. Deviations from initial trend! Variable with * is in differences.

## D. Adjustment under money targeting with revision of the money target

In this second sub-variant, the monetary authorities reduce the money supply target immediately by 1 percent. The last six columns of Table 10 summarise the main effects of this policy rule for the euro area.

In the steady state, the price level does not deviate from its baseline level, and the values of the real variables, including the relative prices, are the same as the ones described in the previous sub-sections.

In the first year, the short-term interest rate increases by 16 basis points, compared with a fall of 15 basis points in the previous sub-variant, and an increase of 39 basis points under a Taylor rule. Private supply for final demand falls now by 0.50 percent, compared with a fall of 0.36 percent in the previous sub-variant, and a fall of 0.56 percent under a Taylor rule. More importantly, we note that the short run price fluctuations are now much smaller than in the previous sub-variant, i.e., no change compared with a 0.37 percent increase in the previous sub-variant, reflecting the long run stability of the price level. After the first year, we notice a gradual adjustment towards the new steady state.

Table 13 summarises the short run adjustment process in the euro area. We note, for example, that, on average, output variability is now lower under money targeting than under a Taylor rule, but that price variability is higher.

The last six columns of table 19 of Appendix B show the results for the U.S.. Here, we find similar qualitative results as reported for the euro area. See also Table 14.

The most important result of the simulations shown in section seven is that money targeting increases the price level permanently, if labour productivity falls and the monetary authorities do not revise their money targets in due course. Moreover, such loose monetary policy slows down the adjustment towards the new steady state.

**TABLE 13 -** **Degree of stabilisation under a permanent supply shock with revision of the money target in the euro area**

|  | 01 | 02 | 03 | var |
|---|---|---|---|---|
| short-term interest rate * | 0.23 | 0.31 | 0.24 | 0.42 |
| private supply for final demand | 10.07 | 8.14 | 6.15 | 0.94 |
| real GDP | 7.74 | 7.40 | 5.53 | 0.95 |
| GDP deflator | 47.28 | -33.41 | -34.52 | 1.37 |
| nominal exchange rate | 8.72 | 10.55 | 9.42 | 0.92 |

**TABLE 14 -** **Degree of stabilisation under a permanent supply shock with revision of the money target in the U.S.**

|  | 01 | 02 | 03 | var |
|---|---|---|---|---|
| short-term interest rate * | 0.09 | 0.03 | 0.04 | 0.44 |
| private supply for final demand | 4.79 | 1.29 | 1.61 | 0.98 |
| real GDP | 3.27 | 1.15 | 1.30 | 0.99 |
| GDP deflator | 13.14 | 19.98 | 24.60 | 0.70 |
| nominal exchange rate | 5.52 | 3.06 | 2.63 | 0.97 |

Money targeting with revision of money target compared with a Taylor rule with revision of the output reference value.

See also not of Table 6. Deviations from initial trend! Variable with * is in differences.

# VIII    Conclusion

In this paper, we investigated with an econometric world model how monetary policy rules affect economic activity in the euro area. For this purpose, we applied three different shocks to the NIME model and we simulated the model under a Taylor rule and under money targeting. The temporary real demand shock allowed us to assess to what extent money targeting, if compared with a Taylor rule, tempers inflationary pressures that arise in the real sector. The productivity shock and the money velocity shock allowed us to examine to what extent money targeting compromises price stability if money growth targets are not revised in the face of these shocks. The results of this paper can be summarised as follows.

First, in the case of a temporary increase in demand, the simulation results indicated that money targeting causes the smallest deviation from trend for private supply in the first year. This is because the induced changes in the interest rate are larger under money targeting than under a Taylor rule in the first year. However, as time progresses and the conditions in the money market and the goods market evolve differently, we found that after the first year money targeting loses its potency to provide more output stability than a Taylor rule. Therefore, we also investigated the implications of a two-pillar strategy that sets the short-term interest rate by weighing the conditions in the money market against the conditions in the goods market. We found that such a policy rule provides more output stability than money targeting or a Taylor rule. However, this higher output stability is gained at the expense of lower stability of the financial variables.

Next, in the case of a permanent change in the velocity of money, the simulation results showed that an autonomous increase in the velocity of money leads to important short run deviations from trend, if the money supply target is not revised. Indeed, in the euro area, a 1 percent drop in money demand increases the output gap by 0.15 percent in the first year. Moreover, the general price level increases by 0.38 percent in the first year, and continues to rise until it has reached its new steady state level, which is 1 percent above the baseline.

Third, in the case of a permanent decline in labour productivity, the simulation results indicated that money targeting tempers the initial decline in output, especially when money targets are not revised. However, such loose monetary policy only delays the adjustment towards the new steady state, and it compromises price stability in the long run when money targets are not revised in due course.

# IX  Appendix A: The monetary sector of the NIME model

The first version of the NIME model is described in Meyermans and Van Brusselen (2000.a, 2000.b, and 2001). These papers are available on the world wide web at www.plan.be, click Language, click Working Papers. For this paper we use an updated version of the NIME model. This update comprises, i.a., the inclusion of Greece in the euro area, an extension of the sample size from 1970 until 2000, the conversion of the data to the new European system of accounts (ESA95), and the re-estimation of the behavioural equations with the new data.

The NIME model distinguishes 6 country blocks. Belgium (BE), the euro area (minus Belgium), the NE block consisting of the countries of the European Union that did not adopt the euro, the United States (US), Japan (JP) and the "rest of the world" (RW).

In each of these country blocks, there are 4 sectors: the household sector, the enterprise sector, the monetary sector, and the public sector. Since this paper deals with monetary policies, we will summarise here the main features of the monetary sector.

## A. The demand for money

In the NIME model, real money balances are part of the intertemporal utility function of the household sector, and the household sector maximizes its intertemporal utility function subject to an intertemporal budget constraint. A set of demand equations for the household sector is derived from this constrained optimisation problem. See Meyermans and Van Brusselen (2000.a) and (2001) for more details. We repeat here the empirical results for the demand for money.

The demand for money balances is determined by a scale variable, the nominal interest rate, the real interest rate, and the user cost of residential buildings. The long run per-capita money demand function reads as:

(A.1) $\quad \ln[M_t/(PCH_t\, NPO_t)] = y\_l0 + y\_lb \ln(SCALEH_t/NPO_t)$
$\qquad + y\_l2 \ln[LIC_t/(1+LIC_t)] + y\_l3 \ln(USERIR_t)$
$\qquad + y\_l4 \ln[(1+LIC_t)\, PCH_t/EPCH_t] + y\_l5\, H_t$

where EPCH is the expected price of private consumption, H is a taste variable affecting preferences, e.g., a dummy for German re-unification, LIC is the interest

rate of the household sector[1], M is the nominal money stock, NPO is the total population, PCH is the price of private consumption, SCALEH is the total available means of the household sector[2], in constant prices, and USERIR is the user cost of residential buildings[3].

Note that the interest rate appears three times in the money demand function: first, in logarithm as the opportunity cost of money, second, as part of the user cost of residential buildings, and third, as part of the real interest rate.

The scale variable, SCALEH, is determined by wealth inherited from the past, plus contemporaneous total income, plus the discounted stream of future non-asset income.

We assume that rigidities prevent the household sector from adjusting its expenditures immediately to its long run equilibrium plans, and we assume that the adjustment process to this equilibrium can be captured by an error correction model. In other words, short run money demand is captured by an error correction mechanism that reads as:

$$
\begin{aligned}
\text{(A.2)} \quad d \ln[M_t/(PCH_t\, NPO_t)] &= y\_sb\ d \ln(SCALEH_t/NPO_t) \\
&+ y\_l2\ d \ln[LIC_t/(1+LIC_t)] + y\_s3\ d \ln(USERIR_t) \\
&+ y\_s4\ d \ln[(1+LIC_t)\, PCH_t/EPCH_t] + y\_s5\ d\ H_t \\
&+ y\_s3\ ECT\_M_{t-1}
\end{aligned}
$$

where ECT_M is the error correction term.

In the empirical application, we measure money by M1[4]. Recent empirical evidence supports the idea of the existence of a stable demand function for M1, see, for example, Stracca (2001). Moreover, it should also be recognised that M1 is easier to target than a broader concept such as M3 since timely information on the narrow concept is easier to obtain, see McCallum (1999).

It should be noted that there might be an aggregation bias in the monetary data of the EU and NE block. Indeed, during much of the period covered by our model, the exchange rates of the countries constituting the EU and NE block were in the Exchange Rate Mechanism of the European Monetary System. However, during some periods there were quite significant crises, e.g., 1992-1993, characterized by significant interest rates hikes and major portfolio shifts between countries, often followed by a realignment of the exchange rates. At the aggregate level, shifts between currencies of the countries of a particular block do not show up in the currency aggregate of that block. However, because the aggregate interest rate of a block is the weighted average of the interest rates of the individual countries, the aggregate interest rate will reflect the variability of the interest rates at the country level. In other words, the aggregate interest rate will show a higher variability then the monetary aggregate.

---

1. A weighted average of the short-term interest rate and the long-term interest rate.
2. See equation (II.4.a) of Meyermans and Van Brusselen (2001).
3. See equation (II.2.b) of Meyermans and Van Brusselen (2001).
4. I.e., line 34, Money, of International Financial Statistics, International Monetary Fund.

To capture this effect, we use dummies in the demand for money functions of the EU and NE block for 1992-1993[1].

The error correction mechanism (A.1)-(A.2) was estimated with the Two-Step Engle-Granger method; see Engle and Granger (1991). The sample size ranges from 1973 until 2000.

Table 15 shows estimates of the long run price and scale elasticities for money demand for the euro area, the NE block, the U.S. and Japan, while Table 16 shows the estimates of the (semi-) elasticities of the short run equation. Note that we impose a unit elasticity for the scale elasticity. The tables show also some diagnostic statistics. First, there is the traditional adjusted R-squared and the Durbin-Watson (see, for example, Johnston (1984)). The Dickey-Fuller (DF) statistic refers to the order of integration of the error term of the long run equations (see, for example, Charemza and Deadman, (1993))[2].

The row "Implicit interest semi-elasticity" in tables 15 and 16 measures the total impact of a change in the interest rate, as defined in equation (II.6.g) of Meyermans and Van Brusselen (2001). Indeed, the interest rate affects demand through three channels: the liquidity effect, the user cost effect, and the intertemporal substitution effect. The numbers presented in this row summarize the total impact of a 100 points increase in the interest rate. We see that an interest rate increase decreases the demand for money in the short run as well as in the long run. Moreover, the interest semi-elasticities are larger, in absolute terms, in the long run than in the short run. All error correction terms are between 0 and -1. Finally, note that we can reject the null-hypothesis of no cointegration.

**TABLE 15 - Long Run (Semi-)Elasticities for Money Demand**

|  | euro area | NE | US | JP |
|---|---|---|---|---|
| Constant | -4.16 | -4.57 | -4.72 | -3.38 |
| Scale effect | 1.00 | 1.00 | 1.00 | 1.00 |
| Nominal interest rate | -0.13 | -0.19 | -0.15 | -0.06 |
| User cost of res. building | 0.01 | 0.00 | 0.00 | 0.01 |
| Real interest rate | -1.19 | -1.44 | -1.25 | -2.09 |
|  |  |  |  |  |
| Implicit interest semi-elasticity | -2.17 | -3.01 | -2.51 | -2.34 |
|  |  |  |  |  |
| Diagnostic statistics |  |  |  |  |
| R2-adjusted | 0.95 | 0.98 | 0.93 | 0.97 |
| Dickey Fuller | -2.79 | -3.90 | -4.30 | -4.98 |
| Augmented Dickey Fuller | -2.74 | -3.84 | -4.22 | -4.91 |

1.  In a few equations some additional dummies have been used, e.g., a dummy to capture the effect of German re-unification, and a dummy to capture the shift in the UK money data which was due to the inclusion of deposits of the building societies in the monetary aggregates as of 1987.
2.  Here, the null-hypothesis of no cointegration is tested against the alternative hypothesis of cointegration. The area of rejection of the null-hypothesis is the area for which the DF test statistic without intercept is smaller than -1.99 (the test is indecisive for values between -1.99 and -1.84) at the 5 percent confidence level, and the area for which the DF test statistic with intercept is smaller than -2.33 (the test is indecisive for values between -2.33 and -2.11) at the 5 percent confidence level.

**TABLE 16 -     Short Run (Semi-)Elasticities for Money Demand**

| | euro area | NE | US | JP |
|---|---|---|---|---|
| Scale effect | 1.00 | 1.00 | 1.00 | 1.00 |
| | ( - ) | ( - ) | ( - ) | ( - ) |
| Nominal interest rate | -0.07 | -0.14 | -0.11 | -0.12 |
| | (0.05) | (0.09) | (0.05) | (0.03) |
| User cost of resid. build | 0.01 | -0.02 | -0.01 | -0.01 |
| | (0.02) | (0.02) | (0.02) | (0.01) |
| Real interest rate | -0.95 | -0.04 | -1.03 | -0.88 |
| | (0.67) | (0.90) | (0.55) | (0.26) |
| Error correction term (t-1) | -0.60 | -0.25 | -0.42 | -0.56 |
| | (0.20) | (0.29) | (0.29) | (0.16) |
| | | | | |
| Implicit interest semi-elasticity | -1.42 | -1.67 | -2.08 | -1.99 |
| | | | | |
| Diagnostic statistics | | | | |
| R2-adjusted | 0.62 | 0.25 | 0.58 | 0.65 |
| Durbin Watson | 1.77 | 1.49 | 1.16 | 1.59 |

Standard errors between brackets.

# X Appendix B: Some additional empirical evidence

**TABLE 17 -** **A temporary real demand shock under a two-pillar strategy**

| | euro area | | | | | | U.S. | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 01 | 02 | 03 | 05 | sq | ss | 01 | 02 | 03 | 05 | sq | ss |
| short-term interest rate * | 1.11 | 1.03 | 1.37 | 0.69 | 0.99 | -0.00 | 1.02 | 1.08 | 1.22 | 0.27 | 0.88 | 0.02 |
| real GDP | 0.25 | 0.43 | 0.40 | -0.09 | 0.29 | -0.00 | 0.48 | 0.52 | 0.41 | -0.24 | 0.39 | -0.00 |
| GDP deflator (PGDP) | 0.06 | 0.25 | 0.50 | 0.82 | 0.55 | -0.00 | 0.01 | 0.11 | 0.24 | 0.46 | 0.29 | 0.03 |
| private supply for final demand | 0.52 | 0.79 | 0.67 | -0.29 | 0.53 | -0.00 | 0.66 | 0.72 | 0.54 | -0.40 | 0.54 | -0.00 |
| | | | | | | | | | | | | |
| *Demand* (in constant prices) | | | | | | | | | | | | |
| private consumption | 0.92 | 1.22 | 1.18 | -0.25 | 0.88 | 0.00 | 0.85 | 1.00 | 0.85 | -0.43 | 0.73 | -0.00 |
| public consumption | -0.00 | 0.03 | 0.07 | 0.07 | 0.06 | 0.00 | -0.00 | 0.03 | 0.07 | 0.05 | 0.06 | -0.00 |
| gross capital formation | -0.40 | 0.16 | -0.16 | -0.47 | 0.30 | -0.00 | 0.02 | 0.04 | -0.24 | -0.46 | 0.30 | -0.00 |
| exports | 0.01 | -0.01 | -0.12 | -0.16 | 0.11 | -0.00 | 0.07 | -0.07 | -0.15 | -0.03 | 0.12 | -0.00 |
| imports | 1.62 | 2.20 | 1.77 | -1.11 | 1.54 | -0.00 | 1.46 | 1.66 | 1.10 | -1.19 | 1.27 | -0.00 |
| | | | | | | | | | | | | |
| *Prices* | | | | | | | | | | | | |
| GDP deflator (PGDP) | 0.06 | 0.25 | 0.50 | 0.82 | 0.55 | -0.00 | 0.01 | 0.11 | 0.24 | 0.46 | 0.29 | 0.03 |
| consumption price/PGDP | -0.06 | -0.08 | 0.02 | 0.32 | 0.17 | 0.00 | -0.01 | 0.01 | 0.09 | 0.24 | 0.14 | 0.00 |
| export price/PGDP | -0.07 | -0.29 | -0.58 | -0.96 | 0.64 | -0.00 | -0.12 | -0.37 | -0.65 | -0.81 | 0.61 | -0.03 |
| import price/producer price | -0.01 | -0.18 | -0.30 | -0.34 | 0.29 | 0.00 | 0.01 | -0.12 | -0.11 | 0.02 | 0.09 | 0.00 |
| | | | | | | | | | | | | |
| *Labour market* | | | | | | | | | | | | |
| total employment | 0.10 | 0.12 | 0.08 | -0.10 | 0.06 | 0.00 | 0.27 | 0.29 | 0.16 | -0.31 | 0.16 | -0.00 |
| private sector employment | 0.12 | 0.14 | 0.09 | -0.12 | 0.11 | 0.00 | 0.31 | 0.34 | 0.19 | -0.36 | 0.30 | -0.00 |
| take home real wage | 0.03 | 0.03 | -0.02 | -0.17 | 0.09 | -0.00 | 0.03 | 0.00 | -0.06 | -0.18 | 0.11 | -0.01 |
| producer real wage | 0.01 | 0.02 | 0.07 | 0.17 | 0.10 | 0.00 | 0.04 | 0.04 | 0.05 | 0.02 | 0.03 | -0.00 |
| | | | | | | | | | | | | |
| *Monetary sector* | | | | | | | | | | | | |
| short-term interest rate * | 1.11 | 1.03 | 1.37 | 0.69 | 0.99 | -0.00 | 1.02 | 1.08 | 1.22 | 0.27 | 0.88 | 0.02 |
| long-term interest rate * | 0.70 | 0.74 | 0.95 | 0.38 | 0.67 | -0.00 | 0.37 | 0.45 | 0.52 | 0.08 | 0.36 | 0.00 |
| eff. nom. exchange rate (-:appr.) | -0.27 | -0.36 | -0.49 | -0.32 | 0.36 | -0.00 | -0.31 | -0.45 | -0.55 | -0.23 | 0.39 | -0.01 |
| eff. real exchange rate (-:appr.) | -0.26 | -0.30 | -0.36 | -0.07 | 0.25 | -0.00 | -0.21 | -0.18 | -0.12 | 0.16 | 0.16 | -0.00 |
| nominal money stock | 0.24 | -0.36 | -1.05 | -1.78 | 1.30 | -0.00 | 0.20 | -0.19 | -0.58 | -0.72 | 0.65 | -0.00 |
| real money stock | 0.24 | -0.53 | -1.57 | -2.91 | 1.99 | 0.00 | 0.20 | -0.30 | -0.91 | -1.42 | 1.07 | -0.04 |
| | | | | | | | | | | | | |
| *Public sector* | | | | | | | | | | | | |
| nominal public revenues | 0.21 | 0.46 | 0.68 | 0.75 | 0.60 | -0.00 | 0.27 | 0.38 | 0.42 | 0.22 | 0.31 | 0.03 |
| real public revenues | 0.15 | 0.20 | 0.18 | -0.07 | 0.14 | 0.00 | 0.25 | 0.27 | 0.18 | -0.24 | 0.23 | -0.00 |
| nominal public expenditures | -0.06 | 0.34 | 0.68 | 1.20 | 0.83 | -0.00 | -0.27 | 0.10 | 0.40 | 0.89 | 0.63 | 0.03 |
| real public expenditures | -0.11 | 0.09 | 0.18 | 0.38 | 0.29 | 0.00 | -0.28 | -0.01 | 0.16 | 0.42 | 0.36 | -0.00 |
| deficit to GDP ratio * (+:surplus) | 0.11 | 0.06 | 0.01 | -0.18 | 0.12 | 0.00 | 0.13 | 0.06 | -0.00 | -0.17 | 0.13 | 0.00 |
| debt to GDP ratio * | -0.30 | -0.57 | -0.71 | -0.26 | 0.50 | 0.00 | -0.43 | -0.57 | -0.58 | 0.04 | 0.42 | 0.00 |
| | | | | | | | | | | | | |
| *Household sector* | | | | | | | | | | | | |
| total available means | 2.36 | 2.29 | 2.16 | -0.42 | 1.78 | 0.00 | 2.81 | 2.77 | 2.70 | -0.19 | 2.14 | 0.02 |
| real disposable income | 0.04 | 0.25 | 0.16 | -0.28 | 0.19 | -0.00 | 0.12 | 0.38 | 0.30 | -0.22 | 0.25 | -0.01 |
| savings as % of disp. inc * | -0.88 | -0.97 | -1.03 | -0.03 | 0.75 | -0.00 | -0.73 | -0.62 | -0.54 | 0.21 | 0.51 | -0.01 |
| | | | | | | | | | | | | |
| *Spill-over effects* | | | | | | | | | | | | |
| effec. foreign output | 0.09 | 0.09 | 0.05 | -0.04 | 0.07 | -0.00 | 0.06 | 0.02 | 0.00 | -0.01 | 0.04 | -0.00 |
| effec. foreign price level | -0.00 | 0.02 | 0.05 | 0.10 | 0.07 | -0.00 | -0.00 | 0.01 | 0.02 | 0.04 | 0.03 | 0.01 |
| effec. foreign interest rate * | 0.13 | 0.17 | 0.19 | 0.08 | 0.14 | -0.00 | 0.10 | 0.17 | 0.19 | 0.01 | 0.13 | -0.00 |
| | | | | | | | | | | | | |
| *Memo items* | | | | | | | | | | | | |
| current account to GDP * | -0.23 | -0.32 | -0.30 | 0.05 | 0.23 | -0.00 | -0.15 | -0.20 | -0.18 | 0.02 | 0.14 | -0.01 |
| total stock of real assets | -0.02 | -0.01 | -0.02 | -0.03 | 0.02 | -0.00 | 0.00 | 0.00 | -0.01 | -0.05 | 0.03 | -0.01 |

**TABLE 18 -     A permanent supply shock in the U.S. under a Taylor rule**

| | with revision of the reference value | | | | | | without revision of reference value | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 01 | 02 | 03 | 05 | sq | ss | 01 | 02 | 03 | 05 |
| short-term interest rate * | 0.14 | 0.07 | 0.07 | 0.07 | 0.09 | 0.00 | -0.25 | -0.27 | -0.24 | -0.22 |
| real GDP | -0.73 | -0.89 | -0.90 | -0.91 | 0.87 | -1.00 | -0.63 | -0.79 | -0.80 | -0.82 |
| GDP deflator (PGDP) | -0.03 | -0.04 | -0.06 | -0.07 | 0.06 | 0.01 | -0.01 | 0.01 | 0.03 | 0.12 |
| private supply for final demand | -0.79 | -0.97 | -0.98 | -0.97 | 0.94 | -1.00 | -0.63 | -0.83 | -0.84 | -0.85 |
| | | | | | | | | | | |
| *Demand* (in constant prices) | | | | | | | | | | |
| private consumption | -0.86 | -1.06 | -1.11 | -1.14 | 1.06 | -1.17 | -0.69 | -0.88 | -0.93 | -0.97 |
| public consumption | -0.33 | -0.71 | -0.74 | -0.79 | 0.69 | -1.00 | -0.33 | -0.70 | -0.73 | -0.78 |
| gross capital formation | -0.78 | -0.88 | -0.83 | -0.78 | 0.82 | -1.05 | -0.53 | -0.77 | -0.77 | -0.77 |
| exports | -0.23 | -0.22 | -0.23 | -0.13 | 0.20 | 0.00 | -0.18 | -0.18 | -0.18 | -0.11 |
| imports | -0.92 | -1.18 | -1.20 | -1.11 | 1.13 | -1.00 | -0.43 | -0.83 | -0.88 | -0.87 |
| | | | | | | | | | | |
| *Prices* | | | | | | | | | | |
| GDP deflator (PGDP) | -0.03 | -0.04 | -0.06 | -0.07 | 0.06 | 0.01 | -0.01 | 0.01 | 0.03 | 0.12 |
| consumption price/PGDP | 0.03 | 0.06 | 0.11 | 0.16 | 0.11 | 0.18 | 0.01 | 0.05 | 0.10 | 0.18 |
| export price/PGDP | -0.17 | -0.45 | -0.70 | -0.97 | 0.69 | -1.01 | -0.14 | -0.39 | -0.62 | -0.94 |
| import price/producer price | 0.02 | -0.14 | -0.02 | 0.06 | 0.07 | -0.00 | 0.01 | -0.12 | -0.05 | 0.01 |
| | | | | | | | | | | |
| *Labour market* | | | | | | | | | | |
| total employment | -0.02 | -0.08 | -0.07 | -0.02 | 0.11 | -0.00 | 0.05 | -0.02 | -0.03 | 0.00 |
| private sector employment | -0.05 | -0.12 | -0.10 | -0.03 | 0.08 | -0.00 | 0.03 | -0.05 | -0.05 | -0.02 |
| take home real wage | -0.71 | -0.79 | -0.85 | -0.94 | 0.84 | -1.21 | -0.70 | -0.78 | -0.84 | -0.95 |
| producer real wage | -0.68 | -0.72 | -0.74 | -0.79 | 0.74 | -1.00 | -0.67 | -0.72 | -0.74 | -0.78 |
| | | | | | | | | | | |
| *Monetary sector* | | | | | | | | | | |
| short-term interest rate * | 0.14 | 0.07 | 0.07 | 0.07 | 0.09 | 0.00 | -0.25 | -0.27 | -0.24 | -0.22 |
| long-term interest rate * | 0.07 | 0.03 | 0.04 | 0.03 | 0.04 | 0.00 | -0.02 | -0.02 | -0.01 | 0.00 |
| eff. nom. exchange rate (-:appr.) | -0.60 | -0.85 | -0.96 | -1.02 | 0.90 | -1.00 | -0.46 | -0.66 | -0.75 | -0.82 |
| eff. real exchange rate (-:appr.) | -0.39 | -0.35 | -0.19 | 0.02 | 0.25 | 0.00 | -0.30 | -0.27 | -0.16 | 0.01 |
| nominal money stock | -1.25 | -1.11 | -1.13 | -1.10 | 1.14 | -0.97 | -0.17 | -0.05 | -0.07 | -0.00 |
| real money stock | -1.25 | -1.13 | -1.18 | -1.19 | 1.19 | -1.16 | -0.17 | -0.11 | -0.20 | -0.30 |
| | | | | | | | | | | |
| *Public sector* | | | | | | | | | | |
| nominal public revenues | -0.75 | -0.91 | -0.93 | -0.93 | 0.89 | -0.92 | -0.67 | -0.82 | -0.81 | -0.74 |
| real public revenues | -0.71 | -0.87 | -0.87 | -0.87 | 0.84 | -0.93 | -0.66 | -0.82 | -0.84 | -0.86 |
| nominal public expenditures | -0.19 | -0.65 | -0.71 | -0.74 | 0.64 | -0.92 | -0.25 | -0.71 | -0.70 | -0.59 |
| real public expenditures | -0.15 | -0.61 | -0.65 | -0.68 | 0.58 | -0.93 | -0.24 | -0.72 | -0.73 | -0.71 |
| deficit to GDP ratio * (+:surplus) | -0.14 | -0.05 | -0.04 | -0.04 | 0.07 | -0.00 | -0.10 | -0.01 | -0.01 | -0.03 |
| debt to GDP ratio * | 0.60 | 0.75 | 0.82 | 0.91 | 0.80 | 0.00 | 0.49 | 0.59 | 0.59 | 0.60 |
| | | | | | | | | | | |
| *Household sector* | | | | | | | | | | |
| total available means | -0.85 | -0.89 | -0.92 | -0.95 | 0.91 | -1.16 | -0.84 | -0.89 | -0.94 | -1.02 |
| real disposable income | -0.64 | -0.90 | -0.95 | -0.98 | 0.90 | -1.17 | -0.61 | -0.86 | -0.92 | -0.97 |
| savings as % of disp. inc * | 0.21 | 0.16 | 0.16 | 0.16 | 0.17 | -0.00 | 0.09 | 0.02 | 0.01 | 0.00 |
| | | | | | | | | | | |
| *Spill-over effects* | | | | | | | | | | |
| effec. foreign output | -0.07 | -0.01 | -0.00 | -0.00 | 0.03 | -0.00 | -0.05 | -0.02 | -0.00 | -0.00 |
| effec. foreign price level | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.00 | 0.01 | 0.01 | 0.00 | 0.00 |
| effec. foreign interest rate * | 0.01 | -0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.03 | 0.03 | 0.04 | 0.05 |
| | | | | | | | | | | |
| *Memo items* | | | | | | | | | | |
| current account to GDP * | 0.05 | 0.07 | 0.03 | -0.00 | 0.04 | -0.00 | 0.01 | 0.04 | 0.01 | -0.02 |
| total stock of real assets | -0.04 | -0.08 | -0.12 | -0.18 | 0.13 | -1.07 | -0.03 | -0.06 | -0.10 | -0.17 |

variables without * : deviation from baseline, in percent;  variables with * : deviation from baseline, in differences;  ss: steady state;

sq : standard deviation of first 5 years.

**TABLE 19 -** **A permanent supply shock in the U.S. under money targeting**

| | without revision of the money target | | | | | | with revision of the money target | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 01 | 02 | 03 | 05 | sq | ss | 01 | 02 | 03 | 05 | sq | ss |
| short-term interest rate * | -0.27 | -0.19 | -0.13 | -0.05 | 0.17 | 0.03 | 0.05 | 0.04 | 0.04 | 0.05 | 0.04 | 0.03 |
| real GDP | -0.60 | -0.77 | -0.80 | -0.88 | 0.78 | -1.00 | -0.71 | -0.88 | -0.89 | -0.90 | 0.86 | -1.00 |
| GDP deflator (PGDP) | 0.20 | 0.35 | 0.51 | 0.74 | 0.52 | 1.02 | -0.03 | -0.03 | -0.05 | -0.04 | 0.04 | 0.02 |
| private supply for final demand | -0.59 | -0.83 | -0.86 | -0.92 | 0.83 | -1.00 | -0.76 | -0.96 | -0.97 | -0.97 | 0.93 | -1.00 |
| | | | | | | | | | | | | |
| *Demand* (in constant prices) | | | | | | | | | | | | |
| private consumption | -0.68 | -0.93 | -1.00 | -1.09 | 0.96 | -1.17 | -0.82 | -1.04 | -1.09 | -1.13 | 1.04 | -1.17 |
| public consumption | -0.25 | -0.62 | -0.69 | -0.81 | 0.66 | -1.00 | -0.33 | -0.71 | -0.73 | -0.79 | 0.69 | -1.00 |
| gross capital formation | -0.40 | -0.75 | -0.76 | -0.80 | 0.71 | -1.06 | -0.72 | -0.89 | -0.83 | -0.79 | 0.81 | -1.06 |
| exports | -0.08 | -0.00 | 0.05 | 0.01 | 0.05 | -0.00 | -0.22 | -0.22 | -0.22 | -0.13 | 0.20 | -0.00 |
| imports | -0.23 | -0.88 | -0.92 | -1.00 | 0.85 | -1.00 | -0.81 | -1.16 | -1.17 | -1.11 | 1.09 | -1.00 |
| | | | | | | | | | | | | |
| *Prices* | | | | | | | | | | | | |
| GDP deflator (PGDP) | 0.20 | 0.35 | 0.51 | 0.74 | 0.52 | 1.02 | -0.03 | -0.03 | -0.05 | -0.04 | 0.04 | 0.02 |
| consumption price/PGDP | 0.03 | 0.11 | 0.15 | 0.21 | 0.15 | 0.19 | 0.03 | 0.06 | 0.11 | 0.16 | 0.11 | 0.19 |
| export price/PGDP | -0.15 | -0.25 | -0.36 | -0.60 | 0.40 | -1.03 | -0.16 | -0.44 | -0.69 | -0.97 | 0.69 | -1.03 |
| import price/producer price | -0.10 | -0.09 | -0.11 | -0.08 | 0.10 | 0.00 | 0.02 | -0.13 | -0.03 | 0.05 | 0.07 | 0.00 |
| | | | | | | | | | | | | |
| *Labour market* | | | | | | | | | | | | |
| total employment | 0.07 | -0.03 | -0.04 | -0.03 | 0.10 | -0.00 | 0.00 | -0.08 | -0.07 | -0.02 | 0.11 | 0.00 |
| private sector employment | 0.05 | -0.06 | -0.07 | -0.05 | 0.06 | -0.00 | -0.03 | -0.12 | -0.10 | -0.04 | 0.08 | 0.00 |
| take home real wage | -0.71 | -0.81 | -0.87 | -0.98 | 0.87 | -1.21 | -0.71 | -0.79 | -0.85 | -0.94 | 0.84 | -1.21 |
| producer real wage | -0.67 | -0.71 | -0.73 | -0.78 | 0.73 | -1.00 | -0.68 | -0.72 | -0.74 | -0.79 | 0.74 | -1.00 |
| | | | | | | | | | | | | |
| *Monetary sector* | | | | | | | | | | | | |
| short-term interest rate * | -0.27 | -0.19 | -0.13 | -0.05 | 0.17 | 0.03 | 0.05 | 0.04 | 0.04 | 0.05 | 0.04 | 0.03 |
| long-term interest rate * | 0.10 | 0.09 | 0.08 | 0.06 | 0.08 | 0.01 | 0.05 | 0.03 | 0.03 | 0.03 | 0.04 | 0.01 |
| eff. nom. exchange rate (-:appr.) | 0.14 | 0.16 | 0.15 | 0.09 | 0.14 | -0.02 | -0.57 | -0.82 | -0.93 | -1.00 | 0.88 | -1.02 |
| eff. real exchange rate (-:appr.) | 0.10 | 0.06 | 0.01 | -0.04 | 0.06 | 0.00 | -0.37 | -0.34 | -0.19 | 0.01 | 0.24 | 0.00 |
| nominal money stock | -0.00 | -0.00 | -0.00 | 0.00 | 0.00 | 0.00 | -1.00 | -1.00 | -1.00 | -1.00 | 1.00 | -1.00 |
| real money stock | -0.23 | -0.47 | -0.66 | -0.95 | 0.67 | -1.21 | -1.00 | -1.03 | -1.07 | -1.13 | 1.07 | -1.22 |
| | | | | | | | | | | | | |
| *Public sector* | | | | | | | | | | | | |
| nominal public revenues | -0.29 | -0.32 | -0.23 | -0.08 | 0.23 | 0.09 | -0.73 | -0.90 | -0.92 | -0.91 | 0.88 | -0.91 |
| real public revenues | -0.49 | -0.68 | -0.74 | -0.82 | 0.71 | -0.93 | -0.70 | -0.87 | -0.87 | -0.87 | 0.84 | -0.93 |
| nominal public expenditures | -0.08 | -0.30 | -0.16 | 0.10 | 0.16 | 0.09 | -0.20 | -0.66 | -0.70 | -0.71 | 0.63 | -0.90 |
| real public expenditures | -0.28 | -0.66 | -0.67 | -0.64 | 0.60 | -0.93 | -0.17 | -0.63 | -0.66 | -0.68 | 0.59 | -0.93 |
| deficit to GDP ratio * (+:surplus) | -0.04 | 0.02 | 0.01 | -0.02 | 0.02 | 0.00 | -0.13 | -0.05 | -0.04 | -0.04 | 0.07 | 0.00 |
| debt to GDP ratio * | 0.28 | 0.27 | 0.19 | 0.13 | 0.21 | 0.00 | 0.58 | 0.73 | 0.79 | 0.87 | 0.77 | -0.00 |
| | | | | | | | | | | | | |
| *Household sector* | | | | | | | | | | | | |
| total available means | -0.89 | -0.98 | -1.03 | -1.09 | 1.01 | -1.11 | -0.85 | -0.89 | -0.92 | -0.96 | 0.92 | -1.10 |
| real disposable income | -0.53 | -0.78 | -0.83 | -0.89 | 0.79 | -1.17 | -0.63 | -0.90 | -0.95 | -0.98 | 0.89 | -1.17 |
| savings as % of disp. inc * | 0.15 | 0.15 | 0.17 | 0.20 | 0.17 | -0.00 | 0.19 | 0.14 | 0.14 | 0.15 | 0.15 | -0.00 |
| | | | | | | | | | | | | |
| *Spill-over effects* | | | | | | | | | | | | |
| effec. foreign output | -0.05 | -0.02 | -0.01 | -0.01 | 0.03 | -0.00 | -0.06 | -0.01 | -0.00 | -0.00 | 0.03 | -0.00 |
| effec. foreign price level | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| effec. foreign interest rate * | 0.14 | 0.11 | 0.09 | 0.06 | 0.10 | -0.00 | 0.02 | 0.00 | 0.01 | 0.01 | 0.01 | -0.00 |
| | | | | | | | | | | | | |
| *Memo items* | | | | | | | | | | | | |
| current account to GDP * | 0.01 | 0.07 | 0.07 | 0.04 | 0.05 | -0.00 | 0.04 | 0.06 | 0.03 | -0.01 | 0.04 | -0.00 |
| total stock of real assets | -0.02 | -0.06 | -0.09 | -0.16 | 0.10 | -1.07 | -0.04 | -0.08 | -0.12 | -0.18 | 0.12 | -1.07 |

variables without * : deviation from baseline, in percent; variables with * : deviation from baseline, in differences; ss: steady state;
sq : standard deviation of first 5 years.

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