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Phillips Curve versus Error Correction Model Determination of Wages in Large-Scale UK Macro Models

*by*

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**Abstract**

In this article the implications of implementing either a Phillips curve or an Error Correction type of wage equation in macro models are investigated. First the implications in an small theoretical model is studied. Secondly, stylized wage equations of the two types is implemented in two large scale UK macro models (HM Treasury and Bank of England) and the multipliers are studied. The exercise highlights some undesired properties with the rest of the macro models and the results shows large differences in responds depending on the rest of the macro model. Generally a Phillips curve wage determination seems to make the reactions more unstable than an ECM type of wage formation.

***Keywords:*** Wage equations, Phillips curve, UK macro models

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# 1. Introduction

At the time this project began, the Norwegian large-scale macro models MODAG and KVARTS had Phillips curves determining wages. This is in contrast to current practice elsewhere, especially in the UK, and for some time the Central Bureau of Statistics (the model's proprietor) had been under pressure to change this to an error correction (ECM) type of model. This motivated my interest in this subject, and this paper is the result of my studies.

The modelling of wages is of great importance for the overall features of large-scale macro models and for the implications of different policy actions. The effects of different models of wage determination on the stability properties of the macro models is another aspect which motivates this paper.

The intention was to experiment with some of the UK models in the Bureau's deposit to try out some different stylized wage equations and also to conduct sensitivity analysis of the different parameters. However the comparative exercise revealed some unpredicted features of other parts of the models. In consequence the comparison is limited to the Bank of England (BE) and HM Treasury (HMT) models, both of autumn 1990 vintage, and to two different forms of wage equation.

An earlier study in this field is to be found in Artis *et al.* (1979). They looked at a system which consists of a price and a price expectation equation, in addition to a series of Phillips curves or ECM type wage equations. They compare the effects on prices and real wages of changes in the models' exogenous variables; import prices and unemployment. This differs from this study in that the rest of the macro model is taken into consideration, in particular the endogeneity of unemployment is considered, and empirical large-scale models are used.

The paper proceeds as follows. Section 1 discusses some of the theoretical differences between a Phillips curve and an ECM approach to wage formation. Section 2 describes how incorporation of stylized alternatives influence the simulation properties of the HMT and BE models (no new empirical estimates are provided) and Section 3 contains some conclusions.

# 2. Some theoretical aspects of different approaches to wage determination

The starting point for comparison of these different forms of wage equation is based on the approach set out in Nickell (1990). In the ECM approach there is a long-term connection between the level of real wages and the level of unemployment (and maybe other variables) whereas in a Phillips curve it is the change in real wages that is affected by the level of unemployment. We will here focus mainly on the long-run features and it is therefore convenient to strip the ECM of dynamics.

The demand side consists of the following equations:

$$y - y^0 = \sigma_1 x - \sigma_2 r + \sigma_3 (m - p) \tag{1}$$

$$i = i^* + \Delta e^e \tag{2}$$

$$\Delta e^e = \Delta p^e - \Delta p^{*e} - \delta\left[(m - p) - c^0\right] \tag{3}$$

$$r = i - \Delta p^e \tag{4}$$

where $y$ is the GDP in real terms (real aggregated demand is assumed to be supplied), $x$ denotes all the exogenous variables directly affecting real demand, for example government expenditure, tax rates and the level of world activity, $r$ is the domestic real interest rate, $m$ is the import price level in domestic currency, $p$ is the domestic price level and $i$ is the nominal interest rate. All variables are in natural logarithms and all small greek letters are positive coefficients. Superscript $*$ denotes foreign magnitudes, superscript $e$ expected values and superscript 0 represents a natural (or initial equilibrium) level. Equation (1) states that the deviation of real goods demand from the (initial) equilibrium level is a function of competitiveness ($m$-$p$), which affects imports and exports in real terms, real interest rates, which affect investment, and other exogenous influences. Equation (2) is an uncovered interest parity condition, determining the domestic interest rate; (3) is an expression for the expected depreciation of domestic currency, and (4) is the definition of the real interest rate.

The supply-side equations are

$$p = \gamma_1 w + (1 - \gamma_1) m + \gamma (y - y^0) \tag{5}$$

$$td = \delta_0 + \delta_1 (y - y^0) - \delta_2 (m - p - c^0) \tag{6}$$

$$y = n \tag{7}$$

$$rpi = ap + (1 - a) m \tag{8}$$

$$w = p + (1-\alpha_1)(m-p) + \alpha(y-y^0) \tag{9a}$$

$$\Delta w = \Delta p + (1-\beta_1)\Delta(m-p) + \beta(y-y^0) \tag{9b}$$

where *w* is the nominal wage, *td* is the trade deficit, *n* is the number employed and *rpi* is the consumer price index. The GDP price index (5) is determined as a mark-up on wages and import prices, the mark-up being an increasing function of demand. The trade deficit (6) is an increasing function of demand and a decreasing function of competitiveness. The production function (7) states that one unit of labour (one person) is required to produce one unit of output. Equation (8) gives the RPI as a geometric average of the GDP price index and the import price index. As for wages, (9a) is the long-run part of the ECM, where the nominal wage outcome is a mark-up on the GDP deflator increasing with competitiveness (real wage resistance) and labour market tightness. (The coefficient $0 < \alpha_1 < 1$ implies some real wage resistance.) The alternative (9b) is the Phillips curve (PC), where wage growth increases with the tightness of the labour market and an average of the growth in import and GDP prices.

One way to compare the PC and the ECM is to difference (9a) and compare it with the Phillips curve (9b):

$$\Delta w = \Delta p + (1-\alpha_1)\Delta(m-p) + \alpha\Delta y \tag{9a'}$$

As we see, the only difference between the two models is that in the ECM wage equation it is the changes in unemployment that influence wage growth, while in the PC equation it is the static difference in the level of unemployment from a fixed level (natural unemployment).

## ECM

Let us first examine the model with wages determined in an ECM-type equation. The details of the derivation are shown in the appendix. By substitution we get the following expression for the deviation in output from an initial equilibrium level:

$$(y-y^0) = \frac{1-\gamma_1\alpha_1}{1-\gamma_1\alpha_1 + (\sigma_2\delta+\sigma_3)(\alpha\gamma_1+\gamma)}\left[\sigma_1 x - (\sigma_2 r^* + \sigma_2\delta c^0)\right] \tag{1''}$$

The expression in front of the square brackets is positive, implying that an expansionary economic policy, an increase in world demand or a decrease in foreign real interest rates, all increase domestic output in the long run. As we see, the import price does not appear in this expression. This is because changes in import prices fully feed into domestic prices, and it is relative prices which determine competitiveness and thereby the domestic activity level.

We can deduce the following expression for the real wage:

$$w-p=\theta\left[\sigma_1 x-\sigma_2\left(r^*+\delta c^0\right)\right] \tag{10'}$$

where

$$\theta=\frac{\alpha(1-\gamma_1)-\gamma(1-\alpha_1)}{1-\gamma_1\alpha_1+(\delta\sigma_2+\sigma_3)(\alpha\gamma_1+\gamma)}.$$

Here too the import price disappears. Changes in import prices, in this model, change both wages and domestic producer prices by the same amount, and thereby do not affect real wages. The sign of $\theta$ in (10') and thus the effect of an exogenous shock on real wages is not obvious, however. If we assume that the direct effects of changes in import prices on wages and on the GDP deflator are equal $(1-\alpha_1)=(1-\gamma_1)$, then the sign is determined by whether or not the coefficient 1 for market tightness is larger for nominal wages than for prices. If nominal wages is most affected, $(\alpha>\gamma)$, then $\theta$ is positive. If the direct effect of market tightness on prices is close to 0, the import price effects on wages might be much larger than on prices and this conclusion still holds. The effect on real wages of either increased government spending, increased world demand or decreased real interest rates abroad is not certain, but will under plausible assumptions push up the domestic real wage.

The real wage expression relevant for workers is the nominal wage deflated by the RPI. With some rearranging we obtain an alternative expression for the real wage, namely

$$w-rpi=\theta^{rpi}\left[\sigma_1 x-\sigma_2\left(r^*+\delta c^0\right)\right] \tag{11}$$

where

$$\theta^{rpi}=\frac{\alpha(1-\alpha\gamma_1)-\gamma(a-\alpha_1)}{1-\gamma_1\alpha_1+(\sigma_2\delta+\sigma_3)(\alpha\gamma_1+\gamma)}$$

The numerator in $\theta^{rpi}$ is larger than in $\theta$, while the denominators are identical; by this real wage measure the effects of expansion are even more likely to result in an increased real wage. Alternatively the rise will be larger. We can deduce the following expression for the price level

$$p=m+\frac{\gamma_1\alpha+\gamma}{1-\gamma_1\alpha_1+(\sigma_2\delta+\sigma_3)(\alpha\gamma_1+\gamma)}\left[\sigma_1 x-\sigma_2\left(r^*+\delta c^0\right)\right] \tag{5''}$$

As we see from (5"), when the import price m is fixed the domestic price level has to increase due to any expansionary change in exogenous variables. And a change in the import price will lead to a proportional increase in the domestic prices.

The size of the effects on nominal prices and wages will be higher the higher the market tightness coefficients are $(\alpha, \gamma)$. The effects will also be higher the lower the import price effects are (higher $\alpha_1, \gamma_1$).

### Phillips curve

We now consider the implications of replacing the ECM wage determination (9a) with a Phillips curve (9b). Defining steady state as a solution where $\Delta w = \Delta p = \Delta m$ we see that from (9b) $y$ has to be equal to $y^0$ (the natural rate of production/employment) in steady state.

With $y = y^0$ we can solve (1) by substituting from (2), (3) and (4) (see appendix) with respect to $p$ and get the following expression for the domestic price level

$$p = m + \frac{1}{\sigma_2\delta + \sigma_3}\left[\sigma_1 x - \sigma_2\left(r^* + \delta c^0\right)\right] \tag{1$^C$}$$

Because production has to reach its natural level in steady state, prices in steady state must be determined in (1) so that total demand equals the natural level of production. An expansionary economic policy must be offset by decreased competitiveness through higher prices.

Comparison with (5") reveals that the effects on domestic prices from changes in the exogenous variables will be larger with a Phillips curve than with an ECM determination of wages, as shown in the appendix.

When ($1^C$) is put together with (5) we get the following expression for the wage level in steady state

$$w = m + \frac{1}{(\sigma_2\delta + \sigma_3)\gamma_1}\left[\sigma_1 x - \sigma_2\left(r^* + \delta c^0\right)\right] \tag{9b$^C$}$$

The real wage in steady state corresponding to (10') must then be

$$w - p = \frac{1-\gamma_1}{(\sigma_2\delta + \sigma_3)\gamma_1}\left[\sigma_1 x - \sigma_2\left(r^* + \delta c^0\right)\right] \tag{10$^C$}$$

Here too, the import price drops out. We see that an expansionary economic policy will increase the real wage when we apply the Phillips curve. Comparing θ from (10') with the corresponding part of ($10^C$) reveals the latter to be smallest in absolute value ($0 < \alpha_1 < 1$ and $0 < \gamma_1 < 1$), independent of the magnitude of the parameters α, β or γ (see appendix). A change in the "expansionary" direction for any of the exogenous variables (except import price, which has no effect at all) will in the long run (if the model will reach a steady state solution) increase the real wage more in the model with the Phillips curve than an ECM wage determination.

With a Phillips curve determination of wages, we see from ($1^C$), ($9b^C$) and ($10^C$) that the market tightness coefficients, both for the goods and the labour market, are of no importance in the steady-state solutions. This is because the long-run solution is defined as the solution where both markets are in some kind of equilibrium. We also see that there is no effect on the long-run solution from any of the wage equation coefficients. The real wage and also the nominal wage, is determined elsewhere in the model - by the aggregate demand and price equations. Prices and wages are forced up by the tightness in the markets for both labour and goods until the resulting loss in competitiveness has offset the initial effect of the rise in governmental expenditure. The positive effect on the level of activity is then completely crowded out. The domestic price level must rise relatively to the import prices so the natural rate of production could be restored. When the IS curve gives us the price level consistent with this level of demand, the price equation implies what the level of the wage and hence the real wage has to be.

The expression for the real wage deflated by RPI-corresponding to (11) is

$$w - rpi = \frac{1 - a\gamma_1}{(\sigma_2\delta + \sigma_3)\delta_1}\left[\sigma_1 x - \sigma_2\left(r^* - \delta c^0\right)\right] \qquad (11^C)$$

As we see also the employees' real wage increases as an effect of any kind of expansion. The effects are bigger than the corresponding effects in the model with the ECM wage equation, and the effect remains higher than for the producer real wage.

Let me sum up what we should expect from this when we implement a stylized version of a Phillips curve and am ECM wage determination in large scale macro models. Expansionary economic policy will increase output with both kinds of wage determination in the short run, but in the long run only with an ECM. Prices and wages are driven up in both cases, but most with a Phillips curve. The real wage will increase when a Phillips curve is implemented, while the effect when we have an ECM is uncertain, but anyway not higher. The long-run effects of an increase in world market prices should only be a similar increase in both domestic prices and wages and have no other effects.

## 3. Implementing stylized wage equations in UK macro models

The outcome of the exercise implementing different stylized wage equations in large-scale econometric macro models is obviously sensitive to the values of the parameters. I will here first go through some arguments discussing the values and particular parameters chosen before going through the results of simulations with these stylized equations.

### The stylized wage equations

When it comes to the precise shaping of my stylized wage equations I will make some changes from the equations (9a) and (9b) in the previous part. In the large-scale empirical macro models there has been a tradition of modelling the real consumption wage, and not the real producer wage used in the earlier theoretical discussion. This makes one change to the argument of the sign of the coefficient compared to (9a) and (9b). There the import price (or the competitiveness) had a positive coefficient because of real wage resistance, here the sign is not obvious. If the coefficient is 0, it will now mean a 100 per cent compensation or rises in the consumer prices caused by a rise in import prices. But on the other hand improved competitiveness (or the higher import price) may make firms more willing to reward their workers. They may be willing to more than compensate the increase in consumer demand prices which follows directly from the initial rise in import prices. On the the other hand, in sheltered sectors the situation will be quite opposite. The rise in import prices does not improve the situation for these firms and they are unwilling to compensate all the increase in consumer prices caused by rise in the import price. It is assumed here that the latter effect is the greatest, i.e. the effect from import prices (or the competitiveness) on consumer real wages is negative.

The rate of unemployment is used as a labour market tightness variable. As the productivity variable, I have used the total productivity defined as GDP per person employed. GDP man per hour would have been much more satisfactory but unfortunately this variable doe not exist in the UK models. When it comes to the change in price variable I have used an adaptive expectation variable. The equation is more or less taken from the LBS model

$$p^e = 1.675 p_{-1} - 0.526 p_{-2} - 0.149 p_{-3} + 0.004$$

The stylized wage equations to be implemented in the models arise from different versions of the following equation.

$$\begin{aligned}
&\Delta w = \alpha_0 + \alpha_1 \Delta p^e + \alpha_2 \Delta q + \alpha_3 \Delta(m-p) - \beta u_{-1} \\
&-\gamma_1 \Delta \ln(1+T_i) - \gamma_2 \Delta \ln(1-T_d) - \gamma_3 \Delta \ln(1+T_e) \\
&-\lambda\left[w_{-1} - \lambda_1 p_{-1} - \lambda_2 q_{-1} - \lambda_3 (m_{-1} - p_{-1}) + \right. \\
&\left. \mu_1 \ln(1+T_i)_{-1} + \mu_2 \ln(1-T_d)_{-1} + \mu_3 \ln(1+T_e)_{-1}\right],
\end{aligned}$$

where all small letters are variables in logs, and $w$ denotes average earnings, $p$ private consumption deflator, $q$ output per head, $m$ import price, $T_i$ indirect tax rate, $T_d$ direct tax rate, $T_e$ employment tax rate and $u$ unemployment rate.

Here we see that setting $\lambda = 0$ is equivalent to a Phillips kind of wage determination, while $\lambda > 0$ and $\lambda_1 = 1$ gives us a kind of ECM representation of a real wage model. With an ECM it is natural to let $\lambda_i \leq \mu_i$ and $\alpha_i \leq \lambda_i$ as long as we want to have the tax wedge variables in the long-term part, since if not it will mean that the direct effect of changes in the respective variables is stronger than the long-run effect (overshooting). All kinds of the tax coefficients would have to be elements of [0,1]. A coefficient of 0 for the retention ratio (1 - direct tax rate) will imply that changes in direct taxes just have demand effects, while with a higher figure there will also be a supply-side effect through changing the real wage. Alternatively with a coefficient of unity there will be no demand effects of a change in direct taxation (Fisher *et al.*, 1990). The parameters $\mu_2$ and $\gamma_2$ represent the long-run and short-run responses respectively. But if $\gamma_2 < 1$ and $\mu_2 = 1$ changes in direct taxation will have demand effects only in the short run. Correspondingly $\gamma_1 = 1$ and $\gamma_3 = 1$ implies that changes in $T_i$ and $T_e$ respectively will result in changes only from the demand side when altering the tax rates. We have here of course the same kind of short term effects if $\gamma_1 = 1$. Letting $\mu_1 = \mu_2 = \mu_3$ gives a case often referred to as a situation where tax switches can change neither the real producer nor real consumption wages.

The fixing of the parameter values here is relatively arbitrary using the background of different theoretical and empirical studies (for example, Layard and Nickell, 1985, Joyce, 1990 and Stølen, 1990). My choice of coefficient of the two main models can be summarized in Table 1.

**Table 1.** Values of coefficients in the stylized wage equations

| | PC | ECM |
|---|---|---|
| $\alpha_0$ | see text | |
| $\alpha_1$, $\alpha_2$ | 1 | 1 |
| $\alpha_3$ | 0.15 | 0.15 |
| $\gamma_1$, $\gamma_2$, $\gamma_3$ | 0.5 | 0.5 |
| $\beta$ | 0.01 | 0.01 |
| $\lambda$ | - | 0.3 |
| $\lambda_1$, $\lambda_2$ | - | 1 |
| $\lambda_3$ | - | 0.15 |
| $\mu_1$, $\mu_2$, $\mu_3$ | - | 0.5 |

When comparing a Phillips curve against a level equation by changing $\lambda$ and the constant term, we must also consider other changes. A shift in "level variables" will, except for the unemployment rate, in an ECM get an extra effect compared with the Phillips curve (as long as the long-term coefficients are bigger than the short-run coefficients). This is one reason to choose $\gamma_i = \mu_i$, which I have done. For the unemployment rate the opposite is the case. A permanent change in the unemployment rate will have a permanent effect on wage growth in a Phillips curve, while it will gradually disappear in an ECM, as the (real) wage converges to the long term "equilibrium" path.

This indicates that it would be wise to let $\beta$ be smaller in a Phillips curve. Letting $\alpha_i$'s and $\gamma_i$'s in the Phillips curve equal the $\lambda_i$'s and $\mu_i$'s respectively in the ECM should secure the partial long-term property to be the same when it comes to these variables. In an ECM the NAIRU may shift as a result of changes in the tax variables, while it is constant in a Phillips curve. Another way to put it is that in an ECM a change in taxes makes it possible for a certain change in unemployment without having a change in real wages as a result. With the simple Phillips curve this is not possible as a long-run property.

The constant term, together with the unemployment coefficient gives the fixed natural rate of unemployment in a Phillips curve, i.e. the level of unemployment which gives no increase in the expected real wage, if all prices are growing at the same speed (price homogeneity: $\alpha_1 = 1$) and the other variables are fixed

$$U^0 = \exp\left(\frac{\alpha_0}{\beta}\right)$$

Also in an ECM equation, the constant term will influence the long-run NAIRU (but here NAIRU is not constant).

Determination of the constant term seems to be a very important and complicated matter. However, as long as we want to see the differences endogenous variables with the different wage equation for different exogenous shocks the constant term does not necessarily matter itself, particularly if the whole model is log linear and we are interested in relative departure from the baseline. In order to standardize the baseline across the wage models we utilize the "constant" term as a time series (i.e. not constant!) securing the wage to be on the same track as in the baseline. The baselines are those produced by the model proprietors or the Macroeconomic Modelling Bureau. The $\alpha_0$ is calculated to force the stylized equation to track the baseline of the macro model. In addition some corrections are made to unemployment to secure a common rate of unemployment between all models, as this probably is the most important variable when it comes to base dependence. The average value of the constant term in the Phillips curve for HMT implies an average national rate of unemployment of 8.5 per cent and the comparable figure for BE is 7.2 per cent. In the HMT model where there is no aggregate wage variable the different sectors have the same wage growth consistent with the average growth rate. In the BE model the equation for the average wage is just replaced by the stylized one.

## Simulation results

To see how different wage equations alter the features of a macro model multiplier analysis is used. The first two multiplier runs are the standard expansionary policy experiments; increased government expenditure and an income tax cut simulations (see Church *et al.*, (1991) for the standard multiplier analysis). In addition to these I have conducted two different world price shocks; a once-for-all jump in all world price related exogenous variables and another with continuous increase in world inflation. The simulations are performed on the 1990/91 vintage of the models (deposit 8) for the period from 1990:3 to 1998:4.

Some of the results are given in Tables 2-7 and in Figures 1 and 2. The first thing that stands is that the differences between the macro models seem to dominate, especially in the short run. The differences caused by the two different wage equations are as one would expect mainly connected with the long-run results. One complicating feature of the simulation is that they do not settle down over the simulation period. This makes it somewhat difficult to infer the long-run results.

***Government expenditure***

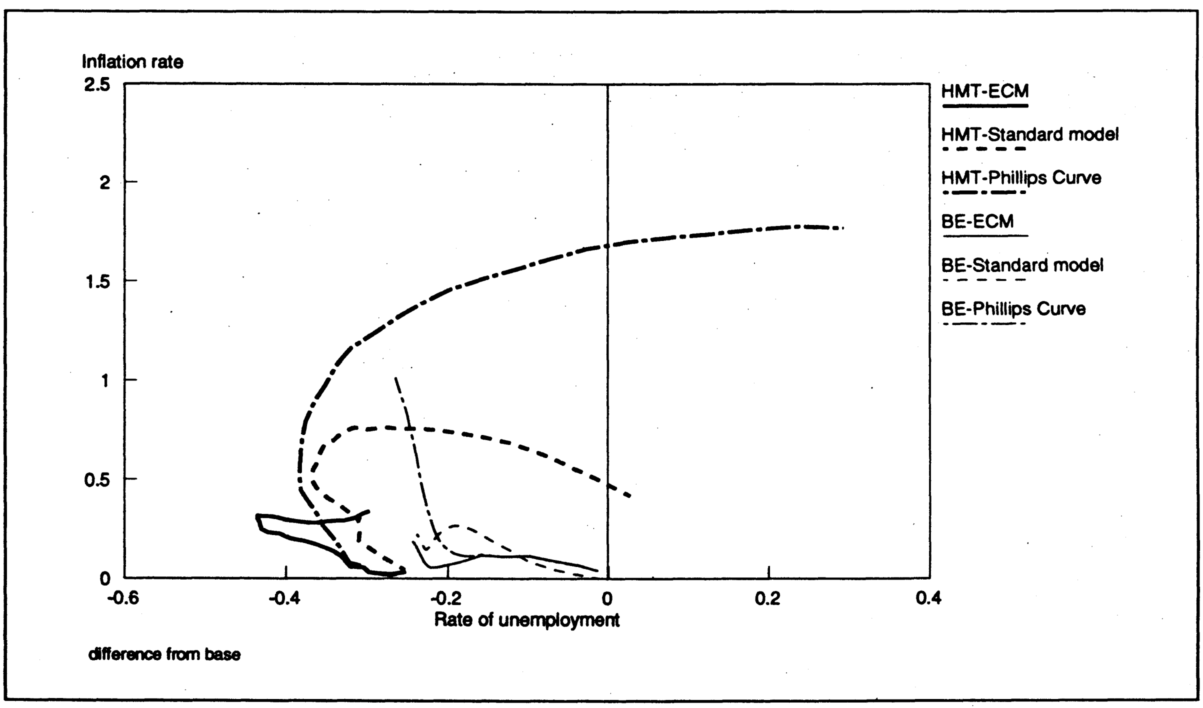
From Table 2 we can see that we get the expected result when it comes to the real wage. Both in the shorter and longer run we get a higher real wage with a Phillips curve and hardly any change from base with an ECM. In both the macro models we see an exploding tendency in the consumer price with a Phillips curve. The changes in inflation and unemployment are plotted in Figures 1 and 2.

**Table2.** Increase in government expenditure by 2 billion (1990 prices)

| | | **HMT8** | | | **BE8** | |
|---|---|---|---|---|---|---|
| | *Quarters after change* | *PC* | *ECM* | *Std mod* | *PC* | *ECM* |
| Real wage % difference from base | 4 | 0.00 | -0.02 | 0.02 | -0.06 | -0.06 |
| | 8 | 0.12 | -0.03 | 0.03 | -0.08 | 0.11 |
| | 12 | 0.32 | -0.03 | 0.03 | -0.05 | -0.14 |
| | 16 | 0.55 | -0.03 | 0.03 | 0.00 | -0.17 |
| | 34 | 1.67 | 0.14 | 0.03 | 0.65 | -0.17 |
| Private consumption deflator % difference from base | 4 | 0.06 | 0.06 | 0.26 | 0.12 | 0.12 |
| | 8 | 0.34 | 0.23 | 0.62 | 0.24 | 0.24 |
| | 12 | 0.87 | 0.44 | 1.14 | 0.37 | 0.32 |
| | 16 | 1.71 | 0.70 | 1.79 | 0.58 | 0.38 |
| | 34 | 9.36 | 2.17 | 4.90 | 3.59 | 0.88 |
| Unemployment rate difference from base | 4 | -0.31 | -0.30 | -0.31 | -0.10 | -0.10 |
| | 8 | -0.35 | -0.35 | -0.33 | -0.16 | -0.16 |
| | 12 | -0.38 | -0.40 | -0.37 | -0.19 | -0.19 |
| | 16 | -0.38 | 0.43 | -0.36 | -0.21 | -0.21 |
| | 34 | 0.29 | -0.29 | 0.03 | -0.27 | -0.24 |

The most striking fact is how the Phillips curve works in the HMT model. After a decline in unemployment for most of the period at the expense of a steadily increasing inflation, inflation (and real wages) explodes, and we get increased unemployment compared to the baseline, as a consequence. Decreased export and increased import through a loss in competitiveness and substitution effects more than offset the initial expansive policy effects on unemployment. It is obvious that the inflation would eventually fall if we increased the simulation period because of the increased unemployment at the end of this simulation. But there is no reason to think that this process will calm down to a steady state path, assumed in the theoretical part of this paper. It seems much more likely to explode in some ever-increasing circles around the "no change" inflation and unemployment point in the chart. The natural rate property of the Phillips curve, does not help much as an equilibrium mechanism, at least not in the context of this macro model, as it seems never to be reached (at least not settled down) with this policy shock. When it comes to the BE model and the Phillips curve it is very much the same, but the inflation "explosion" seems to come later and does not come down during the simulation period.

**Figure 1.** Effects of a 2 billion (1990 prices) increase in government expenditure




Another striking element is the closeness in the effects on the consumer price for the first 6 years are in the BE model (independent of wage model) and the HMT model with an ECM determining the wage (and with a PC the first 2 years). This is an indication that in the short and medium run, the choice between a Phillips curve and an ECM to determine the wages is not of great importance. The interaction with other parts of the model could be crucial for the results; in particular the exchange rate and the labour-related equations influence the way the two alternative ways of wage determination work in a full-scale macro model setting. In this short- to medium-term simulation period the dynamics and how fast changes in exogenous variables feed through the model will obviously be of considerable importance.

Table 2 also shows the standard HMT model responses. It is striking that the effects both on prices and unemployment in the short and medium term is much closer to the Phillips curve than the ECM results. By the end of the simulation period it lies about half way between the PC and ECM results. This shows (as the wage equation is in some kind of the "ECM spirit") how important the detailed specification is. When it comes to the real wage, the results from the standard model point out the closeness to the ECM; there is hardly any discrepancy at all.

In the unemployment/inflation chart Figure 1, we see that the standard model performance is surprisingly similar to the Phillips curve. In addition to the effects via exports and imports, a closer inspection reveals that there is a big cycle in private fixed investment that is partly driving the responses in production and unemployment. Also with my stylized ECM wage equation, where competitiveness settles down rather quickly, we experience the same type of cycle in investment. This investment cycle contributes to the "long-term" cycle in unemployment and therefore also on the difference between the models (because this kind of cycle is absent in the BE model).

The effects on prices and wages is much larger in the HMT model. The decrease in unemployment is largest in the HMT model, at least for the first 23 quarters with any kind of wage equation. Right from the first quarter we see this much higher impact in the HMT model. This simply tells us that increased governmental spending has a larger effect on unemployment in the standard HMT model than in the standard BE model. We therefore get greater pressure on wages and prices in the HMT model. Increased domestic costs lead to an increasing partially force towards a higher unemployment rate.

By the end of the simulation, there is a rather different development in the effects on unemployment between the two wage models in the two macro models. In the BE model the unemployment falls a little bit more down with the Phillips curve than with the ECM, while the opposite occurs for the HMT simulations. The explanation behind this difference between the macro models is the effects from the exchange rate determinations. Prices are growing faster at the end of the simulation period with the Phillips curve in the BE model (compared with the baseline), this is more than offset by a sharp depreciation of the £ relative to the base.

This relative gain in competitiveness in the BE model (with a Phillips curve) does not happen in the HMT model.

In the BE model the real exchange rate is modelled and this is related directly to the current balance of payments and the accumulation of public sectors borrowing requirement (PSBR). Increased government expenditure increases the trade deficit and the PSBR and hence lowers the real exchange rate. Thus we get higher domestic wage inflation, but because of the striking fall in the nominal exchange rate import prices are increased even more than domestic prices. This strange effect does not take place in the HMT model simulations. The relatively big drop in the exchange rate in the BE model leads to an increase in competitiveness thereby reinforcing the initial effects on the activity. Increased import prices also increase the domestic price level. The difference with respect to the exchange rate mechanism seems thus to contribute to close the gap in performance between the models.

Closer inspection of the results reveals that it must be the unemployment, or the supply relationship that is the main explanation behind the differences between the performance of the two macro models. Both the effects on GDP and employment are pretty close over the first four years, while the unemployment effects are not. In the BE model the effect on unemployment from an increase in government expenditure is much smaller than in the HMT model. The higher effect on unemployment in the HMT model results in the much higher wage and price responses in this model. The differences in modelling the supply side of the labour market in the BE and HMT models are discussed in Turner *et al.* (1989), where there were found no good empirical evidence to support the BE equations, which directly model unemployment (thereby only implicitly labour supply).

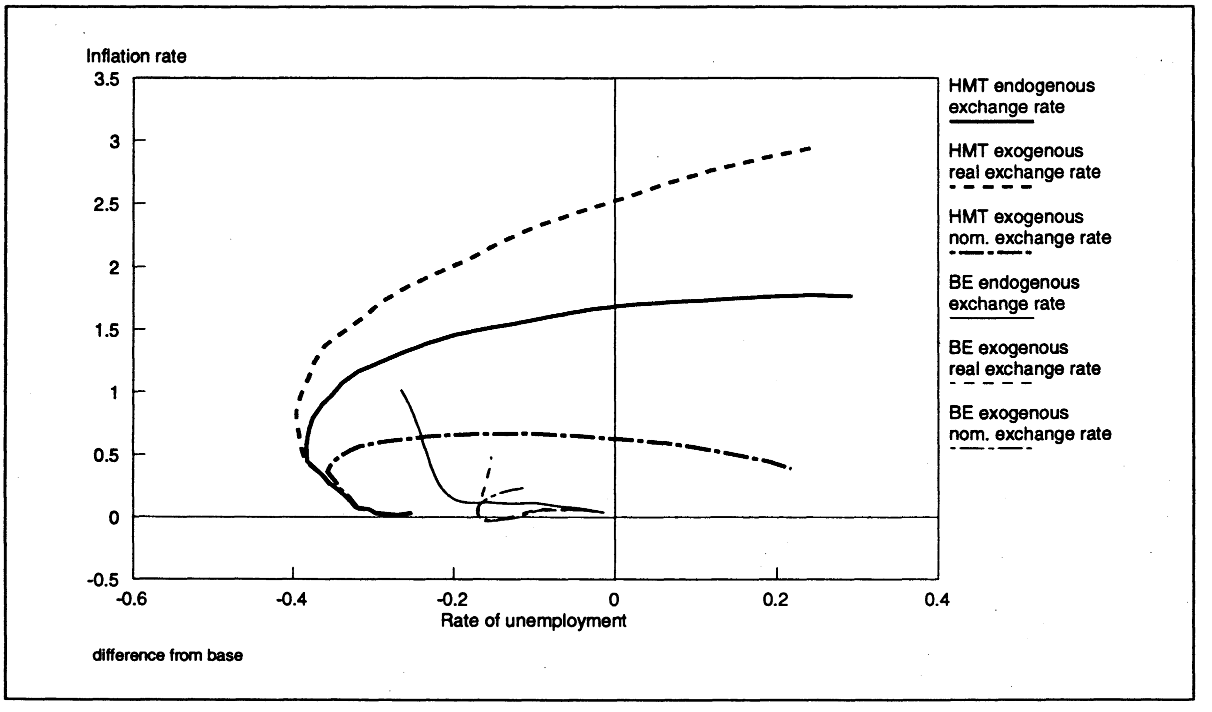
The difference in the results between the macro models are of such a magnitude as to be uncomfortable. To see more clearly how the difference in exchange rate equation affects the results between the macro models, some extra simulations were conducted: the same shifts with a fixed real exchange rate, which could be interpreted as a common exchange rate mechanism in the PPP spirit. The results are shown in Table 3.

**Table 3.** Increase in government expenditure by 2bn (1990 prices). Fixed real exchange rate

| | *Quarters after change* | HMT8 *PC* | HMT8 *ECM* | BE8 *PC* | BE8 *ECM* |
|---|---|---|---|---|---|
| Real wage | 4 | 0.01 | -0.02 | -0.04 | -0.04 |
| % difference | 8 | 0.12 | -0.04 | -0.07 | -0.10 |
| from base | 12 | 0.30 | -0.03 | -0.03 | -0.13 |
| | 16 | 0.51 | -0.03 | 0.02 | -0.15 |
| | 34 | 1.89 | 0.14 | 0.50 | -0.15 |
| Private | 4 | 0.06 | 0.06 | 0.07 | 0.07 |
| consumption | 8 | 0.33 | 0.21 | 0.05 | 0.04 |
| deflator | 12 | 0.88 | 0.43 | 0.02 | -0.05 |
| % difference | 16 | 1.79 | 0.70 | 0.03 | -0.17 |
| from base | 34 | 13.02 | 2.61 | 1.31 | -0.62 |
| Unemployment | 4 | -0.30 | -0.30 | -0.10 | -0.10 |
| rate | 8 | -0.35 | -0.35 | -0.14 | -0.14 |
| difference | 12 | -0.39 | -0.40 | -0.16 | -0.16 |
| from base | 16 | -0.40 | -0.43 | -0.17 | -0.17 |
| | 34 | 0.24 | -0.29 | -0.15 | -0.16 |

The main impression is that the differences between the macro models increases. From the Figure 2, we see that in the HMT/PC simulation inflation is exploding more than ever. When it comes to the BE model in the Phillips curve case, we see this strange feature that after a short while inflation is decreasing, then later on we get a steadily growing rate of inflation with only a negligible decrease in the effect on unemployment as a result. Compared with the corresponding HMT results, it looks as though the dynamics are slower in addition to the previously discussed fact that the impact on both inflation and unemployment is much smaller. There is reason to expect that the curve in the inflation-unemployment figure, if we increased the simulation period, would bend over like the HMT model (after a while the effect will be increased unemployment and thereafter a decrease in inflation). That the shift would converge to a stable solution cannot be ruled out, but does not seem likely.

**Figure 2.** Effects of a 2 billion (1990 prices) increase in government expenditure




In this simulation, there should by definition, be no changes in the UK market shares. The reason that we get the movement towards higher unemployment as a result of higher inflation has therefore to be found in domestic conditions. When competitiveness is not allowed to decrease as a response to increased domestic costs, it seems obvious that we should get slower responses in unemployment, as we see in the Figure for the HMT model. The reason behind the opposite reaction in the BE simulation, is still the perverse reaction from the standard exchange rate equation.

A third variant of this simulation is made by fixing the nominal exchange rate. This is the way that models are often run and should for that reason be relevant. Results are shown in Table 4 and Figure 2. Compared with the results from the simulations with the real exchange rate fixed, the main difference is the smaller long-term effects on nominal prices and wages, especially in the the simulations with the HMT model.

**Table 4.** Increase in government expenditure by 2bn (1990 prices). Fixed nominal exchange rate

| | *Quarters after change* | HMT8 *PC* | HMT8 *ECM* | BE8 *PC* | BE8 *ECM* |
|---|---|---|---|---|---|
| Real wage | 4 | 0.01 | -0.02 | -0.04 | -0.04 |
| % difference | 8 | 0.14 | -0.02 | -0.07 | -0.11 |
| from base | 12 | 0.35 | -0.02 | -0.03 | -0.13 |
| | 16 | 0.62 | 0.01 | 0.02 | -0.15 |
| | 34 | 1.46 | 0.09 | 0.50 | -0.14 |
| Private | 4 | 0.06 | 0.05 | 0.06 | 0.06 |
| consumption | 8 | 0.29 | 0.18 | 0.04 | 0.03 |
| deflator | 12 | 0.72 | 0.33 | 0.02 | -0.04 |
| % difference | 16 | 1.31 | 0.44 | 0.04 | -0.11 |
| from base | 34 | 4.10 | 0.63 | 0.80 | -0.14 |
| Unemployment | 4 | -0.30 | -0.30 | -0.10 | -0.10 |
| rate | 8 | -0.34 | -0.35 | -0.14 | -0.14 |
| difference | 12 | -0.35 | -0.38 | -0.16 | -0.16 |
| from base | 16 | -0.32 | -0.40 | -0.17 | -0.18 |
| | 34 | 0.22 | -0.35 | -0.11 | -0.19 |

From the chart, we see that with the Phillips curve in the HMT simulation, it is not that obvious any longer that inflation is exploding, and that there might now be a stable solution. For the BE model in the Phillips curve case, we see a strange feature in that inflation is decreasing after one year, but then increases later on which results in a decrease in the effect on unemployment. Compared with the corresponding HMT results it looks like the dynamics are slower as well, as there is a weaker impact on both inflation and unemployment. It does not seem likely any more that the shift would converge to a stable solution. The difference in the responses between the macro models are suddenly rather the magnitudes than "the shape of performance". Thus it seems that the inclusion of the standard exchange rate equations make the magnitudes more similar, but has the opposite effect when it comes to the stability properties and the way the models work.

There is a strange result in the BE/ECM simulations where the exchange rate (nominal or real) is fixed; consumer prices decrease after 10 periods. (We see the same kind of strange behaviour for the Phillips curve, when it comes to the small negative effect on inflation in the medium term.) This can be explained as follows. Increased government expenditure leads to a decrease in the overall productivity, as measured in this wage equation (and is therefore also the explanation for the strange negative effects on real wages we se in all the simulations with this model). This lowers wages more than the small decrease in unemployment manages to increase it. When the exchange rate equation operates, however, the direct effect on domestic prices from higher import prices (large fall in the exchange rate) offsets the partial negative effect from the decrease in productivity through wages. What is then left to be explained is why the effects on wages from the decrease in (overall) productivity is not offset by the direct effect it has on prices. The reason behind this is that the key productivity variable, when it comes to price determination, is production per employee in manufacturing. In these simulations manufacturing productivity moves in the opposite direction (increased labour productivity) from the overall productivity. Therefore changes in productivity partially force down both prices and wages! This is also part of the explanation of the general difference between models, as this effect is much smaller, but present, in the HMT model.

***Cut in income tax***

The effects of a tax cut are to some extent the same as those of the government expenditure shock. We see from Table 5 that in the first 3 or 4 years the difference in the effects on real wages is rather small, both between the two different wage equations, and between the two macro models. The real wage falls about 0.5 per cent, which is in line with the imposed tax wedge parameters. The explanation that the boost in employment does not lead to any higher real wage (than -0.5 per cent) is that it is offset by an increased competitiveness (the "not-100-per-cent" real wage resistance working backwards). After some time, there is no improvement in competitiveness and then the decreased unemployment increases the real wage in the Phillips curve. Because the lowering effect on unemployment has more or less stabilized, there is not the same push on the real wage in the ECM model.

Looking at the effect on unemployment, we see that the Phillips curve and the ECM models do not drift apart before after the first 4 years. This is closely connected with the result that the effects on both real wage and the price level do not differ very much in that period. As in the government expenditure shock, the differences between the macro models is much larger. After a while the difference, when it comes to the relative effects on unemployment between the models is even greater than in the government expenditure shock. One reason is that with this shock the exchange rate performance does not differ very much between the BE and

HMT simulations (except some in the end of the simulation period especially in the BE/PC simulation).

**Table 5.** Cut in income tax rate by 1 pence

| | | HMT8 | | BE8 | |
|---|---|---|---|---|---|
| | *Quarters after change* | *PC* | *ECM* | *PC* | *ECM* |
| Real wage | 4 | -0.45 | -0.48 | -0.41 | -0.42 |
| % difference | 8 | -0.43 | -0.47 | -0.43 | -0.46 |
| from base | 12 | -0.33 | -0.46 | -0.45 | -0.50 |
| | 16 | -0.13 | -0.44 | -0.47 | -0.57 |
| | 34 | 2.08 | -0.23 | 0.11 | -0.67 |
| Private | 4 | -0.32 | -0.34 | -0.28 | -0.29 |
| consumption | 8 | -0.67 | -0.74 | -0.63 | -0.66 |
| deflator | 12 | -0.81 | -0.97 | -0.92 | -1.00 |
| % difference | 16 | -0.63 | -1.05 | -1.09 | -1.26 |
| from base | 34 | 6.44 | -0.19 | 0.70 | -1.30 |
| Unemployment | 4 | -0.08 | -0.08 | -0.03 | -0.03 |
| rate | 8 | -0.25 | -0.25 | -0.08 | -0.08 |
| difference | 12 | -0.41 | -0.42 | -0.14 | -0.14 |
| from base | 16 | -0.50 | -0.52 | -0.19 | -0.19 |
| | 34 | -0.24 | -0.74 | -0.36 | -0.34 |

At the end of the simulation there is once more the rather different development in the effects on unemployment between the two wage models in the two macro models. Also here the unemployment in the BE/PC model falls more than with the BE/ECM, while the opposite is happening in the HMT simulations. The positive effect on private consumption from the increased real consumption wage is the basis for the increased output in all the models. The increased real wage we see in the end of the Phillips curve simulations pushes up private consumption and thereby partially increases production. The explanation behind the difference between the macro models is the "old" effects from the different exchange rate determinations. Where the effects on prices at the end of the simulation period are growing very fast with the Phillips curve in the BE model, this is offset by a sharp decline in the exchange rate. The initial gain in competitiveness is therefore kept in the BE with a Phillips curve, which is not the case in the HMT model.

Also here we have the exploding effect on consumer prices with the Phillips curve in the second half of the simulation period, especially in the HMT model. In the ECM simulations there is a marked difference between the macro models. The effect on the consumer price level in the BE model stabilizes at around -1.3 per cent. After the peak after four years at about -1.1 per cent, the effect is steadily decreasing in the HMT model. Some of the explanation is that productivity in manufacturing is falling towards the end of the period in the perturbed HMT simulation (which has a direct effect on domestic prices).

***Jump in world market prices***

In this simulation all variables concerning world market prices are increased by one per cent over the whole period. As we see from Table 6 the difference in effects between the two alternative wage equations must be judged to be minor, while the difference in outcome between the macro models is considerable. That the differences between the simulations with the two alternative wage models are small is what we should expect on the basis of the results from the small theoretical macro model. But the change in world market prices affects both real wage and unemployment in the HMT model at the end of the simulation period and this is not in line with those results.

The striking feature of the BE simulations is that the domestic price level in the first five (seven with the Phillips curve) years has decreased as a result of increased prices abroad. The main explanation behind this rather strange result is obviously, once more, the exchange rate equation. When the exchange rate works the way it does here, the effects in general are very small. This is very much in contrast to the multipliers found in the HMT simulations where especially large positive effects on prices are found, which increase over the whole simulation period. This effect is very much in contrast to the result from the theoretical part, where we had price homogeneity and where domestic prices did increase in line with prices abroad. The effect on domestic prices that they are continuously rising after the rather small initial jump in world market prices is a little bit worrying when it comes to the stability properties of this model. To be sure that this result is not the product of the stylized wage equation, the same simulation has been conducted with the standard HMT model. This simulation mainly showed the same result, at least when it comes to stability. But the swings are smaller, and the real wage is decreasing rather than increasing in the last half of the simulation period.

**Table 6.** Jump in world market prices by 1 per cent

| | | HMT8 | | | BE8 | |
|---|---|---|---|---|---|---|
| | *Quarters after change* | *PC* | *ECM* | *Std mod* | *PC* | *ECM* |
| Real wage | 4 | -0.10 | -0.09 | -0.08 | 0.09 | 0.07 |
| % difference | 8 | -0.02 | -0.02 | 0.01 | -0.09 | -0.08 |
| from base | 12 | 0.06 | 0.00 | 0.04 | -0.04 | 0.02 |
| | 16 | 0.16 | 0.02 | 0.03 | -0.03 | -0.01 |
| | 34 | 0.69 | 0.42 | -0.39 | -0.01 | 0.01 |
| Private | 4 | 0.25 | 0.27 | 0.23 | -0.22 | -0.23 |
| consumption | 8 | 0.67 | 0.78 | 0.64 | -0.36 | -0.37 |
| deflator | 12 | 1.22 | 1.23 | 1.19 | -0.28 | -0.29 |
| % difference | 16 | 1.93 | 1.83 | 1.74 | -0.19 | -0.17 |
| from base | 34 | 7.37 | 5.52 | 3.44 | 0.06 | 0.27 |
| Unemployment | 4 | -0.07 | -0.07 | -0.07 | 0.01 | 0.01 |
| rate | 8 | -0.14 | -0.14 | -0.14 | 0.03 | 0.03 |
| difference | 12 | -0.14 | -0.14 | -0.14 | -0.02 | -0.02 |
| from base | 16 | -0.11 | -0.12 | -0.11 | 0.00 | 0.00 |
| | 34 | 0.32 | 0.23 | 0.25 | -0.02 | -0.03 |

The big and unsettling price responses are an indication of a marked departure from price homogeneity. To check this in both models, and also to get rid of the effects caused by the exchange rate, the same kind of simulation were made with the exchange rate exogenous, by decreasing it by one per cent. This simulation of course shows completely different results for the BE model; the effect on domestic prices is positive and by the end of the simulation it is not far from 1.0 indicate the presence of price homogeneity in the price and wage model.

We still got the large price increase in the HMT simulation. Even if it is definitely much smaller, it is still far from 1.0 which reinforces the impression of departure from price homogeneity. This simulation was also carried out with the standard HMT model. The simulation shows a large cycle when it comes to the price response. It reaches a peak of about 1.7 after six years and show a sharp decline there after; after 34 quarters it is down to 1.1.

There is, however, no sign of stabilization. It is not possible to say from this simulation around what "price effect line" the cycle will fluctuate. Since the stylized ECM wage equation features both dynamic and static price homogeneity, the conclusion is that there seems to be a severe departure from price homogeneity in the HMT model. For more about price homogeneity in this and other models, see Church and Wallis (1992).

**Table 7.** Depreciation of nominal exchange rate - equivalent to a jump in world market prices of 1 per cent

| | | **HMT8** | | | **BE8** | |
|---|---|---|---|---|---|---|
| | *Quarters after change* | *PC* | *ECM* | *Std mod* | *PC* | *ECM* |
| Real wage | 4 | -0.07 | -0.07 | -0.08 | 0.00 | 0.02 |
| % difference | 8 | -0.02 | -0.01 | 0.02 | -0.01 | -0.01 |
| from base | 12 | 0.01 | -0.01 | 0.07 | -0.01 | -0.03 |
| | 16 | 0.08 | 0.00 | 0.09 | 0.02 | -0.03 |
| | 34 | 0.16 | 0.12 | -0.25 | 0.15 | -0.02 |
| Private | 4 | 0.13 | 0.13 | 0.23 | 0.20 | 0.21 |
| consumption | 8 | 0.37 | 0.38 | 0.61 | 0.48 | 0.49 |
| deflator | 12 | 0.65 | 0.65 | 1.05 | 0.67 | 0.68 |
| % difference | 16 | 0.97 | 0.90 | 1.39 | 0.79 | 0.78 |
| from base | 34 | 2.00 | 1.60 | 1.11 | 1.11 | 0.84 |
| Unemployment | 4 | -0.03 | -0.03 | -0.07 | -0.02 | -0.02 |
| rate | 8 | -0.07 | -0.06 | -0.13 | -0.03 | -0.04 |
| difference | 12 | -0.08 | -0.07 | -0.11 | -0.05 | -0.05 |
| from base | 16 | -0.06 | -0.06 | -0.06 | -0.05 | -0.05 |
| | 34 | 0.20 | -0.15 | 0.15 | 0.00 | -0.03 |

## 4. Conclusions

To a large extent the results show that the differences between the two macro models dominate the difference in the wage equation. The main sources of the difference in performance between the models seems to be the exchange rate equation and the unemployment mechanism and the lack of price homogeneity in the HMT model.

There is, however, some evidence of an unstable (or more unstable) result when connecting the HMT and BE macro models with a Phillips curve instead of an ECM-type wage model. It seems to be the interaction with the exchange rate mechanism which causes much of the instability. In the simulations with a fixed nominal exchange rate, the responses with the Phillips curve wage determination are much more stable than in the ordinary model mode.

In the choice of wage equation, econometric properties of the alternative equations should be the most important guide. On the other hand one should also look at this choice in relation to the the rest of the model to be sure that the overall properties are reasonable.

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## Appendix

Further details on the calculation of the solution of the small stylized macro models in Section 2.

### With an ECM-type wage determination

Let us first substitute for *w* and *p* in (5) and (9a) respectively

$$p = m + \frac{\gamma_1\alpha + \gamma}{1-\alpha_1\gamma_1}\left(y - y^0\right) \tag{5'}$$

and

$$w = m + \frac{\gamma\alpha_1 + \alpha}{1-\gamma_1\alpha_1}\left(y - y^0\right) \tag{9a'}$$

Using the definition of the real interest rate (4), the nominal interest rate determination (2) and substitute in for the expected depreciation, and put the whole thing in for real interest rate, gives us the following equation for the deviation in output from the initial equilibrium level:

$$\left(y - y^0\right) = \sigma_1 x - \sigma_2 r^* - \sigma\delta c^0 + (\sigma_2\delta + \sigma_3)(m - p) \tag{1'}$$

Setting in for p from (5') gives us:

$$\left(y - y^0\right) = \frac{1-\gamma_1\alpha_1}{1-\gamma_1\alpha_1 + (\sigma_2\delta + \sigma_3)(\alpha\gamma_1 + \gamma)}\left[\sigma_1 x - \left(\sigma_2 r^* + \sigma_2 c^0\right)\right] \tag{1''}$$

From (5') and (9a') we can get this expression for the real wage:

$$w - p = \frac{\alpha(1-\gamma_1) - \gamma(1-\alpha_1)}{1-\alpha_1\gamma_1}\left(y - y^0\right) \tag{10}$$

Putting in for $\left(y - y^0\right)$ from (1'') and we obtain this solution for the real wage

$$w - p = \theta\left[\sigma_1 x - \sigma_2\left(r^* + \theta c^0\right)\right] \tag{10'}$$

where

$$\theta = \frac{\alpha(1-\gamma_1)-\gamma(1-\alpha_1)}{1-\gamma_1\alpha_1+(\delta\sigma_2+\sigma_3)(\alpha\gamma_1+\gamma)}.$$

The numerator in (1") has to be positive, because both $\gamma_1$ and $\alpha_1$ are fractions and therefore positive and less than unity. The denominator in (1") and (10') is identical and has to be positive for the same reason as above. The sign of the numerator of θ in the expression of the real wage (10') is however not obvious. If we assume that the relative direct effects of changes in the import prices on the wages and on the GDP deflator equals $(\alpha_1 = \gamma_1)$, the sign would be determined of whether or not the direct effects of changes in labour market tightness is larger for nominal wages than for prices. If nominal wages is most affected $(\alpha > \gamma)$ the numerator (and thereby θ) would be positive. The numerator is bigger the larger the direct import price effect on prices, and the smaller the effect on wages is. If the direct effect of market tightness on prices is close to 0, the import price effects on wages might be much larger than on prices and the conclusion still holds. Market tightness affecting (direct) prices more than wages seems a plausible assumption. In that case θ will be positive.

By using (5'), (9a'), (8) and (1') we could get this expression for the real earnings defined as wages deflated by the RPI

$$w - rpi = \theta^{rpi}\left[\sigma_1 x - \left(\sigma_2 r^* + \sigma_2 \delta c^0\right)\right] \tag{11}$$

where

$$\theta^{rpi} = \frac{\alpha(1-a\gamma_1)-\gamma(a-\alpha_1)}{1-\gamma_1\alpha_1+(\sigma_2\delta+\sigma_3)(\alpha\gamma_1+\gamma)}$$

That $\theta^{rpi} > \theta$ is obvious because the only difference between the two expressions is that 1 is replaced by "*a*" in two places. Because 0<a<1 the magnitude of two negative elements in $\theta^{rpi}$ compared with θ are reduced.

The solution for the price level is obtained by substituting $(y - y^0)$ from (1") into (5')

$$p = m + \frac{\gamma_1\alpha+\gamma}{1-\gamma_1\alpha_1+(\sigma_2\delta+\sigma_3)(\alpha\gamma_1+\gamma)}\left[\sigma_1 x - \sigma_2\left(r^* + \delta c^0\right)\right] \tag{5''}$$

To see that the effect on prices from an exogenous shock is bigger with a Phillips curve than an ECM we start with rearranging (5")

$$p = m + \frac{1}{\left(\frac{1-\gamma_1\alpha_1}{\gamma_1\alpha+\gamma}\right)+(\sigma_2\delta+\sigma_3)}\left[\sigma_1 x - \sigma_2\left(r^* + \delta c^0\right)\right] \qquad (5''')$$

Comparison with the corresponding expression for the nominal price level in the Phillips curve case ($1^C$) reveals that the only difference between the two expressions is the existence of the first component in brackets in the denominator of (5'''):

$$\left(\frac{1-\gamma_1\alpha_1}{\gamma_1\alpha+\gamma}\right)$$

When this expression is positive the denominator in (5''') will be greater than the one in ($1^C$) which will imply that changes in the exogenous variables will affect the prices more with the PC than with the ECM wage determination. That this expression is positive is obvious as long as $\gamma_1$ and $\alpha_1$ both are between 0 and 1, and all parameters are positive.

That the magnitude of the effect from the exogenous shocks on real wages is bigger than with the Phillips curve than the ECM, is something we can see from comparing $\theta$ with the corresponding part of the expression for the real wage in the PC case in ($10^C$):

$$\frac{1-\gamma_1}{(\sigma_2\delta+\alpha_3)\gamma_1} > \frac{\alpha(1-\gamma_1)-\gamma(1-\alpha_1)}{1-\gamma_1\alpha_1+(\delta\sigma_2+\sigma_3)(\alpha\gamma_1+\gamma)} = \theta$$

$$\Downarrow$$

$$\frac{1-\gamma_1}{(\sigma_2\delta+\alpha_3)\gamma_1} > \frac{(1-\gamma_1)-\gamma\frac{(1-\alpha_1)}{\alpha}}{\frac{(1-\gamma_1\alpha_1)}{\alpha}+\frac{\gamma}{\alpha}(\delta\sigma_2+\sigma_3)+(\delta\sigma_2+\sigma_3)\gamma_1}$$

We see that this must be true, because the second term of the numerator on the right hand side is the only difference from the numerator on the other side, and this is negative, making the numerator smaller. In the same way, the two first elements in the denominator on the left-hand side, which are both positive, is the only difference here which also reduces the right-hand side. Both the effects partially make the left-hand side bigger than the right-hand side QED.

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