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ABSTRACT

What Caused the Early Millenium Slowdown? Evidence Based on Vector Autoregressions*

This Paper uses a simple VAR for the industrialized world (aggregate of 17 countries), the US and the euro area to analyse the underlying shocks of the recent slowdown, i.e. supply, demand, monetary policy and oil price shocks. The results of two identification strategies are compared. One is based on traditional zero restrictions and, as an alternative, an identification scheme based on more recent sign restrictions is proposed. The main conclusion is that the recent slowdown is caused by a combination of several shocks: a negative aggregate supply and aggregate spending shock, the increase of oil prices in 1999, and restrictive monetary policy in 2000. These shocks are more pronounced in the US than the euro area. The results are somewhat different depending on the identification strategy. It is illustrated that traditional zero restrictions can have an influence on the estimated impact of certain shocks.

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Contents

1 Introduction

Between the first quarter of 1994 and the second quarter of 2000 (1994Q1-2000Q2), industrialised world (aggregate of 17 countries) real GDP grew at an average annual rate of 3.1 percent. This was even 3.9 percent for the US. At the same time, annual inflation was historically very low: on average less than 2 percent. Activity weakened at the end of 2000 and industrialised countries experienced negative growth by the end of 2001. In this paper, we analyse the underlying sources of this slowdown and the preceding expansion by estimating a simple four-variables VAR for the industrialised world, the US and the Euro area for the sample period 1980Q1-2002Q2. Two different identification strategies are used. One is based on traditional zero contemporaneous and long-run restrictions and, as an alternative, we propose an identification scheme based on more recent sign restrictions. In contrast to a lot of previous recessions, the recent fluctuations do not have an obvious cause. We find that the recent slowdown was caused by a combination of several shocks: negative supply and demand shocks (the latter especially between 2001Q2 and 2001Q4), the increase of oil prices in 1999, and restrictive monetary policy in 2000. These shocks are more pronounced in the US than the Euro area. Some of these patterns also occurred during the recession of the early 1990s. We also show that the results are somewhat different depending on the identification strategy, especially with respect to the effects of oil price and monetary policy shocks in explaining the recent recession. The former shocks were much more important with traditional restrictions and the latter with sign restrictions.

Since the seminal work of Sims (1980), VARs are often used as a tool for analysing underlying disturbances in explaining recessions, as in Blanchard (1993) and Walsh (1993), each of whom analyse the 1990-1991 recession in the US. Blanchard (1993) estimates a VAR on the components of GDP and finds that the recession was associated with large negative consumption shocks. Walsh (1993) analyses aggregate supply, aggregate spending, money demand and money supply disturbances. His results suggest that the downturn was due to restrictive monetary policy and negative aggregate spending factors. In contrast to these papers, we analyse the recent slowdown.[1] Moreover, in contrast to the previous literature, this analysis is done at the industrialised world level, and a comparison is made

[1]Related papers are Labhard (2002), who applies the Blanchard (1993) methodology on the recent slowdown and Uhlig (2001), who analyses the behaviour of the FED in 2001.

between the US and the Euro area. The latter two constitute the most important part of the aggregate variables.

Within this VAR framework, we identify four types of underlying disturbances, i.e. an oil price, aggregate supply, aggregate demand (spending) and monetary policy shock. In order to identify these shocks, we use two alternative strategies. The first is based on conventional zero contemporaneous and long-run restrictions. We use an extended version of the Gali (1992) and Gerlach and Smets (1995) identification strategy. The model is closely related to the latter. The difference, however, is that we include an oil price shock and our estimates are based on industrialised world variables instead of individual country variables. Since we are using industrialised world aggregates, we do not have problems in modelling the exchange rate, a critique often mentioned regarding the Gerlach and Smets (1995) model for some of the more open countries.

The second identification strategy is based on more recent sign restrictions, pioneered by Faust (1998), Uhlig (1999) and Canova and De Nicoló (2002a, 2002b). The advantage of this agnostic identification procedure is that we do not have to impose zero constraints on the contemporaneous impact matrix or the long-run effects of the shocks. Short-run restrictions are typically not based on theoretical considerations, and long-run restrictions, as shown by Faust and Leeper (1997), can be highly misleading. In contrast, the agnostic approach only makes explicit use of restrictions that researchers often use implicitly. In their analysis, researchers experiment with the model specification until the results look reasonable. For example, according to conventional wisdom, a restrictive monetary policy shock is expected to have a negative impact on prices and a temporary effect on output. This a priori theorising is made more explicit with sign restrictions, and at the same time, no additional short and long-run conditions are necessary. In contrast to Faust (1998), Uhlig (1999) and Canova and De Nicoló (2002a), we not only identify monetary policy shocks, but a full set of shocks (oil price, supply, demand and monetary policy). The identification of additional shocks should also help to identify the monetary policy shock. Canova and De Nicoló (2002b) also identify supply, demand and monetary policy shocks in the G-7 countries, but their restrictions are based on the sign of the cross correlations of the impulse responses, while ours are only based on the sign of impulse response functions themselves. The latter is somewhat less stringent. Using these alternative restrictions, we show in this paper that traditional zero constraints can have an influence on the estimated impact of certain shocks. In particular, we find a higher contribution of monetary policy shocks in explaining the recent slowdown with sign restrictions, while oil price shocks were more important with conventional restrictions. Also for the early 1990's recession, differences with respect to the impact of supply, oil price and monetary policy shocks are found between our two alternative identification strategies.

The rest of the paper is structured as follows. In Section 2, we present the VAR model and the results of impulse response analysis for both identification strategies. Using the results obtained from the VAR, in Section 3 we present a decomposition of output, prices, oil prices and the interest rate in order to analyse the underlying disturbances of the recent slowdown. Apart from the industrialised world aggregates, we also provide a comparison between the US and Euro area and a comparison with the early 1990's recession. Finally, Section 4 concludes.

2 A simple four variables industrialised world-VAR

In this section, we present the model and the results of a simple four variables industrialised world-VAR. Section 2.1 discusses the basic model and the data used to estimate the VAR. The first identification strategy, based on traditional restrictions, is presented in Section 2.2. As an alternative, we discuss an identification strategy based on more recent sign restrictions in Section 2.3. These models are then used to analyse the underlying shocks of recent fluctuations in Section 3.

2.1 The model and data

Consider the following specification for a vector of endogenous variables Y_t:

$$Y_t = c + \sum_{i=1}^{n} A_i Y_{t-i} + B\varepsilon_t \tag{1}$$

where c is an $(n \times 2)$ matrix of constants and linear trends, A_i is an $(n \times n)$ matrix of autoregressive coefficients and ε_t is a vector of structural disturbances. The endogenous variables, Y_t, that we include in the VAR are the first difference of oil prices (Δoil_t), industrialised world output growth (Δy_t), consumer inflation (Δp_t) and the short-term nominal interest rate (s_t). These variables are assumed to be a covariance stationary vector process. For Δoil, Δy and Δp, we can reject the hypothesis of the existence of a unit root at the 10 percent level (using Augmented Dickey-Fuller and Phillips-Perron tests). We can, however, not reject the hypothesis of a unit root in s. Given the low power of these tests in relatively small data sets, we follow Gali (1992) and Gerlach and Smets (1995) and assume that s is stationary since the nominal rate can not have a unit root when both the real rate (for theoretical reasons) and inflation are stationary. Plots of these linearly detrended series indicate no evidence of non-stationarity. The data are obtained from NiGEM and are constructed as a weighted average of 17 individual countries: Belgium, Canada, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Japan, the Netherlands, Austria, Portugal, Sweden, Spain, UK and US.[2] The main series are presented in Figure 1. During the sample period, we detect three main downturns: in the early eighties, the early nineties and the recent slowdown. At the industrialised world level, we experienced two quarters of negative output growth in 2001Q2 and 2001Q3, which is an indication of a real recession. The inflation rate and the short-term nominal interest rate gradually decrease over the sample period. Using these four variables, the VAR is estimated for the sample period 1980Q1-2002Q2, with three lags.[3]

Within this framework, we identify four types of underlying disturbances, respectively an oil price, aggregate supply, aggregate demand (spending) and monetary policy shock: $\varepsilon_t' = \begin{bmatrix} \varepsilon_t^{oil} & \varepsilon_t^{s} & \varepsilon_t^{d} & \varepsilon_t^{m} \end{bmatrix}$. In order to identify these shocks, we use two different identification procedures. The first is based on traditional zero contemporaneous and long run restrictions, and is discussed in the next subsection. As an alternative, we present the results based on sign restrictions in Section 2.3.

2.2 Traditional identification strategy

For the traditional identification strategy, we use an extended version of the Gali (1992) and Gerlach and Smets (1995) strategy. Equation (1) can be rewritten as follows (disre-

[2]There might be an aggregation bias if structural parameters are substantially different across countries. We therefore also present results for US and Euro area separately in Section 3.2 to check the robustness of the results.

[3]Initially, we started with a larger sample period starting in the seventies. Several tests, however, indicate that there is a structural break for the interest rate equation around 1980. We do not have any stability problems in our final sample period. Lag length is determined by standard likelihood ratio tests and AIC information criterium.

garding for simplicity deterministic variables):

$$\begin{bmatrix} \Delta oil_t \\ \Delta y_t \\ \Delta p_t \\ s_t \end{bmatrix} = \left[I - \sum_{i=1}^{n} A_i \right]^{-1} \begin{bmatrix} b_{11} & b_{12} & b_{13} & b_{14} \\ b_{21} & b_{22} & b_{23} & b_{24} \\ b_{31} & b_{32} & b_{33} & b_{34} \\ b_{41} & b_{42} & b_{43} & b_{44} \end{bmatrix} \begin{bmatrix} \varepsilon_t^{oil} \\ \varepsilon_t^{s} \\ \varepsilon_t^{d} \\ \varepsilon_t^{m} \end{bmatrix} \tag{2}$$

We assume that there is a contemporaneous impact of an oil price shock on all the other variables in the system, but no immediate impact of the other shocks on oil prices. This corresponds to $b_{12} = b_{13} = b_{14} = 0$ in equation (2). The assumption of exogenous contemporaneous oil price movements is commonly used in the empirical VAR-literature,[4] but is very restrictive. In the next subsection, we analyse the robustness of this assumption by using sign restrictions.

Following Blanchard and Quah (1989), Gali (1992) and Gerlach and Smets (1995), we rely on a vertical long-run Philips curve to assume that demand and monetary policy shocks have no long-run impact on the level of real output. Supply shocks are thus associated with permanent shocks to output. One may argue that even demand disturbances can have a long-run impact on output but those long-run effects are typically assumed to be small compared to those of supply disturbances and are assumed not to affect the estimates. Using this approach, demand and monetary policy shocks with permanent effects are therefore labelled as supply shocks. Again, this long run neutrality is relaxed when we use sign constraints as an alternative. The long-run output neutrality gives us two additional restrictions:[5]

$$\begin{aligned} A(L)^{-1}_{21} b_{13} + A(L)^{-1}_{22} b_{23} + A(L)^{-1}_{23} b_{33} + A(L)^{-1}_{24} b_{43} &= 0 \\ A(L)^{-1}_{21} b_{14} + A(L)^{-1}_{22} b_{24} + A(L)^{-1}_{23} b_{34} + A(L)^{-1}_{24} b_{44} &= 0 \end{aligned}$$

with $A(L) = [I - \sum_{i=1}^{n} A_i]$.

In order to discriminate between aggregate demand and monetary policy shocks, we follow Bernanke and Blinder (1992) and use the restriction that monetary policy shocks have no contemporaneous effect on output, i.e. $b_{24} = 0$. The aggregate demand shocks are also often called aggregate spending or IS-shocks. Monetary policy shocks are shocks

[4] See, for example, Sims (1992) among others.

[5] For a discussion of potential problems with long-run restrictions, see Faust and Leeper (1997).

with a temporary effect on output, and are a combination of monetary policy, money demand and possibly exchange rate shocks, as long as these shocks have an influence on the short-term interest rate. However, monetary policy shocks should be the main underlying source, and these shocks should be interpreted as 'deviations from an average policy rule'. We should be very careful in interpreting the latter because there is no single monetary policy regime in the industrialised world. Accordingly, monetary policy shocks are somewhat artificial. The zero contemporaneous effects of a monetary policy shock on output is also relaxed in the next subsection.

These conditions are sufficient to fully identify the model, and the impulse response functions to an oil price, aggregate supply, aggregate demand and monetary policy shock are presented in Figure 2, together with 84th and 16th percentiles error bands based on 1000 Monte Carlo draws.[6] The results are as expected and consistent with theory. There is a permanent effect of an oil price shock (first row of Figure 2) on the level of output and prices. The pass-through of an oil price shock is much faster for prices than the pass-through for output, as the latter only starts falling after 4 quarters. The interest rate temporarily increases after a positive oil price shock to offset the inflationary pressures. In general, we find very similar output and price patterns after a supply shock (second row). This illustrates the fact that oil price shocks are also reflected in a shift of the aggregate supply curve, which is standard in the literature. The impact of both shocks on output and prices is, however, only complete after respectively 12 and 16 quarters for an oil price and a supply shock.

After a positive aggregate spending shock (third row), output immediately increases and gradually returns to baseline after 7 quarters. There is a permanent increase of the price level and a temporary increase of the nominal interest rate. An unexpected rise in the interest rate (monetary policy shock, row four) leads to a decrease in GDP, with a maximum impact after 5 quarters, and a gradual decrease in prices. This is consistent with the results of most of the empirical literature on the effects of monetary policy shocks.[7] The impact of an aggregate supply shock on oil prices is insignificant, while oil prices rise after a positive demand shock and fall after a restrictive monetary policy shock. This illustrates that oil prices do react to other shocks and might suggest that

[6] Error bands are calculated as suggested by Sims and Zha (1999).

[7] For example, Christiano et al. (1998) and Peersman and Smets (2001).

the contemporaneous zero constraints are to stringent. This is analysed in more detail in the next section. Generally, these results for the industrialised world aggregates are very similar to the existing evidence at the individual country level.

2.3 Identification based on sign restrictions

In this section, we discuss the robustness of the previous results if we use an alternative identification strategy. As already mentioned, some of the zero short-run restrictions are very stringent and not based on theoretical considerations. The assumption that the oil price is contemporaneously exogenous could be questionable, since it is a financial variable. On the other hand, ordering the oil price last, i.e. allowing for an immediate impact of the other shocks on the oil price, but assuming that there is no contemporaneous impact of oil price shocks on other variables, is even more stringent. This would imply that the general price level does not immediately react to a shift in oil prices, the latter being part of it. Similarly, assuming a zero contemporaneous impact of a monetary policy shock on output is inconsistent with a large class of general equilibrium monetary models (Canova and Pina, 1999).

Long-run restrictions are often better justified by theory. Nevertheless, some equilibrium growth models (for example many overlapping generations models) allow for permanent effects of aggregate demand and monetary policy shocks on output because they can affect the steady state level of capital (Gali, 1992). Furthermore, relying on long-run conditions can be highly misleading. Faust and Leeper (1997) show that substantial distortions are possible due to small sample biases and measurement errors when using these type of restrictions.

In order to check the robustness of our previous results, we use an alternative identification procedure that does not suffer from these problems. Faust (1998), Kieler and Saarenheimo (1998), Uhlig (1999) and, Canova and De Nicoló (2002a) use sign restrictions on the impulse response functions to identify a monetary policy shock. The advantage of their approach is that zero constraints on the contemporaneous impact matrix or the long-run effects of the shocks are not necessary. Instead, restrictions which are often used implicitly, consistent with the conventional view, are made more explicit. For example, a contractionary monetary policy shock leads to a fall in nonborrowed reserves, output and prices. In contrast to these papers, we do not only identify monetary policy shocks, but a full set of shocks. The identification of additional shocks should also help to identify the monetary policy shock.[8]

Since the shocks are mutually orthogonal, $E(\varepsilon_t \varepsilon_t^{'}) = I$, the variance-covariance matrix of equation (1) is equal to: $\Omega = BB'$. For any possible orthogonal decomposition B, we can find an infinite number of admissible decompositions of Ω, $\Omega = BQQ'B'$, where Q is any orthonormal matrix, i.e. $QQ' = I$. Possible candidates for B are the Choleski factor of Ω or the eigenvalue-eigenvector decomposition, $\Omega = PDP' = BB'$, where P is a matrix of eigenvectors, D is a diagonal matrix with eigenvalues on the main diagonal and $B = PD^{\frac{1}{2}}$. Following Canova and De Nicoló (2002a, 2002b), we start from the latter in our analysis. More specifically, $P = \prod_{m,n} Q_{m,n}(\theta)$ with $Q_{m,n}(\theta)$ being rotation matrices of the form:

$$Q_{m,n}(\theta) = \begin{bmatrix} 1 & \cdots & 0 & \cdots & 0 & \cdots & 0 \\ \cdots & \ddots & \cdots & \cdots & \cdots & \cdots & \cdots \\ 0 & \cdots & \cos(\theta) & ... & -\sin(\theta) & \cdots & 0 \\ \vdots & \vdots & \vdots & 1 & \vdots & \vdots & \vdots \\ 0 & \cdots & \sin(\theta) & \cdots & \cos(\theta) & \cdots & 0 \\ \cdots & \cdots & \cdots & \cdots & \cdots & \ddots & \cdots \\ 0 & \cdots & 0 & \cdots & 0 & \cdots & 1 \end{bmatrix} \quad (3)$$

Since we have four variables in our model, there are six bivariate rotations of different elements of the VAR: $\theta = \theta_1, \cdots, \theta_6$, and rows m and n are rotated by the angle θ_i in equation (3)[9]. All possible rotations can be produced by varying the six parameters θ_i

[8] If only monetary policy shocks are identified, impulse responses that match the restrictions of the monetary policy shock are accepted even if the responses to the other shocks are unreasonable. This is not possible if more shocks are identified because the responses to all shocks have to be consistent with the sign restrictions. The cost, of course, is that you have to impose more restrictions.

[9] We have, $P = \begin{bmatrix} \cos\theta_1 & -\sin\theta_1 & 0 & 0 \\ \sin\theta_1 & \cos\theta_1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & \cos\theta_2 & -\sin\theta_2 & 0 \\ 0 & \sin\theta_2 & \cos\theta_2 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} \cos\theta_3 & 0 & -\sin\theta_3 & 0 \\ 0 & 1 & 0 & 0 \\ \sin\theta_3 & 0 & \cos\theta_3 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$ $\begin{bmatrix} \cos\theta_4 & 0 & 0 & -\sin\theta_4 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ \sin\theta_4 & 0 & 0 & \cos\theta_4 \end{bmatrix} \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & \cos\theta_5 & 0 & -\sin\theta_5 \\ 0 & 0 & 1 & 0 \\ 0 & \sin\theta_5 & 0 & \cos\theta_5 \end{bmatrix} \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & \cos\theta_6 & -\sin\theta_6 \\ 0 & 0 & \sin\theta_6 & \cos\theta_6 \end{bmatrix}$ for six variables.

in the range $[0, \pi]$. In order to transform an infinite number of rotations into a large but finite number, we grid the interval $[0, \pi]$ into M points.[10] For the contemporaneous impact matrix determined by each point in the grid, B_j $(j = 1, \cdots, M^6)$, we generate the corresponding impulse responses:

$$R_{j,t+k} = A(L)^{-1} B_j \varepsilon_t \tag{4}$$

A sign restriction on the impulse response of variable p at lag k to a shock in q at time t is of the form:

$$R^{pq}_{j,t+k} \gtrless 0 \tag{5}$$

The sign conditions that we impose are based on a typical aggregate demand and aggregate supply diagram, which remains the core of many macroeconomic textbooks. We assume that after an unexpected rise of the interest rate (monetary policy shock), a, the response of output and prices is not positive, and there is not an immediate increase of the oil price.

$$\begin{aligned} R^{1a}_{j,t+k} &\leqslant 0,\ k = 0 \\ R^{2a}_{j,t+k} &\leqslant 0,\ k = 0, \cdots, 4 \\ R^{3a}_{j,t+k} &\leqslant 0,\ k = 0, \cdots, 4 \\ R^{4a}_{j,t+k} &\geqslant 0,\ k = 0 \end{aligned}$$

For output and prices, we choose a value of k, i.e. the time period over which the sign restriction is binding, being equal to four quarters. This is consistent with the restrictions of Uhlig (2001) and Faust (1998). Reducing this value has hardly any influence on the results. Nevertheless, we select this value in order to limit the number of plausible decompositions.[11] Also larger values of k do not alter the results significantly. For the response of oil prices and the interest rate, we only impose a contemporaneous constraint, since these are financial and fully flexible variables.

After a positive demand shock, b, we assume that the response of output and prices is not negative and there is not an immediate fall of the oil price and the interest rate. These effects are consistent with a shift of the aggregate spending or IS-curve. Consequently, the

[10] In our case, $M = 12$, which implies $12^6 = 2985984$ possible rotations.

[11] The results with fewer restrictions are available upon request.

difference with a monetary policy shock is the opposite sign of the interest rate response relative to output, prices and oil prices. The results are also very robust to changes in the number of restrictions. We choose, however, a similar number of restrictions as for the monetary policy shock.

$$\begin{aligned} R^{1b}_{j,t+k} &\geqslant 0,\ k=0 \\ R^{2b}_{j,t+k} &\geqslant 0,\ k=0,\cdots,4 \\ R^{3b}_{j,t+k} &\geqslant 0,\ k=0,\cdots,4 \\ R^{4b}_{j,t+k} &\geqslant 0,\ k=0 \end{aligned}$$

An oil price shock can be considered as a shift of the aggregate supply curve. Accordingly, an increase in the oil price, c, does not have a positive impact on output and not a negative impact on prices. As a result, the nominal interest rate does not decrease:

$$\begin{aligned} R^{1c}_{j,t+k} &\geqslant 0,\ k=0 \\ R^{2c}_{j,t+k} &\leqslant 0,\ k=0,\cdots,4 \\ R^{3c}_{j,t+k} &\geqslant 0,\ k=0,\cdots,4 \\ R^{4c}_{j,t+k} &\geqslant 0,\ k=0 \end{aligned}$$

Since the oil price shock can be considered as a supply shock, the signs of the responses of output, prices and the interest rate to a supply shock are the same. However, in contrast to an oil price shock, the sign of the response of oil prices after a supply shock is uncertain. Some supply shocks give rise to substitution effects in the production function. In that case, a positive supply shock, d, can have negative effects on the oil price. On the other hand, the nature of the supply shock can also be complementary with oil input in the production process, resulting in a positive response of oil prices. As a consequence, we do not impose a restriction on the response of oil prices. In order to disentangle the two shocks, we assume that the oil price shock is the shock with the largest contemporaneous impact on the oil price:

$$\begin{aligned} R^{2d}_{j,t+k} &\geqslant 0,\ k=0,\cdots,4 \\ R^{3d}_{j,t+k} &\leqslant 0,\ k=0,\cdots,4 \\ R^{4d}_{j,t+k} &\leqslant 0,\ k=0 \\ R^{1d}_{j,t+k} &< R^{1c}_{j,t+k},\ k=0 \end{aligned}$$

Out of 2985984 rotations, we select the possible decompositions that match all the imposed conditions on the sign of the impulse responses of the four different shocks. More specifically, the responses of the four identified shocks should be consistent with an oil price, supply, demand and monetary policy shock. The imposed restrictions allow us to uniquely disentangle the four shocks. Decompositions that match only the criteria of three or less shocks are rejected.

Computing error bands, based on Monte Carlo integration, for the estimates is somewhat problematic. If you want to use 1000 draws to calculate the error bands, 2985984*1000 decompositions have to be evaluated. It is beyond the capacity of current computers to produce these results within a reasonable period of time.[12] Therefore, we apply the following reduced procedure. For each Monte Carlo draw, we also draw one rotation out of all possible rotations, and check the imposed restrictions. Solutions that match all the restrictions are kept and the others are rejected. On average, 105 draws are needed to generate one solution that match all the conditions. For our results, we report the median response based on 1000 solutions, i.e. 105000 draws, together with 84th and 16th percentiles error bands.[13]

Impulse response functions in Figure 3 look very similar as the responses based on the traditional identification strategy, but there are some interesting differences. As expected, the oil price response to a supply shock is uncertain. On average, the sign of the response is the same as the sign of the output response (in contrast to the oil price shock), which indicates that supply shocks have complementary effects on oil input in the production process. The uncertainty is, however, very high. There are even a large number of negative responses. An interesting result is the response of oil prices to a demand and monetary policy shock. In contrast to the conventional identification strategy, we find a substantial impact of both shocks. The magnitude is around three times as high. The largest part of the effect is even instantaneously. This implies that the contemporaneous zero constraint for oil prices in the traditional approach is probably too stringent. Part of the demand and monetary policy shocks are then identified as oil price shocks.

On the other hand, we do not find permanent effects of a monetary policy and demand

[12] Calculating all 2985984 possible decompositions for 1 single draw, checking the sign restrictions and storing the results takes about four hours on a pentium III desktop.

[13] This can be done in less than 1 hour on a pentium III computer.

shock on the level of output, which was assumed in Section 2.2. The median responses are zero in the long-run, but error bands are very wide. In a previous version of the paper, we only showed the range of solutions of all possible rotations for the point estimates, i.e. no formal error bands. For all these solutions, however, we did find a permanent effect on output for both shocks. Adding a number of restrictions on the lagged interest rate responses to all shocks, i.e. imposing interest rate smoothing, results also in a small permanent, but insignificant effect on output for the median responses. The same is true for the US estimates reported in Section 3.2.

However, the immediate effect of a monetary policy shock on output is also substantial. More than 1/3 of the total impact is estimated to occur within one quarter. The maximum impact of a monetary policy shock is also larger than the impact based on traditional restrictions, even though the size of the interest rate shock is smaller.[14] In Appendix A, we discuss the quantitative differences between both approaches for respectively an exogenous oil price and monetary policy shock based on a simulation. It is illustrated that the differences between both approaches are substantial. The output response to a normalised shock, for example, is almost three times as large for both shocks with the sign restrictions procedure.

The correlations of the estimated shocks across both methodologies are reported in Table 1. These correlations are very high. The lowest correlation is 0.82 between both oil price shocks, and the highest correlation is 0.92 (supply shocks). The table also indicates that part of the oil price shocks in the traditional approach is now picked up by supply, demand and monetary policy shocks.

3 Decomposing output, prices, oil prices and the interest rate

Based on the estimates of the previous section, we can calculate the shocks and the cumulative effects of these shocks on output, prices, oil prices and the interest rate. This

[14] This is also reflected in the variance decompositions of output and prices (not reported in this paper). With traditional restrictions, monetary policy shocks explain respectively 10 and 8 percent of output growth and inflation fluctuations (at business cycle horizon). With sign restrictions, this is respectively 19 and 16 percent.

means that output, prices, oil prices and the interest rate can be written as the sum of a deterministic component, the contribution of current and past oil price shocks, current and past aggregate supply shocks, current and past aggregate demand shocks, and current and past monetary policy shocks. We start with discussing the recent fluctuations in Section 3.1. In Section 3.2, we make a comparison between the United States and Euro area to investigate whether the underlying disturbances were similar and check the robustness of the aggregate results. A comparison with the recession in the early 1990's is made in Section 3.3. The latter also allows us to assess whether the VAR succeeds in determining the generally accepted causes of past recessions and to compare the results with other empirical research. In our discussion of the results, we also focus on the differences between both identification procedures.

3.1 Interpreting the recent fluctuations

The time-series of the shocks are presented in Figure 4, and the contribution of these shocks to output, prices, oil prices and the interest rate are presented (as deviations from baseline, i.e. the deterministic component) in Figure 5 for the period 1995Q1-2002Q2. For reasons of legibility, we only show the median estimates.[15] In our discussion, distinction is made between the contribution to output (recent slowdown), prices and the interest rate.

3.1.1 The contribution to output

Starting in 1995, there is a continuous increase in the level of output due to positive supply shocks (typical characterised as the new economy). These positive effects stagnate around 2000Q2, after which there is a negative contribution of supply shocks to output until the end of 2002Q2. These results are very consistent across both identification strategies. The fall in output is only a bit more pronounced with the conventional approach. This is also shown in Table 2. This table contains the median contributions of the shocks to output *growth*. Bold figures are significant, i.e. upper and lower error bands have the same sign. Actual figures are the sum of a baseline (deterministic) component and the contribution of all shocks.[16] Growth was on average more than 0.3 percent higher as a result of positive

[15] Figures with confidence bands are available upon request, but the conclusions are not altered. Significance is also reported in Tables 2-4.

[16] Because we report the median estimates, the sums reported in the tables are not exact.

non-oil supply shocks between 1995 and 2000 for both methodologies (columns 6 and 7 of Table 2) and output fell by respectively 0.40 and 0.32 percent between 2001Q1 and 2002Q2 for the traditional and sign restrictions approach.

Also the results for the contribution of demand shocks are very similar for both approaches. The contribution to output growth was positive in 1998 and 1999, but turned negative in 2000 and 2001. Until the beginning of 2001, however, the decline was mostly due to the closing down of a positive output gap, because at the same time, there were still a number of positive demand shocks (illustrated in Figure 5). These positive shocks were, however, not sufficient to offset the return to potential output (the return to potential output is visually illustrated by the impulse response functions to a demand shock in Figures 2 and 3). For the last three quarters of 2001, demand shocks made a substantial contribution to the slowdown of around 1 percent (Table 2), resulting in an accumulated contribution below baseline output. In 2002, the contribution to output growth is again positive.

The negative supply and demand shocks are accompanied by a negative impact of oil price shocks. The result is, however, highly influenced by the methodology used. For both methods, we find that declines in oil prices during the period 1997-1998 had positive effects on output afterwards (though larger with traditional restrictions). The figures are, on the other hand, different for the increases of oil prices in 1999 and the first quarter of 2000. With conventional methods, this had a negative and highly significant impact on industrialised world output growth of 0.44 percent in 2001 (column 4 of Table 2). This is the result of the slow pass-through of oil price shocks mentioned in Section 2.2. This finding is not consistent with the results obtained using alternative restrictions: the impact of oil price shocks is estimated to be insignificant.

The opposite is true for the impact of monetary policy shocks. Both methods find a significant positive contribution of monetary policy shocks to output growth in 2000 as a result of easy monetary policy in 1999. The magnitude is much larger with sign restrictions: 0.72 percent compared to 0.24 percent with traditional constraints. On the other hand, restrictive monetary policy had a small, but insignificant, negative effect on output growth in 2001 using conventional restrictions (0.09 percent),[17] but restrictive

[17] This total insignificant negative effect is the combination of a significant negative effect in the first two quarters and a significant positve effect in the last two quarters in 2001.

monetary policy played an important and significant role using sign conditions: output is estimated to have fallen by 0.38 percent in 2001.

In sum, we find a very important role for aggregate demand and aggregate supply shocks in explaining the recent slowdown across both identification methods. With traditional restrictions, we also find a considerable impact of oil price shocks, while restrictive monetary policy played a major role with sign restrictions. These results indicate that a lot of the effects of oil price shocks from the traditional approach are picked up by monetary policy shocks using sign conditions in explaining the recent slowdown, and illustrate that restricting the contemporaneous response of oil prices and output to a monetary policy shock to be zero can have a substantial influence on the results and the conclusions.

3.1.2 The contribution to prices and oil prices

Between 1996 and 2000, also often called the new economy period, the inflation rate was on average around 0.3 percent lower due to the positive supply shocks. This favourable contribution, however, stagnated in 2001 and became unfavourable in 2002. This is illustrated in Table 3. This table contains the decompositions of inflation rates. Columns 6 and 7 show the contribution of supply shocks. In addition to the supply shocks, favourable oil price shocks in 1997 and 1998 also significantly reduced the inflation rate in 1998 and 1999 for both methodologies. Conversely, and consistent with the results for output, unfavourable oil price shocks made a considerable upward contribution to the inflation rate in 2000 and the beginning of 2001 with conventional restrictions, but there was hardly any contribution using sign restrictions. Following subsequent positive demand shocks between 1998 and 2001, inflation was on average more than 0.2 percent higher in 1999 and 2000. The large negative demand shocks in 2001 had, on the other hand, significant deflationary effects between 2001Q3 and 2002Q1. Finally, we find an upward pressure of monetary policy shocks on inflation in 2000 and 2001 as a result of a slow pass-trough of easy monetary policy in 1999.

The contribution of the shocks to the oil price level is a nice illustration of different results obtained from both identification procedures (third row in Figure 5). The total rise of oil prices relative to baseline of about 80 percent in 1999 and 2000 is completely due to oil price shocks with the traditional approach. With sign conditions, this is 40 percent less, which is the cause of a more modest impact of oil shocks in explaining the recent slowdown found in Section 3.1.1. In contrast, demand and monetary policy shocks had also a substantial impact on the rise of oil prices in 1999 and 2000. Respectively 16 and 28 percent is explained by the latter two shocks with our alternative approach.

To summarise, recent oil price movements are largely explained as an endogenous reaction to demand and monetary policy shocks with sign restrictions, but as exogenous oil price shocks when using traditional restrictions. As we will discuss in Section 3.3, these contradicting results for oil price shocks between both approaches are not found for the early 1990's recession.

3.1.3 The contribution to the interest rate

The level of the interest rate can be decomposed into three main components: a baseline part, the endogenous reaction to other shocks (supply, demand and oil price shocks), and the contribution of exogenous monetary policy disturbances. The contribution of the shocks to the interest rate are presented in Table 4 and in the last row of Figure 5. The relative small response of the interest rate to supply shocks, found in Section 2, results in a modest reduction of the interest rate due to these shocks in the period under investigation for both identification procedures. The reaction of monetary authorities to oil price shocks is different between our two alternative methods. We never find a significant influence between 1995 and 2002 with sign restrictions. However, using traditional restrictions, interest rates were significantly lower in 1998 and 1999, but higher in 2000 and 2001 as a consequence of oil price shocks (Table 4, column 4). Following a number of aggregate spending shocks, central banks had to set the interest rate significantly higher between 1999 and the beginning of 2001 than it would have been without these shocks, with a maximum of respectively 69 and 96 basis points above baseline for conventional and sign restrictions in 2000Q2. On the other hand, interest rates fell with respectively 1.35 and 1.98 percent between 2000Q2 and 2001Q4 due to negative demand shocks.

As already mentioned, the VAR captures shocks, which can be defined as deviations of monetary policy from an average policy rule over time and across countries. More specifically, the contribution of monetary policy shocks to the level of the interest rate can be considered as the worldwide stance of monetary policy. Differences are found between our two identification strategies. With the conventional approach, monetary policy was stimulating in 1996 and 1997, restrictive in 1998 and relatively neutral afterwards (with the exception of some individual quarters, for example in 2000Q3 and 2000Q4). With sign constraints, the stance was relatively easy in 1996 and 1999, but significantly restrictive in 2000 and 2001. By the end of 2000, interest rates were even 75 basis points above neutral. This too restrictive stance of monetary policy also contributed to the recent recession, as discussed in Section 3.1.1. For the first two quarters of 2002, we find again a relatively easy stance of monetary policy in the industrialised world for both methods.

3.2 Comparison between the United States and the Euro area

An extension of the previous analysis involves making a comparison between the United States and the Euro area. This can be done by estimating the VAR-model separately for both areas. Both areas can be considered as large, relatively closed economies. A discussion of the estimation results is reported in Appendix B. Impulse response functions are very similar to the industrialised world-VAR, which illustrates that an aggregation bias is probably not important. Time series of the shocks are plotted in Figure 6, and the contributions of oil price, supply, demand and monetary policy shocks to output, prices and the interest rate for respectively the traditional approach and sign restrictions procedure are presented in Figures 7a and 7b. The left panels show the results for the US, and the right panels the results for the Euro area. The second and third blocks of Tables 2 to 4 contain the contributions to the growth rate of output, inflation and the interest rate level.

A first feature is that the contribution and volatility of the shocks was much higher in the US over the past seven years, which is, however, not the case for the whole sample period.[18] With respect to oil price shocks, the results are very similar for both areas and consistent with the aggregate results. We find a negative effect on output with the traditional approach and almost no effect with sign conditions (even positive effects for the US in 2002). Whilst the effects of oil price shocks had the same sign and magnitude in both areas, this is not the case for the other shocks. These other underlying disturbances are discussed in the next subsections.

[18] See, for example, the discussion of the early 1990's recession in Section 3.3.

3.2.1 Impact of supply shocks

With conventional restrictions, supply shocks made an accumulated positive contribution to output of 4.4 percent over the period 1996-2000 for the US, while this was hardly 1.4 percent for the Euro area for the same period. The 'new economy' idea was clearly more a US phenomenon. Moreover, negative supply shocks led to a fall in output of 0.7 percent in 2001 in the US but only 0.1 percent in EMU. This difference between both areas also emerges with sign restrictions. Using the latter method, however, the positive contribution of supply shocks to output was less for the US (2.8 percent accumulated).

3.2.2 Impact of demand shocks

The pattern of demand shocks was different across both areas, which is also reflected in the contribution to output and prices in Figures 7a and 7b. In the US, the contribution of demand shocks to output between 1996 and 2001 is always above baseline with traditional restrictions and most of the time with sign constraints. From the beginning of 2000 onwards, demand shocks became mainly negative and the contribution to output turned below baseline in 2001. Accordingly, output growth was respectively 1.07 and 1.26 percent lower in 2001 for both approaches. The demand shocks also had a positive influence on inflation until the end of 2001, after which there was a negative contribution. In order to stabilize the effects of demand shocks, the Fed had to set the interest rate significantly above or below baseline, with peaks of +2.14 and +2.42 percent in 2000Q2 and troughs of -0.61 percent in 2002Q2 and -1.74 percent in 2001Q4 for respectively conventional and sign restrictions.

For the Euro area, there were a number of negative demand shocks between 1995 and 1997 with corresponding effects on output growth and inflation, after which there was a positive trend, though very small in magnitude, until the end of 2000. In 2001, output fell respectively 0.10 and 0.33 percent due to negative demand shocks for our two methods. The impact on interest rate fluctuations was also more moderate.

3.2.3 Impact of monetary policy shocks

Monetary policy in the US was rather stimulating until the beginning of 2000. The contribution of monetary policy shocks to the level of the interest rate was most of the time negative (columns 10 and 11 in Table 4 and third row in Figures 7a and 7b). This reinforced the ongoing boom in the US. Consistent with the industrialised world estimates, this effect is more pronounced with sign restrictions. According to the latter, output growth is estimated to have been 1.11 percent higher in 2000 as a result of weak monetary policy. Conversely, monetary policy became very restrictive by the end of 2000. In 2000Q4, the interest rate was respectively 54 and 114 basis points above an average policy rule for our two alternative identification procedures. With conventional constraints, the contribution of tight monetary policy to the recession in 2001 was modest at the annual level, and only significant for the first two quarters of the year. Using sign restrictions, however, annual growth was 0.53 percent lower and significant. Assessing the stance of monetary policy in 2001, we find conflicting results between our two approaches. Monetary policy is estimated to have been expansionary with traditional restrictions and restrictive with sign conditions. On the other hand, both methods find again a relatively weak stance of monetary policy in the first two quarters of 2002. These findings about the stance of monetary policy in the US are somewhat in contrast with the results of Uhlig (2001). He finds that the Fed monetary policy stance was relatively neutral in 2000 and 2001.

In the Euro area, policy became stimulating in 1999, after the introduction of the Euro. European Central Bank interest rates were always below an average policy rule until the middle of 2000. The impact on output growth was significantly positive in 2000. From the middle of 2000 onwards, in contrast to the US, monetary policy was always relatively neutral in the Euro area. We find, however, a significant negative effect on output growth in 2001Q3 and Q4 using sign restrictions. This is mainly the result of reversed effects of past stimulating shocks following long-run neutrality of monetary policy on the level of output.

To summarise, consistent with the aggregate results, we find a very moderate contribution of monetary policy shocks to the early millennium slowdown with conventional restrictions for both areas. We do find, on the other hand, a significant impact when using our alternative procedure.

3.3 Comparison with the early 1990's recession

Another extension of the analysis is comparing the recent slowdown with the recession of the early 1990's. This gives us extra information about the timing of the shocks. Moreover, we can also evaluate whether the VAR succeeds in determining the generally accepted causes of the previous recession and compare the results with previous work. The contributions of the shocks to output, for the period 1984-1994, are presented in Figure 8 for respectively the US and Euro area.

3.3.1 Euro area

For the early 1990's recession, we find a very consistent pattern across both methodologies. Looking at the onset of the recession, we notice a sequence of several shocks. In the Euro area, these were negative supply (after a long period of positive supply shocks), oil price (Gulf war) and monetary policy shocks (at the time of the ERM-crisis), in combination with a return to baseline after positive demand shocks following the German unification boom, accompanied by negative demand shock towards the end of the recession (the contribution of demand shocks to the level of output became only negative at the end of 1992). The sequence of the shocks is comparable with the current situation in the US (see Section 3.2). Both the timing and magnitude of the effects are analogous across both methodologies. The only difference is that, in the case of sign restrictions, we find a larger impact of monetary policy shocks at the time of the ERM-crisis and a smaller impact of supply and demand shocks. This is also an illustration of a possible underestimation of the impact of monetary policy shocks when the immediate and long-run impact is restricted to zero.

3.3.2 United States

The recession started much earlier in the US, with negative supply shocks, followed by a number of negative demand shocks and oil price effects. The recovery started with a number of positive monetary policy shocks, comparable with the recent willingness to cut interest rates by the Fed, after which an increase caused by demand shocks followed.

Also for the US, we find consistency in the patterns of shocks across both methodologies. There is, however, a difference in magnitude. On the one hand, effects of monetary policy shocks are now comparable across both methods. The same is true for demand shocks. On the other hand, the influence of supply shocks is much higher with the traditional approach, and oil price shocks play a more important role with sign restrictions. This finding is surprising, given the opposite results for oil price shocks in explaining the early millennium slowdown. Zero contemporaneous constraints on the oil price reaction does not necessarily imply an overestimation of the impact. The opposite is also possible. These findings for the US are generally consistent with the results of Walsh (1993) and Blanchard (1993).

4 Conclusions

In this paper, we have analysed the underlying sources of the early millennium slowdown using a simple four variables VAR for the industrialised world, US and Euro area. Within this VAR, we identify four shocks, i.e. supply, demand, monetary policy and oil price shocks, based upon two different identification strategies. One is based on traditional zero contemporaneous and long-run constraints, and we propose an alternative based on more recent sign restrictions. We find that the recent slowdown is caused by a combination of several shocks. Across both methodologies, we find an important role for negative aggregate spending shocks. In addition, there were negative aggregate supply shocks, negative effects of restrictive monetary policy in 2000 and a negative impact of oil price increases in 1999. The magnitude of the latter two is different between both approaches. We find an important role for oil price shocks with conventional restrictions and for monetary policy shocks using sign conditions.

Our results also indicate that we should be careful in interpreting results based upon zero restrictions. Even if the impulse responses look very similar, historical decompositions (or variance decompositions) could be different. Imposing zero contemporaneous constraints can have a significant influence on the identified shocks. In this paper, for example, we find an important role for oil price shocks in explaining the recent slowdown and the early 1990's recession with the traditional approach. If we use sign restrictions to identify the shocks, we find a stronger impact of oil shocks in the early 1990's, but only a very small recent impact. With this alternative approach, recent oil price fluctuations (increases in 1999 and fall in 2001) are mainly explained as a response to positive and negative demand and monetary policy shocks. In addition, we find also evidence that restricting the immediate impact of monetary policy shocks to be zero can underestimate the impact. An example is a more important role for monetary policy disturbances in the Euro area during the ERM-crisis and the significant impact on the early millennium slowdown when a contemporaneous impact is allowed.

A Appendix: Comparison between both approaches: A simulation of the effects of oil price and monetary policy shocks

In this appendix, we evaluate the quantitative importance of the differences between the impulse response functions of the two alternative identification strategies. As discussed in Section 2, these impulse responses look relatively similar. Figures 2 and 3 show the responses to one standard deviation shocks. The size of the estimated shocks are, however, not the same in both cases, which makes a comparison very difficult. Therefore, we report in this appendix the results of a normalised simulation. In particular, we compare the results of an exogenous oil price increase of 10 percent and an exogenous shift of the interest rate of 50 basis points. Both simulations are very relevant. Exogenous oil price movements occur very frequently.[19] Examples are shifts of quota agreed between OPEC countries, other exogenous movements in the supply of oil, or fluctuations as a result of shifts in the risk of a war. The latter happened, for example, following the Gulf war or terrorist attacks. An important issue is then the impact of these shocks on the economy, in particular on output growth and inflation. A typical oil price shock is estimated to be 14.6% and 10.2% for respectively the conventional and sign restrictions methodology. We report the results of a 10% rise in oil prices. The second simulation, an exogenous increase of the interest rate of 50 basis points, is very relevant for the debate on the monetary transmission mechanism. There is still a lot of uncertainty about the exact impact of a shift in the stance of monetary policy on the real economy. We do not

[19] In fact, oil price shocks explain respectively 85% and 54% of total oil price variance with traditional and sign restrictions.

report the results of the comparison of aggregate supply and demand shocks because of normalisation problems.[20]

The results are shown in figure A1. The left column contains the impulse responses to a 10 percent increase of oil prices, and the right column the responses to a rise in the interest rate of 50 basis points. The black lines are the responses based on sign restriction, together with 84th and 16th percentiles error bands (dotted black lines). The grey line is the estimated response based on traditional restrictions. Since the zero restrictions also match the sign restrictions in most cases, we can consider the traditional solution as one of the solutions of the sign restrictions approach.[21] The response of oil prices, prices and the interest rate to a 10 percent increase of the oil price is very similar across both methods. The result of the traditional approach always lies within the confidence bands of the sign conditions. The main difference, however, is the response of output. The effect on output is estimated to be much smaller with conventional restrictions, and lies outside the error bands. This implies that the solution obtained with conventional restrictions lies in the tails (below 16th percentile) of all possible solutions. The difference is also economically very important. A 10 percent rise in the oil price has, on average, a long-run negative effect on output of 0.22 percent with traditional restrictions. The median response based on sign restrictions predicts an impact of 0.48 percent, which is more than double.

The results of an exogenous interest rate rise of 50 basis points by monetary authorities are clearly different across both methods. Most responses based on conventional restrictions lie outside the error bands of the distribution of sign constraints. The response of oil prices is much smaller: 2.7 percent in the long-run, compared to a median response of 21.0 percent with sign restrictions. More important in the context of the monetary transmission mechanism, also the effect on output and prices is much smaller with traditional restrictions. The maximum impact on output is -0.27 percent with traditional restrictions, while the impact lies between -0.39 and -1.04 percent with sign restrictions (median impact of -0.67 percent), economically an important difference. The median long-run impact on prices lies just inside the error bands (though not in the short-run). The difference with

[20] It is not clear whether we should normalise on the contemporaneous or the long-run impact of the shocks.

[21] The only exception is the response of output to an oil price shock. Using traditional restrictions, the contemporaneous effect is slightly above zero. As a consequence, this solution would be rejected with sign restrictions. The effect is, however, extremely small and does not affect the main message of the results.

the median estimate based on sign conditions is, however, very high. The latter is more than double: -0.81 percent compared to -0.32 percent using conventional restrictions.

In sum, this appendix shows that the differences between both approaches for the impact of an exogenous oil price and monetary policy shock are substantial and economically very relevant.

B Appendix: VAR for US and Euro area

In this appendix, we present the estimation results for the US and Euro area. Both areas can be considered as large, relatively closed economies. Consequently, we can use the same variables and identification strategy as the industrialised world model of Section 2. Impulse response functions are comparable between both areas and very similar to the industrialised world-VAR. For the traditional approach, this is illustrated in Figures A2 and A3. We find a stronger impact of an oil price shock on output in the US, while the effects on the price level are very similar. The immediate impact of a typical supply shock on output is also larger in the US, but the magnitude of the long-run impact is very comparable. The long-run impact on the price level is, however, somewhat larger in the Euro area. The size of a monetary policy shock is more than double in the US: 70 basis points increase of the short term interest rate relative to a 30 basis points increase in the Euro area. The monetary policy reaction function to this monetary policy shock is, on the other hand, much smoother in the Euro area. This results in a similar impact on the price level, but a stronger impact on output in the US.

Figures A4 and A5 contain the results when we use sign restrictions to identify the shocks. Again, we use the same restrictions as for the aggregate estimates. Impulse responses are also very analogous in both areas and the differences between the two alternative identification strategies are consistent with the results at the industrialised world level. Notable are the permanent output effects of the median responses to an aggregate demand and monetary policy shock in the US. Uncertainty is, however, very high and the error bands very wide. In addition, although the smaller effect of a monetary policy shock on the interest rate with the sign restrictions approach, the impact on output is much larger in both areas.

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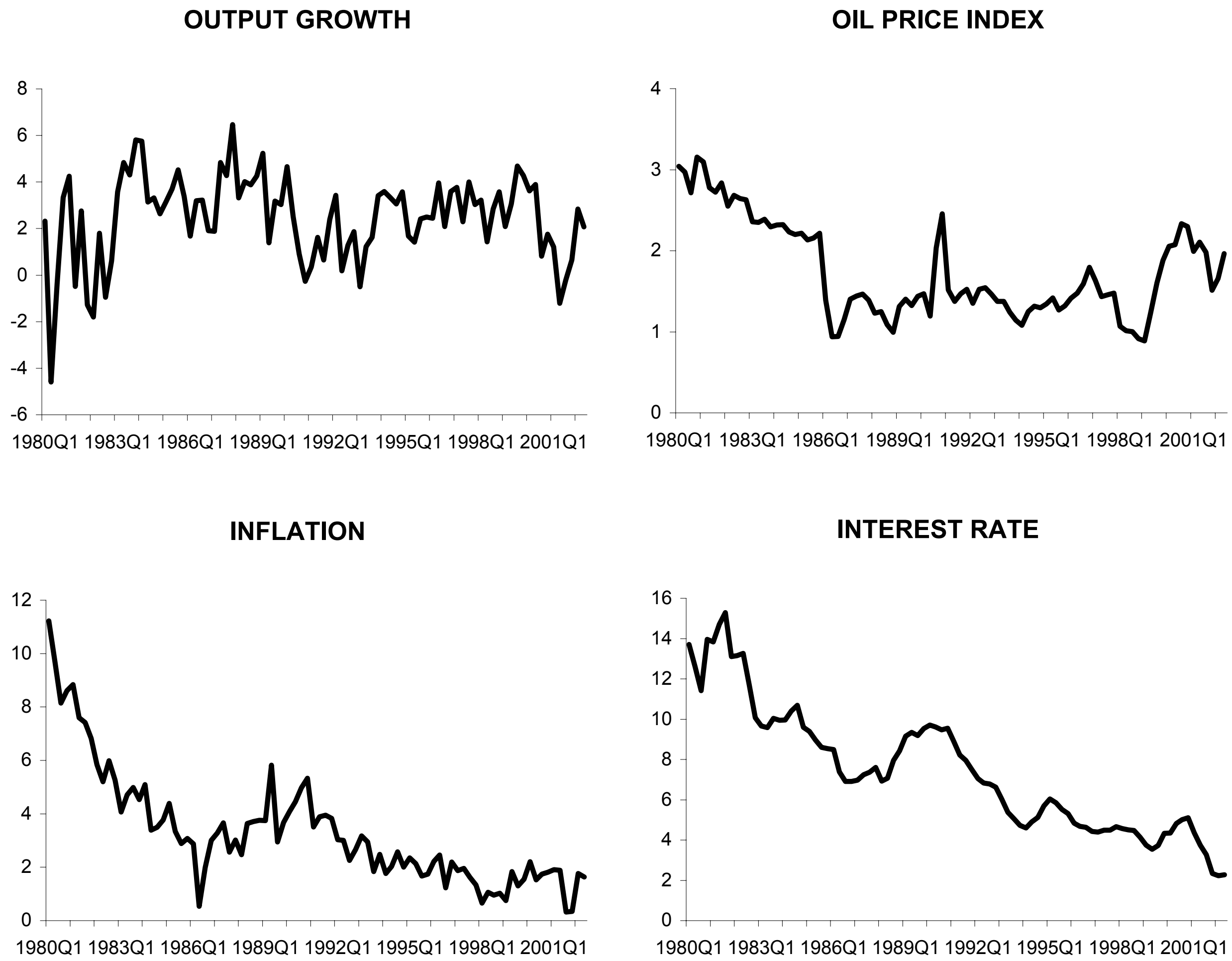
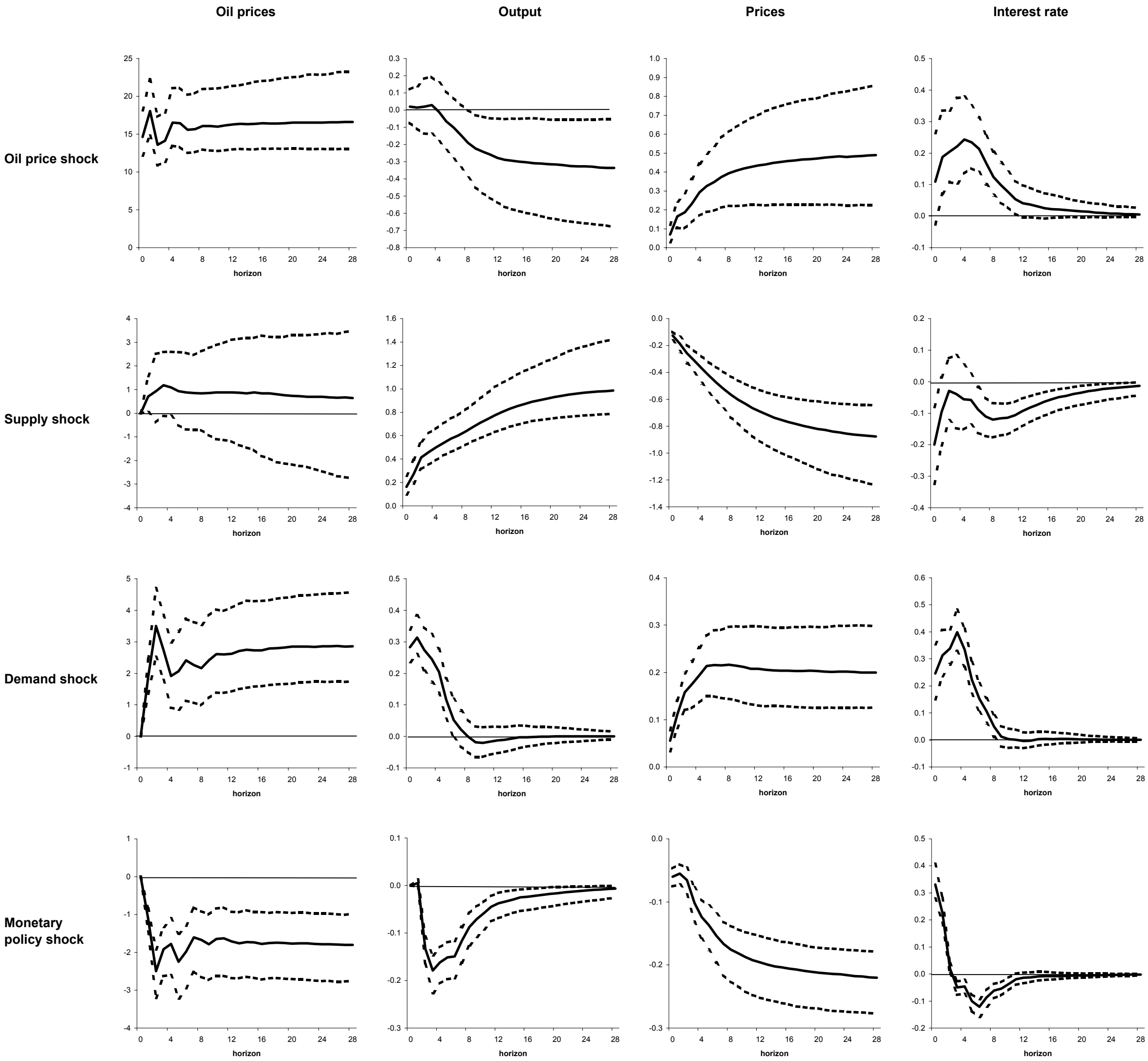
Figure 1: Industrialised world variables



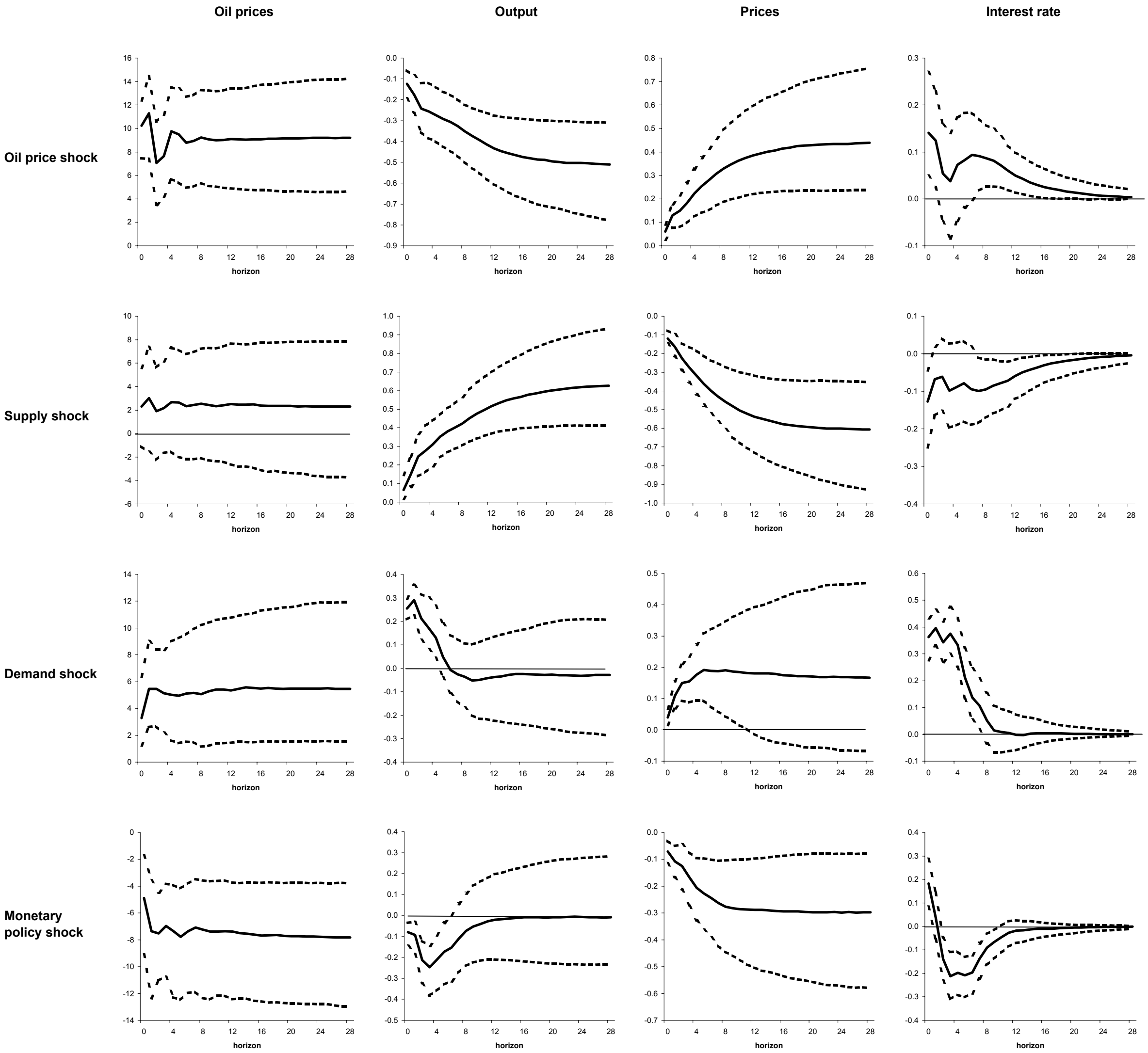
Note: Observations are weighted averages of 17 individual countries, output growth and inflation are annualised quarter on quarter rates and the interest rate is a weighted average of the 3-month interest rate

Figure 2: Industrialised world VAR - Impulse responses based on traditional identification



Note: median impulse responses with 84th and 16th percentiles error bands based on Monte Carlo integration, horizon is quarterly.

Figure 3: Industrialised world VAR - Impulse responses based on sign restrictions



Note: median impulse responses with 84th and 16th percentiles error bands based on Monte Carlo integration, horizon is quarterly.

Figure 4: Industrialised world shocks: 1995Q1-2002Q2

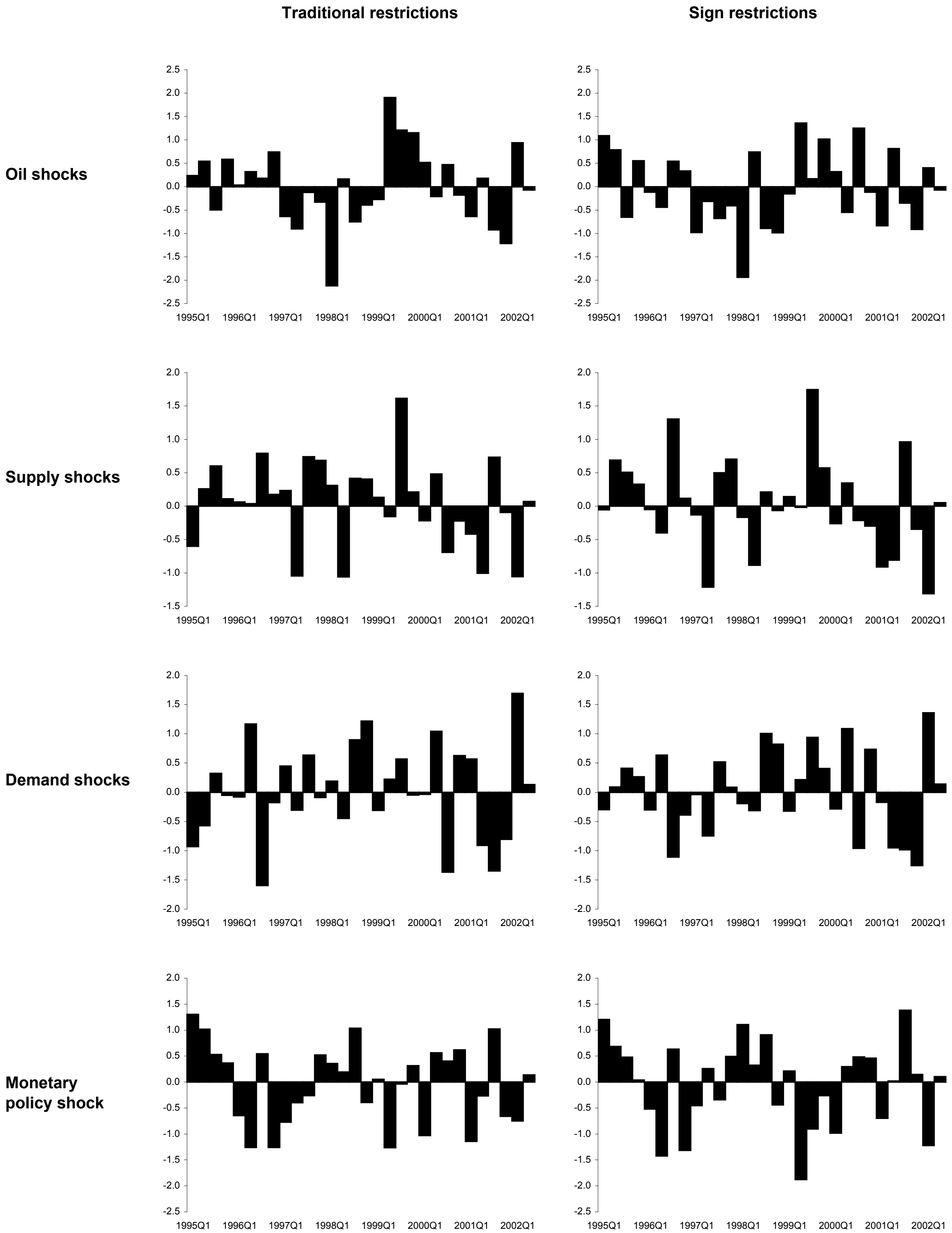
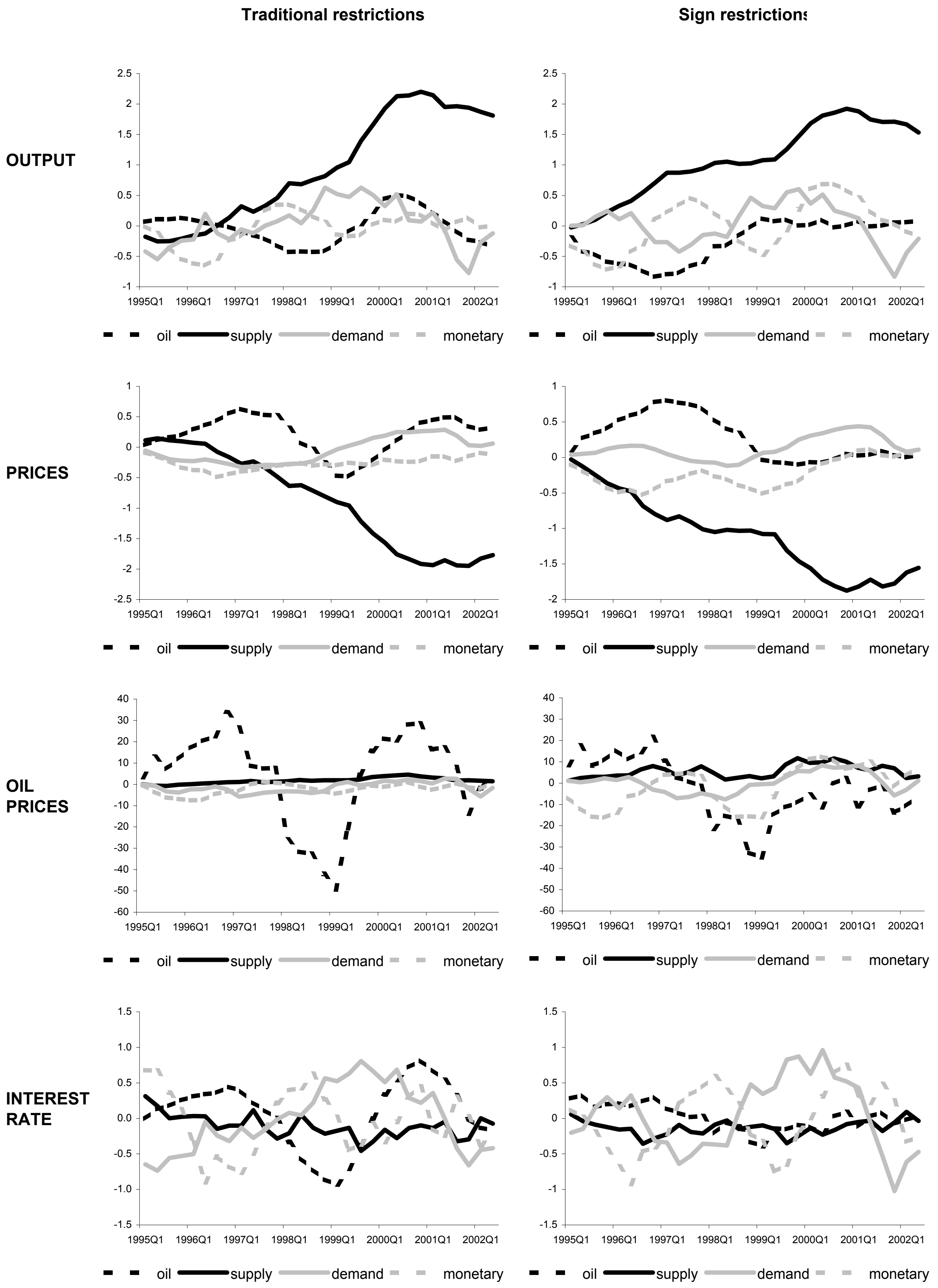


Figure 5: Contribution of industrialised world shocks to output, prices, interest rate and oil prices



Note: The starting values of the contributions for the shocks with permanent effects, I.e. all shocks on the price and oil price level, and oil price and supply shocks on output are normalised to 1995Q1 values. There are, however, still propagation effects of shocks that occurred before 1995.

Figure 6: United States and Euro area shocks: 1995Q1-2002Q2

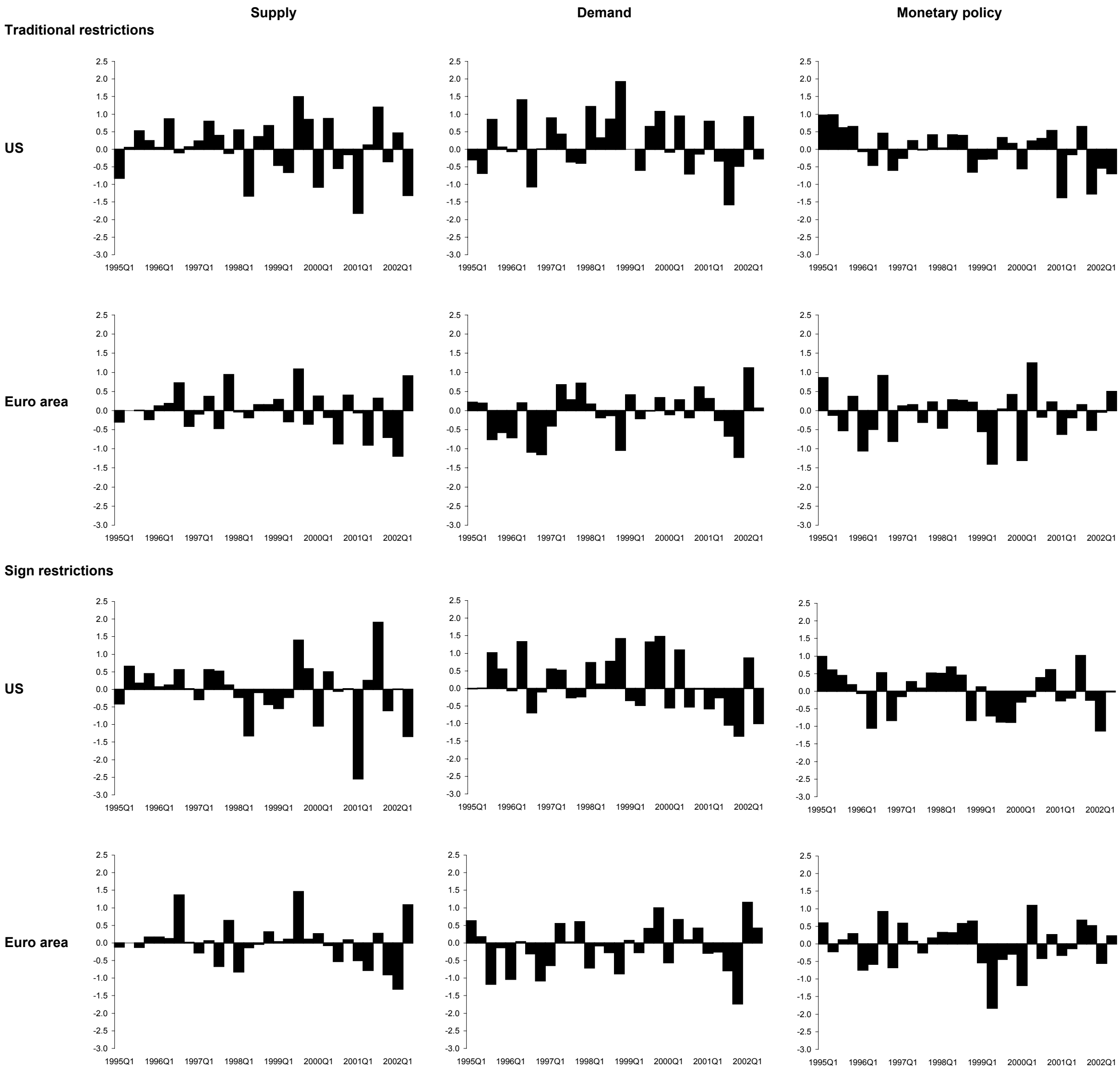
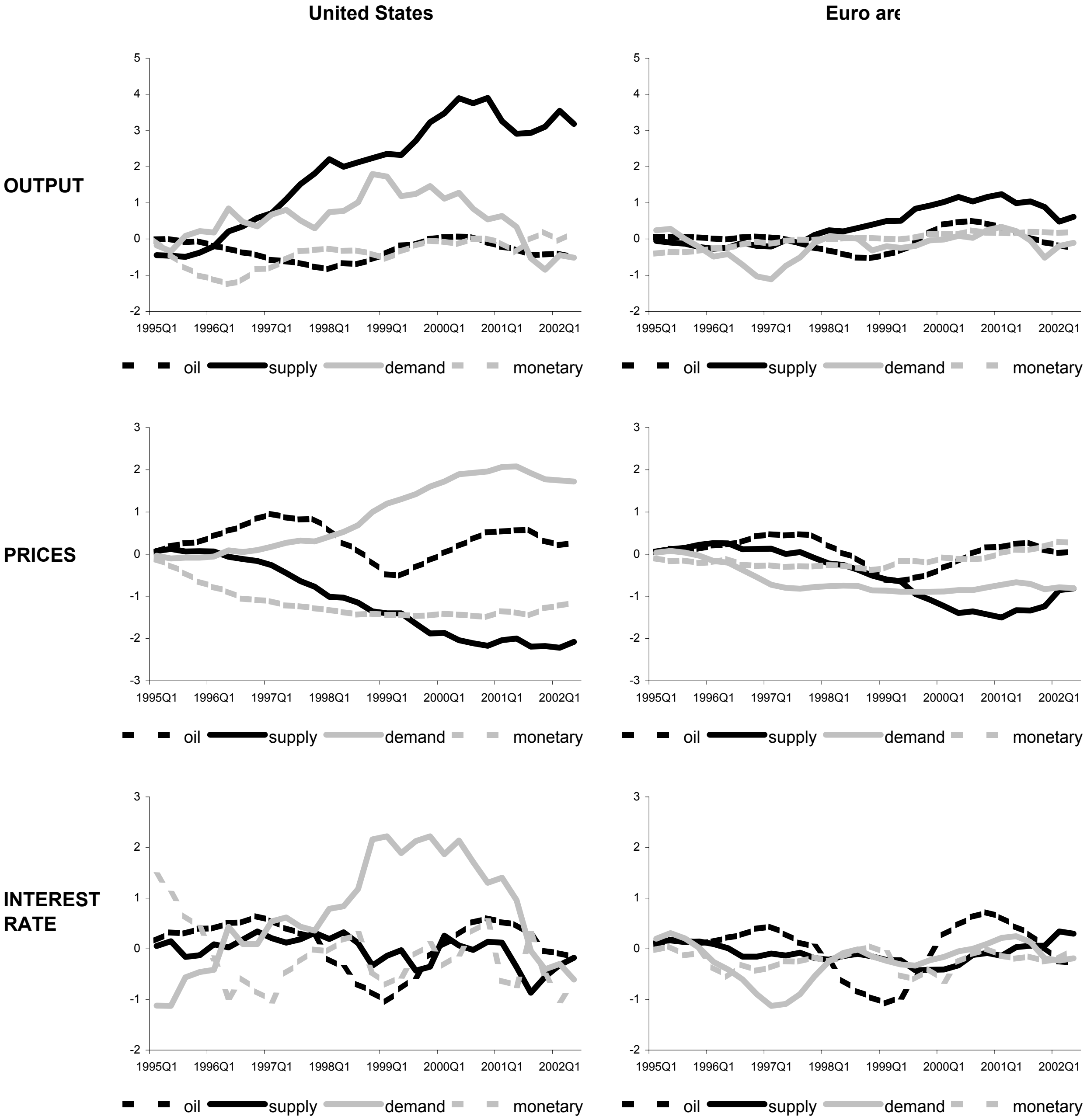
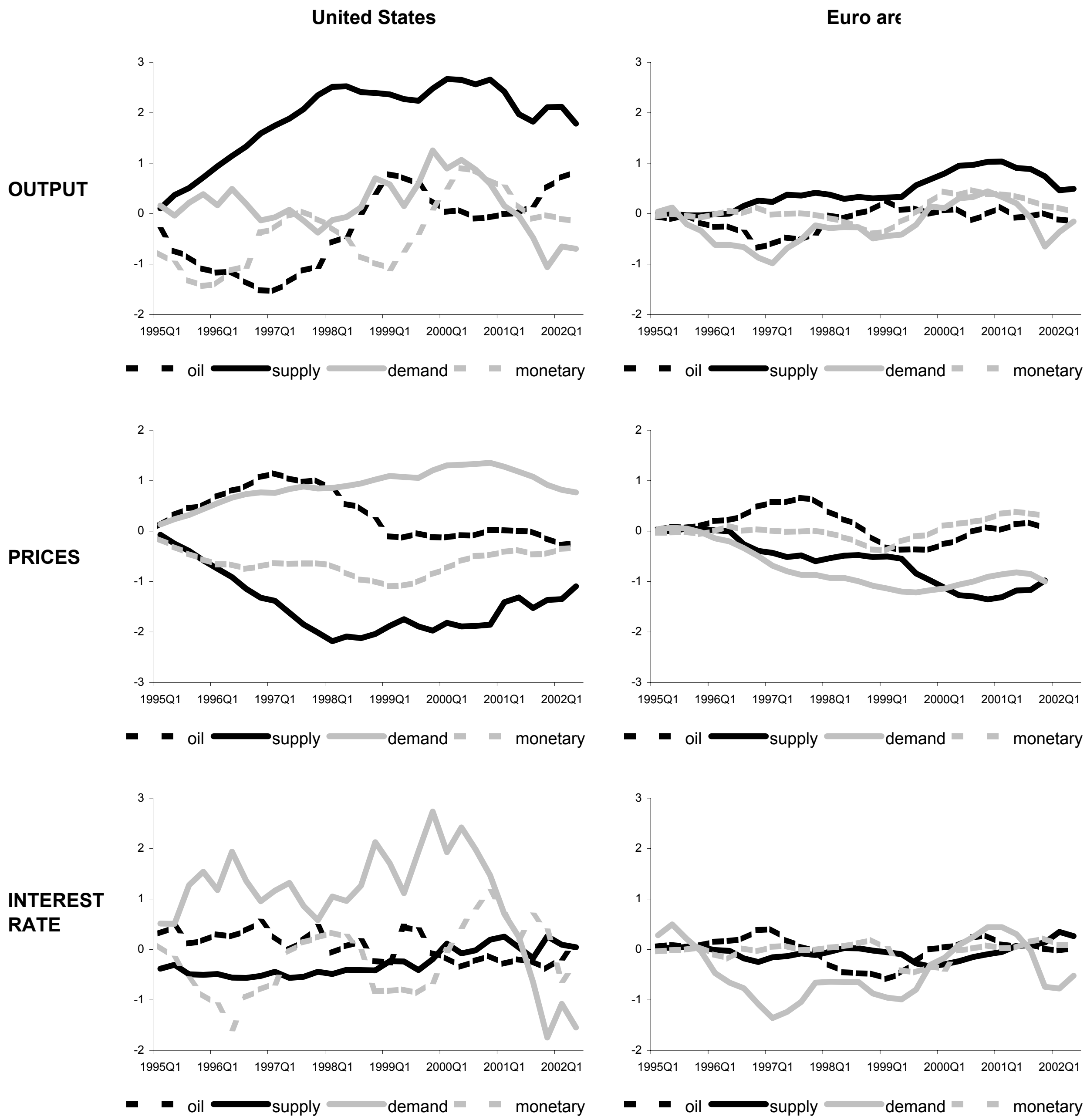


Figure 7a: Contribution of shocks to output, prices and interest rate: a comparison between US and Euro area - traditional restrictions



Note: The starting values of the contributions for the shocks with permanent effects, I.e. all shocks on the price ans oil price level, and oil price and supply shocks on output are normalised to 1995Q1 values. There are, however, still propagation effects of shocks that occurred before 1995.

Figure 7b: Contribution of shocks to output, prices and interest rate: a comparison between US and Euro area - sign restrictions

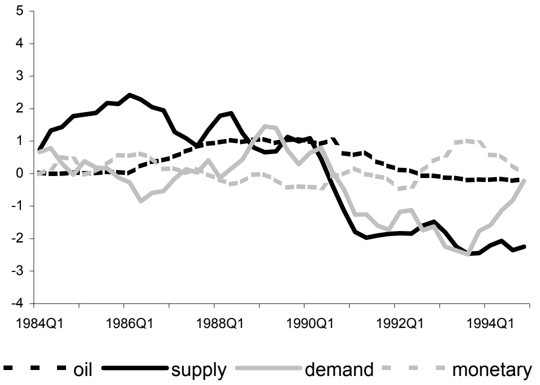


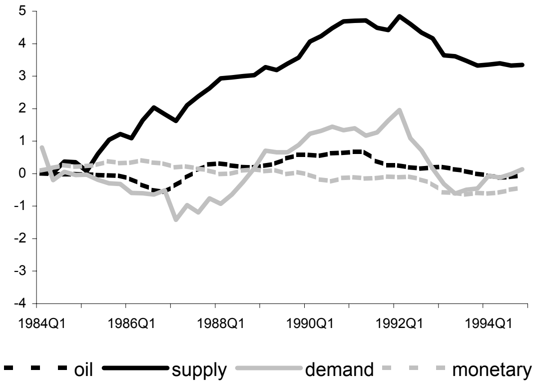
Note: The starting values of the contributions for the shocks with permanent effects, I.e. all shocks on the price ans oil price level, and oil price and supply shocks on output are normalised to 1995Q1 values. There are, however, still propagation effects of shocks that occurred before 1995.

Figure 8: Contribution of shocks to output: the early 90's recession

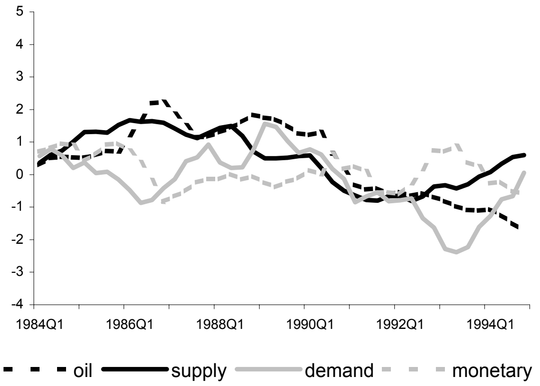
US | **Euro area**

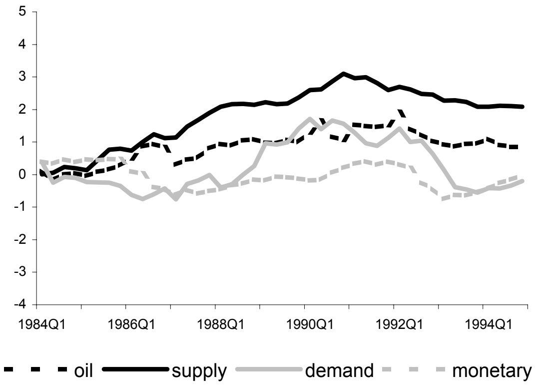
Traditional restrictions





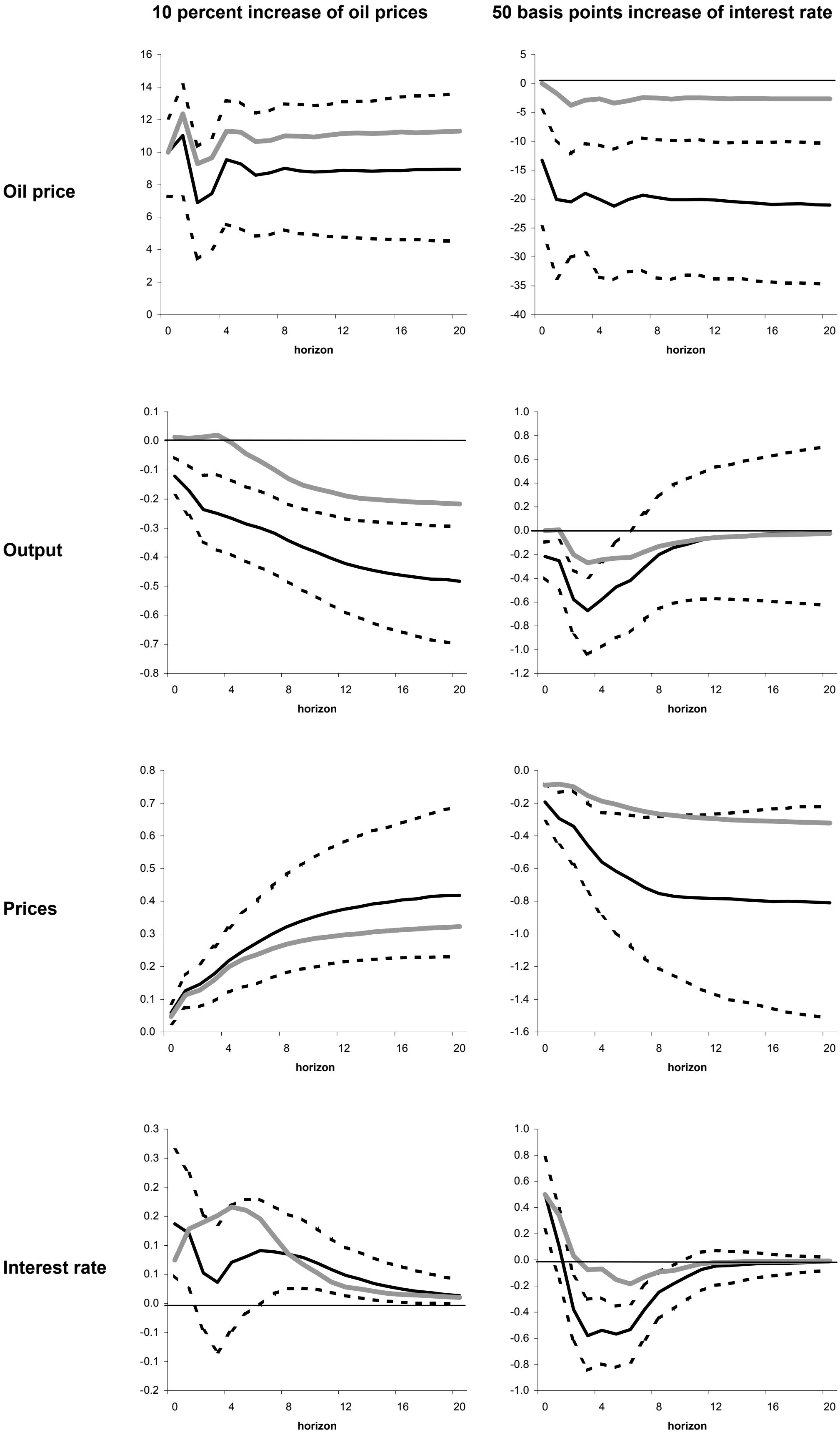
Sign restrictions





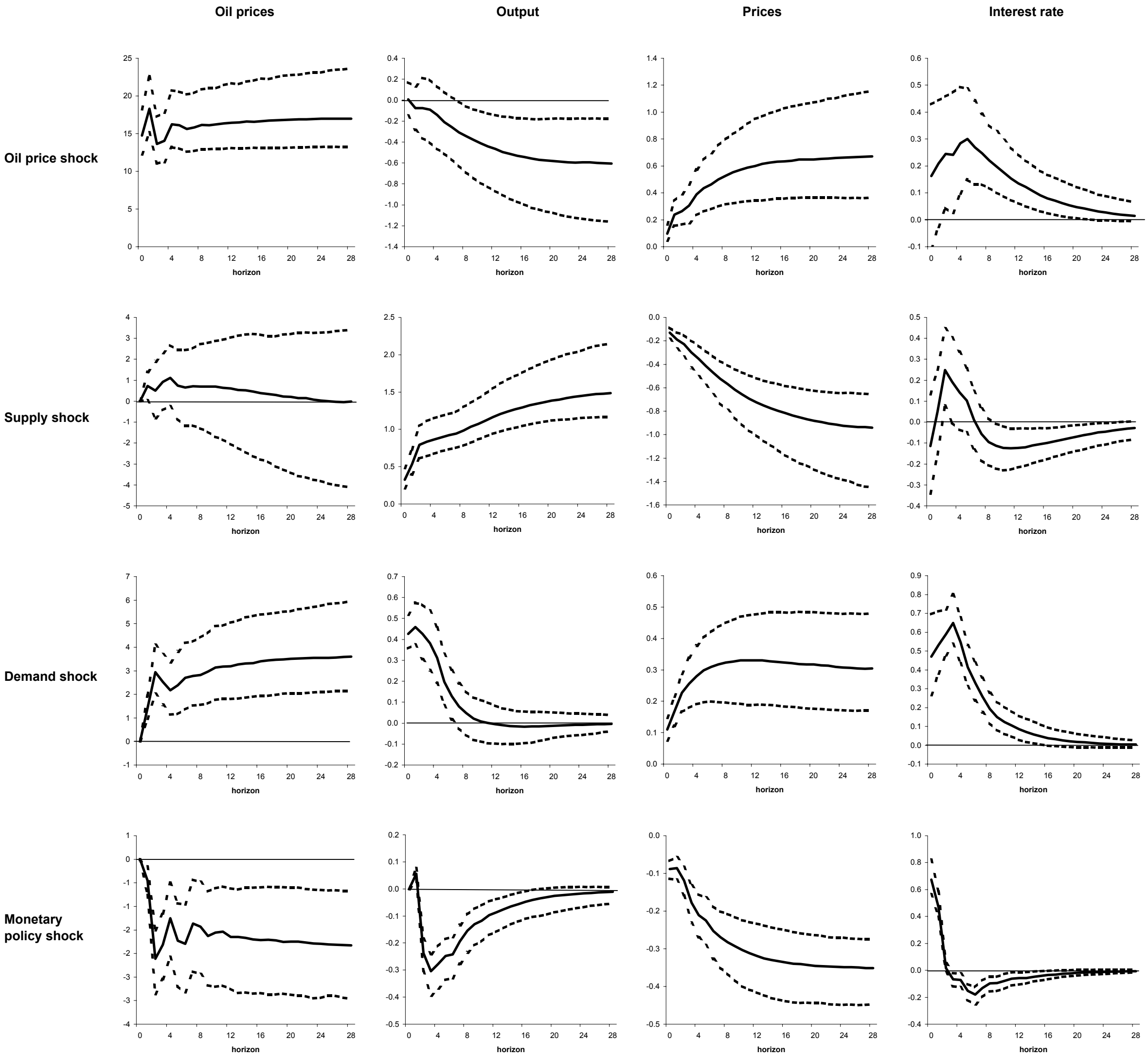
Note: The starting values of the contributions for the shocks with permanent effects, I.e. all shocks on the price ans oil price level, and oil price and supply shocks on output are normalised to 1984Q1 values. There are, however, still propagation effects of shocks that occurred before 1984.

Figure A1: Industrialised world VAR - Results of a simulation



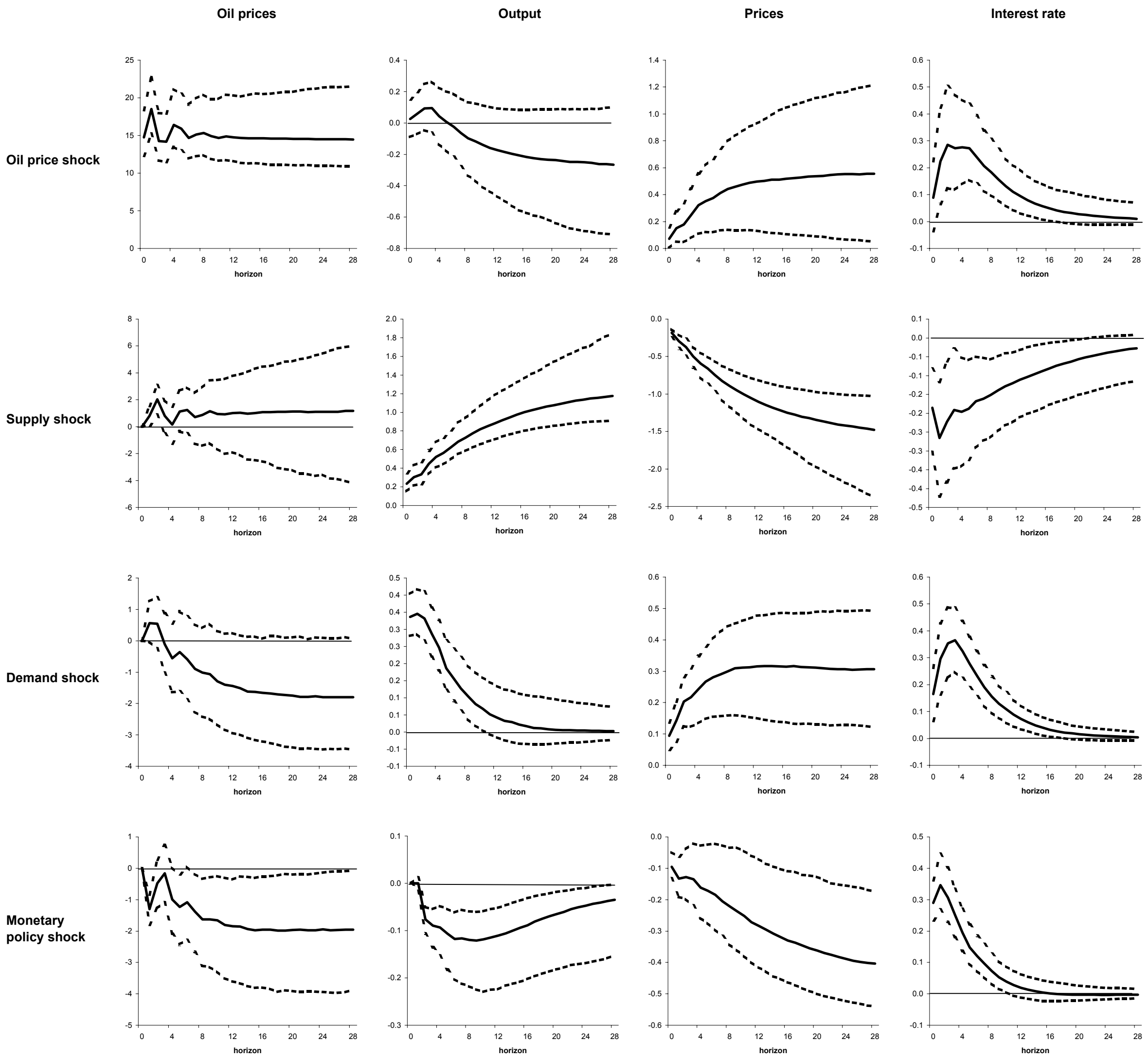
Note: black lines are responses based on sign restriction with 84th and 16th percentiles error bands based on Monte Carlo Integration
grey lines are responses based on traditional restrictions

Figure A2: US VAR - Impulse responses based on traditional identification



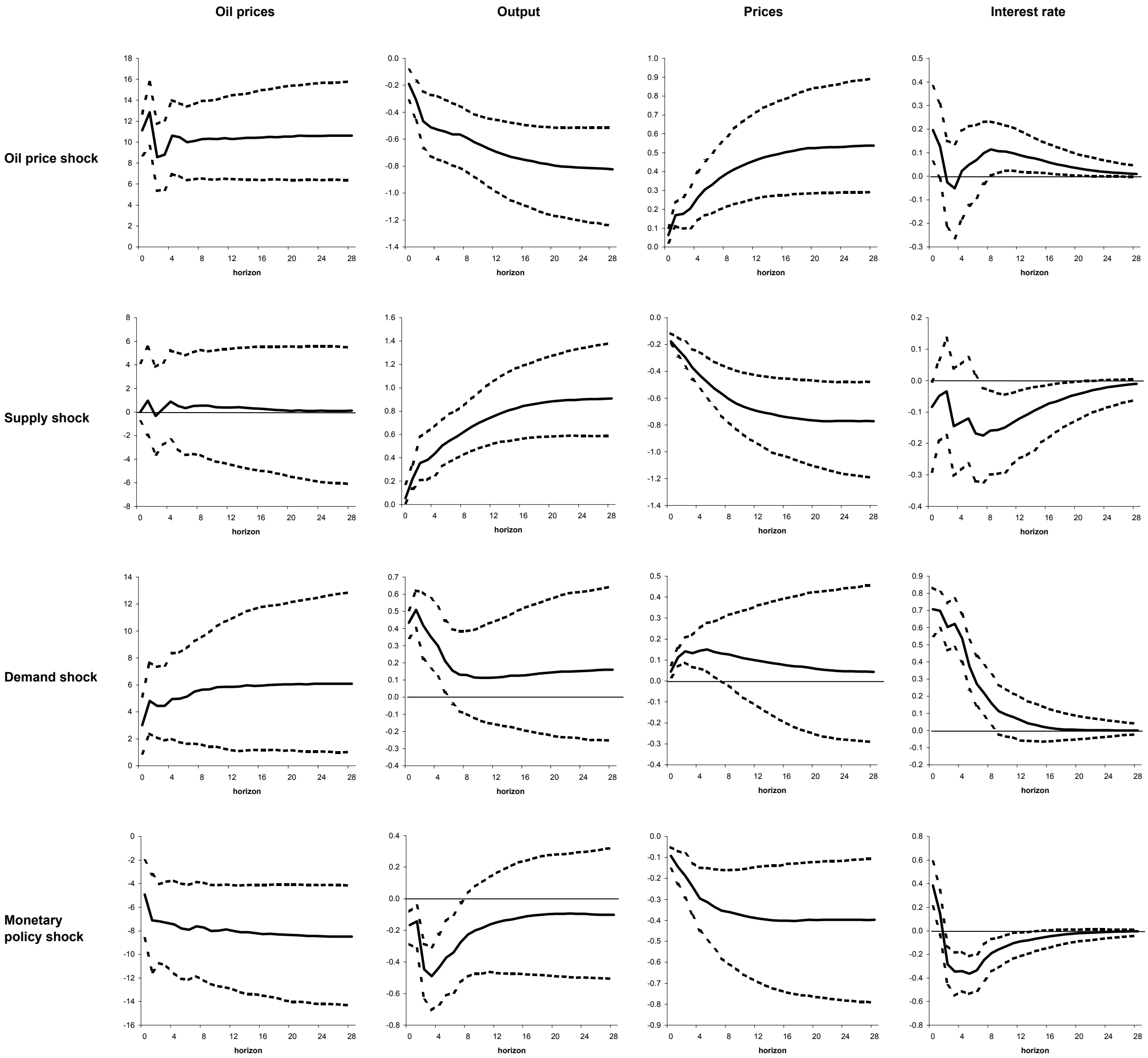
Note: median impulse responses with 84th and 16th percentiles error bands based on Monte Carlo integration, horizon is quarterly.

Figure A3: Euro area VAR - Impulse responses based on traditional identification



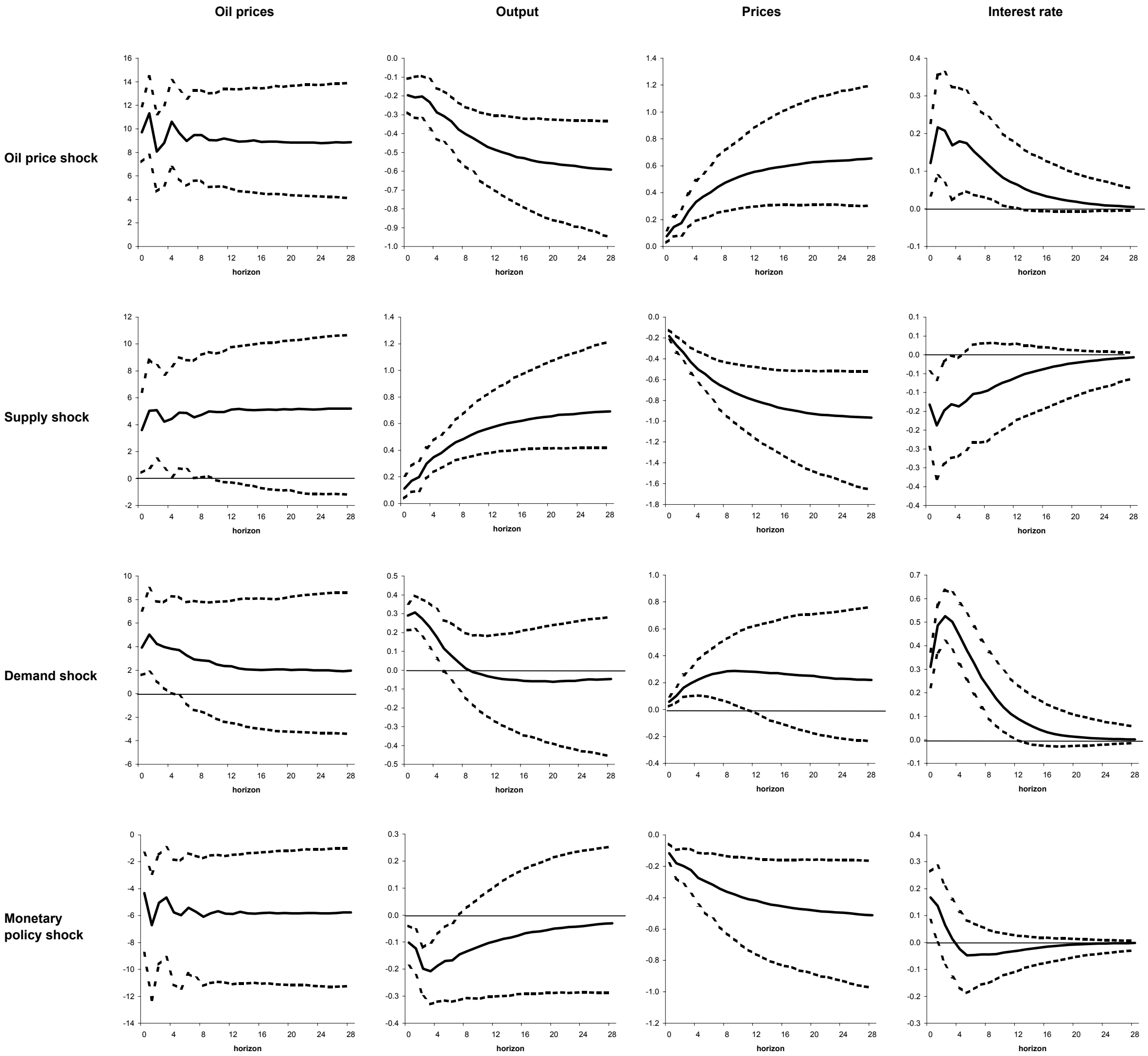
Note: median impulse responses with 84th and 16th percentiles error bands based on Monte Carlo integration, horizon is quarterly.

Figure A4: US VAR - Impulse responses based on sign restrictions



Note: median impulse responses with 84th and 16th percentiles error bands based on Monte Carlo integration, horizon is quarterly.

Figure A5: Euro area VAR - Impulse responses based on sign restrictions



Note: median impulse responses with 84th and 16th percentiles error bands based on Monte Carlo integration, horizon is quarterly.

Table 1: Correlation of shocks across methodologies

	Sign restrictions			
	Oil	Supply	Demand	Monetary
Traditional restrictions				
Oil	0.82	0.21	0.27	-0.44
Supply	-0.37	0.93	0.04	-0.11
Demand	-0.34	-0.23	0.88	-0.23
Monetary	0.25	0.21	0.39	0.86

Table 2 - Decomposition of growth rates

Industrialised world

	Actual	Baseline		Oil		Supply		Demand		Monetary	
		(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
1995	2.41	**2.57**	**2.53**	0.13	**-0.59**	**-0.25**	0.18	0.11	**0.46**	**-0.19**	-0.17
1996	2.70	**2.48**	**2.45**	-0.07	**-0.27**	**0.19**	**0.37**	**0.30**	-0.09	**-0.26**	0.18
1997	3.25	**2.40**	**2.38**	**-0.23**	-0.04	**0.37**	**0.39**	0.08	**-0.28**	**0.62**	**0.69**
1998	2.87	**2.31**	**2.29**	-0.23	**0.50**	**0.39**	0.20	**0.29**	**0.36**	0.12	**-0.42**
1999	3.07	**2.22**	**2.20**	**0.38**	**0.32**	**0.54**	0.19	0.25	0.40	**-0.32**	-0.04
2000	3.43	**2.13**	**2.13**	**0.48**	-0.03	**0.82**	**0.59**	**-0.27**	-0.11	**0.24**	**0.72**
2001	0.76	**2.03**	**2.05**	**-0.44**	-0.01	-0.09	-0.01	**-0.56**	**-0.69**	-0.09	**-0.38**
2000Q1	0.90	**0.53**	**0.53**	**0.20**	0.01	**0.26**	**0.21**	**-0.18**	**-0.23**	0.07	**0.33**
2000Q2	0.98	**0.53**	**0.53**	0.07	0.07	**0.22**	**0.13**	**0.20**	**0.17**	-0.03	0.05
2000Q3	0.20	**0.52**	**0.52**	-0.02	**-0.10**	0.01	0.06	**-0.44**	**-0.27**	**0.14**	0.02
2000Q4	0.44	**0.51**	**0.52**	-0.09	0.02	0.06	0.08	-0.01	-0.05	-0.01	-0.08
2001Q1	0.30	**0.51**	**0.51**	**-0.14**	0.05	-0.05	-0.02	0.14	-0.08	**-0.12**	**-0.12**
2001Q2	-0.30	**0.50**	**0.51**	**-0.14**	**-0.09**	**-0.19**	**-0.12**	**-0.31**	**-0.32**	**-0.13**	**-0.20**
2001Q3	-0.05	**0.50**	**0.50**	**-0.18**	0.03	0.00	-0.03	**-0.49**	**-0.36**	**0.13**	**-0.15**
2001Q4	0.16	**0.49**	**0.50**	**-0.15**	0.05	-0.03	0.01	**-0.22**	**-0.30**	**0.08**	-0.06
2002Q1	0.71	**0.49**	**0.49**	-0.05	-0.01	-0.06	-0.05	**0.50**	**0.38**	**-0.17**	-0.11
2002Q2	0.52	**0.48**	**0.48**	-0.08	0.03	**-0.07**	**-0.11**	**0.14**	**0.23**	0.03	-0.10

United States

	Actual	Baseline		Oil		Supply		Demand		Monetary	
		(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
1995	2.64	**3.05**	**3.03**	-0.06	**-1.10**	**-0.46**	**0.63**	**0.86**	**0.84**	**-0.92**	**-0.79**
1996	3.50	**2.97**	**2.95**	**-0.27**	**-0.49**	**0.70**	**0.86**	**0.51**	0.00	**-0.51**	0.14
1997	4.34	**2.89**	**2.88**	**-0.35**	0.00	**1.05**	**0.84**	0.15	-0.26	**0.57**	**0.85**
1998	4.19	**2.81**	**2.80**	-0.03	**1.12**	**0.79**	0.49	**0.49**	0.32	0.17	-0.46
1999	4.03	**2.72**	**2.71**	**0.51**	**0.73**	**0.51**	-0.14	0.32	**0.52**	0.04	0.33
2000	3.69	**2.64**	**2.63**	0.20	**-0.55**	**1.16**	0.25	-0.47	0.23	0.20	**1.11**
2001	0.25	**2.57**	**2.57**	-0.37	0.18	**-0.66**	**-0.52**	**-1.07**	**-1.26**	-0.02	**-0.53**
2000Q1	0.63	**0.66**	**0.66**	0.07	-0.20	**0.28**	0.17	**-0.32**	**-0.34**	-0.03	**0.35**
2000Q2	1.18	**0.66**	**0.66**	0.03	0.04	**0.43**	-0.09	**0.17**	0.19	-0.09	**0.34**
2000Q3	0.14	**0.65**	**0.65**	-0.03	-0.16	-0.15	-0.06	**-0.46**	-0.20	**0.16**	-0.03
2000Q4	0.27	**0.65**	**0.65**	-0.14	0.02	**0.15**	0.10	**-0.32**	**-0.27**	-0.01	**-0.16**
2001Q1	-0.15	**0.64**	**0.64**	-0.10	0.04	**-0.60**	**-0.17**	0.05	**-0.43**	**-0.11**	-0.16
2001Q2	-0.40	**0.64**	**0.64**	-0.08	-0.01	**-0.34**	**-0.43**	**-0.30**	**-0.24**	**-0.27**	**-0.31**
2001Q3	-0.07	**0.63**	**0.63**	-0.18	**0.20**	0.00	-0.15	**-0.85**	**-0.45**	**0.35**	-0.24
2001Q4	0.68	**0.62**	**0.63**	0.01	**0.32**	0.18	**0.24**	**-0.30**	**-0.59**	**0.21**	0.12
2002Q1	1.23	**0.62**	**0.63**	0.04	**0.22**	**0.43**	0.05	**0.40**	**0.41**	**-0.26**	-0.10
2002Q2	0.28	**0.61**	**0.62**	-0.11	0.08	**-0.34**	**-0.30**	-0.10	-0.05	**0.25**	-0.04

Euro area

	Actual	Baseline		Oil		Supply		Demand		Monetary	
		(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
1995	2.39	**2.20**	**2.17**	0.09	**-0.15**	-0.14	-0.02	0.09	0.25	**0.16**	**0.15**
1996	1.47	**2.19**	**2.18**	-0.03	**-0.30**	-0.06	0.09	**-0.76**	**-0.60**	**0.15**	0.12
1997	2.42	**2.18**	**2.19**	-0.10	-0.10	0.13	**0.26**	0.03	0.05	**0.14**	-0.06
1998	2.81	**2.16**	**2.17**	-0.36	**0.48**	**0.32**	0.05	**0.54**	0.27	**0.09**	-0.11
1999	2.72	**2.15**	**2.15**	0.27	0.14	**0.39**	0.14	-0.13	0.10	0.03	0.12
2000	3.57	**2.14**	**2.14**	**0.63**	-0.09	**0.41**	**0.44**	0.25	**0.52**	**0.14**	**0.42**
2001	1.61	**2.12**	**2.13**	**-0.31**	0.01	-0.06	-0.02	-0.10	**-0.33**	0.01	-0.08
2000Q1	0.89	**0.53**	**0.53**	**0.23**	0.08	**0.11**	0.10	0.02	-0.04	0.00	**0.20**
2000Q2	0.84	**0.53**	**0.53**	0.07	0.02	**0.15**	**0.16**	**0.11**	**0.20**	-0.02	-0.08
2000Q3	0.49	**0.53**	**0.53**	0.03	**-0.23**	-0.11	0.04	-0.06	0.05	**0.11**	**0.10**
2000Q4	0.73	**0.53**	**0.53**	-0.06	0.12	**0.13**	0.06	**0.21**	**0.11**	**-0.07**	-0.08
2001Q1	0.56	**0.53**	**0.53**	-0.11	**0.15**	**0.07**	0.01	0.09	**-0.11**	-0.01	0.01
2001Q2	0.03	**0.53**	**0.53**	**-0.11**	**-0.21**	**-0.24**	**-0.10**	**-0.12**	**-0.13**	-0.01	-0.02
2001Q3	0.16	**0.53**	**0.53**	**-0.17**	0.02	0.04	0.00	**-0.27**	**-0.29**	0.04	**-0.07**
2001Q4	-0.23	**0.53**	**0.53**	-0.13	0.08	**-0.14**	**-0.11**	**-0.46**	**-0.56**	0.00	**-0.10**
2002Q1	0.36	**0.53**	**0.53**	**-0.08**	**-0.13**	**-0.39**	**-0.27**	**0.32**	**0.28**	-0.03	-0.03
2002Q2	0.66	**0.53**	**0.53**	-0.08	-0.03	**0.11**	0.02	0.07	**0.21**	0.03	**-0.07**

(1) : Traditional restrictions

(2) : Sign restrictions

Median estimated values based on Monte Carlo integration

Bold figures are significant: median, upper and lower bands of estimates have the same sign

Table 3 - Decomposition of inflation

Industrialised world

	Actual	Baseline		Oil		Supply		Demand		Monetary	
		(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
1995	2.13	**2.31**	**2.34**	**0.14**	**0.37**	**0.19**	-0.21	**-0.25**	0.02	**-0.24**	**-0.33**
1996	1.98	**2.16**	**2.17**	**0.29**	**0.35**	-0.12	**-0.42**	-0.09	0.08	**-0.23**	-0.19
1997	1.84	**2.01**	**2.00**	**0.16**	0.11	**-0.31**	**-0.30**	-0.06	**-0.17**	0.07	**0.18**
1998	1.12	**1.86**	**1.84**	**-0.54**	**-0.39**	**-0.34**	-0.16	0.09	-0.05	0.07	-0.07
1999	1.17	**1.71**	**1.68**	**-0.40**	**-0.44**	**-0.42**	**-0.19**	**0.27**	**0.21**	0.00	-0.06
2000	1.74	**1.56**	**1.53**	**0.55**	0.02	**-0.62**	**-0.44**	**0.18**	**0.24**	0.05	**0.28**
2001	1.55	**1.41**	**1.37**	**0.26**	0.08	**-0.17**	-0.03	-0.04	-0.03	**0.05**	**0.12**
2000Q1	0.55	**0.39**	**0.38**	**0.16**	0.03	**-0.14**	**-0.09**	0.04	**0.06**	**0.09**	**0.14**
2000Q2	0.38	**0.38**	**0.37**	**0.16**	-0.02	**-0.19**	**-0.13**	**0.06**	0.04	-0.02	**0.09**
2000Q3	0.44	**0.37**	**0.36**	**0.16**	0.04	**-0.08**	**-0.07**	0.00	0.05	-0.01	0.03
2000Q4	0.45	**0.36**	**0.35**	**0.15**	**0.09**	**-0.09**	**-0.07**	0.02	0.03	0.01	0.03
2001Q1	0.48	**0.35**	**0.34**	**0.04**	-0.02	-0.02	0.04	0.02	0.01	**0.08**	**0.09**
2001Q2	0.47	**0.34**	**0.33**	**0.04**	0.02	**0.08**	**0.07**	0.01	-0.01	0.00	0.03
2001Q3	0.08	**0.33**	**0.32**	0.01	**0.05**	**-0.09**	**-0.09**	**-0.10**	**-0.11**	**-0.08**	**-0.10**
2001Q4	0.09	**0.32**	**0.31**	**-0.15**	**-0.06**	-0.01	0.03	**-0.16**	**-0.16**	**0.07**	-0.03
2002Q1	0.44	**0.31**	**0.30**	**-0.06**	-0.02	**0.12**	**0.15**	-0.01	**-0.07**	**0.06**	0.07
2002Q2	0.41	**0.30**	**0.29**	**0.04**	**0.03**	**0.06**	**0.06**	**0.04**	0.02	**-0.03**	-0.01

United States

	Actual	Baseline		Oil		Supply		Demand		Monetary	
		(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
1995	2.27	**2.48**	**2.51**	**0.30**	**0.51**	0.11	**-0.66**	-0.10	0.44	**-0.51**	**-0.52**
1996	2.12	**2.34**	**2.36**	**0.42**	**0.47**	-0.16	**-0.75**	0.13	**0.38**	**-0.59**	**-0.37**
1997	1.93	**2.20**	**2.21**	**0.26**	0.16	**-0.48**	**-0.64**	0.19	0.14	**-0.26**	0.03
1998	1.06	**2.06**	**2.08**	**-0.68**	**-0.47**	**-0.54**	-0.33	**0.37**	0.11	-0.18	-0.24
1999	1.63	**1.93**	**1.93**	**-0.58**	**-0.61**	**-0.42**	0.13	**0.71**	0.22	-0.06	-0.05
2000	2.51	**1.79**	**1.79**	**0.65**	0.04	**-0.49**	-0.04	**0.50**	0.23	0.00	**0.41**
2001	2.01	**1.65**	**1.64**	**0.22**	0.02	-0.08	**0.39**	0.10	-0.21	0.07	0.13
2000Q1	0.84	**0.45**	**0.45**	**0.18**	0.00	0.00	**0.14**	**0.13**	0.10	**0.06**	**0.13**
2000Q2	0.56	**0.44**	**0.44**	**0.16**	0.03	**-0.20**	-0.07	**0.18**	0.01	-0.03	**0.13**
2000Q3	0.52	**0.43**	**0.43**	**0.17**	0.00	**-0.09**	0.00	0.02	0.02	-0.03	0.07
2000Q4	0.55	**0.42**	**0.42**	**0.17**	**0.09**	**-0.07**	0.00	0.04	0.02	-0.02	0.01
2001Q1	0.82	**0.41**	**0.41**	0.02	0.00	**0.13**	**0.44**	**0.11**	-0.08	**0.13**	0.06
2001Q2	0.45	**0.41**	**0.40**	0.03	-0.02	0.02	0.10	0.02	-0.08	-0.03	0.04
2001Q3	-0.02	**0.40**	**0.39**	0.00	0.00	**-0.19**	**-0.20**	**-0.15**	**-0.11**	**-0.07**	**-0.08**
2001Q4	0.20	**0.39**	**0.38**	**-0.25**	**-0.14**	0.01	**0.13**	**-0.13**	**-0.17**	**0.17**	0.00
2002Q1	0.27	**0.38**	**0.38**	**-0.11**	**-0.12**	-0.05	0.02	-0.02	**-0.12**	**0.06**	**0.10**
2002Q2	0.62	**0.37**	**0.37**	**0.07**	0.03	**0.13**	**0.23**	-0.03	-0.05	**0.07**	0.03

Euro area

	Actual	Baseline		Oil		Supply		Demand		Monetary	
		(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
1995	3.08	**3.00**	**3.03**	0.10	0.06	0.14	0.04	0.05	-0.04	**-0.22**	-0.01
1996	2.63	**2.78**	**2.81**	**0.18**	**0.25**	0.05	**-0.17**	**-0.34**	**-0.30**	-0.06	0.07
1997	2.03	**2.57**	**2.58**	**0.17**	**0.33**	-0.16	**-0.38**	**-0.47**	**-0.43**	-0.09	-0.03
1998	1.50	**2.37**	**2.37**	**-0.54**	**-0.42**	-0.32	-0.02	0.00	-0.17	-0.02	**-0.16**
1999	1.17	**2.16**	**2.15**	**-0.54**	**-0.53**	**-0.45**	**-0.20**	-0.10	-0.20	0.09	0.03
2000	2.14	**1.95**	**1.94**	**0.49**	0.22	**-0.50**	**-0.53**	0.05	0.11	0.11	**0.31**
2001	2.40	**1.74**	**1.72**	**0.27**	**0.18**	0.00	0.09	**0.10**	0.13	**0.20**	**0.20**
2000Q1	0.65	**0.49**	**0.49**	**0.17**	**0.09**	**-0.14**	**-0.16**	0.01	0.02	**0.13**	**0.18**
2000Q2	0.49	**0.48**	**0.47**	**0.16**	0.06	**-0.16**	**-0.15**	0.03	**0.08**	-0.03	0.01
2000Q3	0.70	**0.46**	**0.46**	**0.20**	**0.17**	0.04	-0.03	0.00	0.04	-0.01	0.03
2000Q4	0.63	**0.45**	**0.45**	**0.14**	**0.08**	**-0.08**	**-0.05**	**0.07**	**0.09**	0.02	0.05
2001Q1	0.58	**0.44**	**0.43**	0.01	-0.05	**-0.07**	0.02	**0.06**	0.04	**0.12**	**0.11**
2001Q2	0.80	**0.42**	**0.42**	**0.06**	**0.11**	**0.16**	**0.13**	**0.05**	0.03	**0.07**	**0.07**
2001Q3	0.40	**0.41**	**0.40**	0.03	0.04	-0.01	0.01	**-0.04**	-0.03	0.00	-0.02
2001Q4	0.29	**0.40**	**0.39**	**-0.16**	**-0.11**	**0.11**	**0.17**	**-0.12**	**-0.13**	0.06	-0.04
2002Q1	0.86	**0.38**	**0.38**	**-0.08**	0.04	**0.37**	**0.36**	**0.06**	-0.04	**0.11**	0.07
2002Q2	0.40	**0.37**	**0.37**	0.03	**0.04**	0.03	-0.01	-0.01	-0.04	-0.03	0.01

(1) : Traditional restrictions

(2) : Sign restrictions

Median estimated values based on Monte Carlo integration

Bold figures are significant: median, upper and lower bands of estimates have the same sign

Table 4 - Decomposition of interest rate

Industrialised world

	Actual	Baseline		Oil		Supply		Demand		Monetary	
		(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
1995	5.68	**5.57**	**5.57**	**0.14**	**0.24**	**0.13**	-0.04	**-0.61**	0.02	**0.47**	-0.10
1996	4.64	**5.22**	**5.19**	**0.36**	0.23	-0.05	**-0.25**	**-0.28**	0.04	**-0.61**	**-0.63**
1997	4.51	**4.86**	**4.83**	**0.18**	0.06	-0.10	-0.17	**-0.15**	**-0.47**	**-0.29**	0.19
1998	4.43	**4.51**	**4.48**	**-0.61**	-0.18	-0.13	-0.09	0.22	-0.03	**0.43**	0.24
1999	3.84	**4.15**	**4.13**	**-0.50**	-0.20	**-0.28**	**-0.22**	**0.66**	**0.61**	-0.21	**-0.48**
2000	4.83	**3.80**	**3.76**	**0.60**	-0.05	-0.17	-0.14	**0.42**	**0.66**	0.09	**0.41**
2001	3.43	**3.46**	**3.40**	**0.38**	-0.03	**-0.19**	-0.07	**-0.18**	**-0.30**	-0.02	**0.31**
2000Q1	4.35	**3.93**	**3.90**	0.34	-0.12	-0.16	-0.14	**0.51**	**0.63**	**-0.33**	0.01
2000Q2	4.83	**3.84**	**3.81**	**0.54**	-0.22	-0.28	-0.23	**0.69**	**0.96**	-0.05	**0.31**
2000Q3	5.02	**3.75**	**3.72**	**0.72**	0.03	-0.14	-0.16	0.29	**0.58**	**0.30**	**0.64**
2000Q4	5.11	**3.67**	**3.62**	**0.82**	0.09	-0.10	-0.08	0.22	**0.52**	**0.45**	**0.75**
2001Q1	4.37	**3.58**	**3.54**	**0.68**	-0.12	-0.13	-0.05	**0.36**	**0.43**	-0.15	0.34
2001Q2	3.74	**3.50**	**3.44**	**0.54**	0.03	-0.05	-0.03	0.00	-0.06	**-0.25**	0.22
2001Q3	3.27	**3.41**	**3.36**	**0.32**	0.09	**-0.32**	-0.18	**-0.42**	**-0.53**	**0.30**	**0.48**
2001Q4	2.35	**3.32**	**3.27**	-0.01	-0.07	**-0.30**	-0.06	**-0.66**	**-1.02**	0.03	**0.25**
2002Q1	2.24	**3.24**	**3.18**	-0.13	-0.02	0.00	0.09	**-0.44**	**-0.61**	**-0.39**	**-0.33**
2002Q2	2.28	**3.15**	**3.09**	-0.17	0.04	-0.07	-0.04	**-0.42**	**-0.47**	-0.14	**-0.26**

United States

	Actual	Baseline		Oil		Supply		Demand		Monetary	
		(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
1995	5.92	**5.45**	**5.47**	**0.30**	0.26	-0.01	**-0.42**	**-0.82**	0.96	**0.91**	-0.40
1996	5.39	**5.17**	**5.20**	**0.52**	0.37	0.17	**-0.51**	0.06	**1.36**	**-0.64**	**-1.09**
1997	5.62	**4.88**	**4.89**	**0.38**	0.20	0.22	**-0.50**	0.50	**0.98**	**-0.44**	-0.06
1998	5.47	**4.60**	**4.60**	-0.52	-0.02	0.06	-0.41	**1.24**	**1.36**	-0.01	-0.07
1999	5.33	**4.32**	**4.31**	**-0.63**	0.14	-0.24	-0.28	**2.15**	**1.87**	-0.31	**-0.78**
2000	6.46	**4.04**	**4.03**	0.36	-0.22	0.10	0.06	**1.75**	**1.97**	0.12	**0.59**
2001	3.69	**3.77**	**3.76**	0.31	-0.28	**-0.43**	0.13	**0.48**	-0.38	-0.39	**0.46**
2000Q1	6.03	**4.14**	**4.12**	0.07	-0.16	0.26	0.12	**1.87**	**1.93**	-0.33	-0.02
2000Q2	6.57	**4.07**	**4.07**	0.27	-0.34	0.07	-0.08	**2.14**	**2.42**	-0.09	0.47
2000Q3	6.63	**4.00**	**3.99**	0.52	-0.22	-0.02	-0.02	**1.71**	**1.98**	**0.34**	**0.85**
2000Q4	6.59	**3.93**	**3.95**	**0.61**	-0.12	0.14	0.19	**1.30**	**1.47**	**0.54**	**1.14**
2001Q1	5.26	**3.87**	**3.85**	**0.53**	-0.28	0.12	0.25	**1.40**	**0.70**	**-0.63**	**0.69**
2001Q2	4.10	**3.80**	**3.80**	**0.49**	-0.19	-0.36	0.04	**0.96**	0.25	**-0.72**	0.23
2001Q3	3.35	**3.73**	**3.72**	0.27	-0.23	**-0.87**	-0.17	-0.04	-0.65	0.29	**0.67**
2001Q4	2.06	**3.66**	**3.65**	-0.04	**-0.39**	**-0.56**	0.26	-0.40	**-1.74**	-0.53	0.35
2002Q1	1.83	**3.60**	**3.57**	-0.08	-0.16	-0.32	0.09	-0.30	**-1.08**	**-1.02**	**-0.61**
2002Q2	1.83	**3.52**	**3.50**	-0.15	0.15	-0.18	0.04	**-0.61**	**-1.55**	**-0.69**	-0.29

Euro area

	Actual	Baseline		Oil		Supply		Demand		Monetary	
		(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
1995	7.00	**6.62**	**6.64**	**0.14**	0.07	0.15	0.04	**0.18**	0.23	-0.04	0.00
1996	5.29	**6.17**	**6.22**	**0.26**	**0.23**	-0.05	**-0.11**	**-0.54**	**-0.75**	**-0.41**	-0.07
1997	4.53	**5.73**	**5.77**	**0.23**	0.15	-0.12	-0.11	**-0.92**	**-1.06**	**-0.25**	0.02
1998	4.13	**5.28**	**5.32**	**-0.66**	**-0.42**	-0.15	0.00	-0.12	**-0.71**	-0.09	0.09
1999	3.11	**4.85**	**4.88**	**-0.66**	-0.34	**-0.33**	**-0.20**	**-0.28**	**-0.75**	**-0.39**	**-0.30**
2000	4.43	**4.39**	**4.43**	**0.53**	0.16	-0.23	-0.19	-0.03	0.14	-0.24	-0.07
2001	4.26	**3.96**	**3.98**	**0.35**	0.06	0.01	0.06	0.10	0.00	**-0.19**	0.11
2000Q1	3.62	**4.56**	**4.61**	0.27	0.04	**-0.41**	**-0.29**	-0.16	-0.17	**-0.64**	**-0.38**
2000Q2	4.31	**4.45**	**4.49**	**0.47**	0.08	**-0.33**	-0.23	-0.05	0.09	-0.26	-0.02
2000Q3	4.78	**4.34**	**4.37**	**0.63**	**0.25**	-0.12	-0.15	0.00	0.25	-0.10	0.02
2000Q4	5.03	**4.22**	**4.27**	**0.73**	**0.28**	-0.08	-0.10	0.10	**0.44**	0.01	0.08
2001Q1	4.75	**4.12**	**4.15**	**0.63**	0.11	-0.14	-0.05	0.22	**0.44**	-0.13	0.03
2001Q2	4.59	**4.01**	**4.04**	**0.45**	0.06	0.03	0.07	**0.25**	**0.30**	-0.19	0.04
2001Q3	4.27	**3.90**	**3.93**	**0.30**	0.11	0.06	0.08	**0.13**	-0.02	-0.15	0.16
2001Q4	3.44	**3.78**	**3.82**	0.04	0.02	0.06	0.14	-0.19	**-0.74**	-0.25	**0.22**
2002Q1	3.36	**3.67**	**3.71**	-0.25	-0.01	**0.34**	**0.35**	-0.23	**-0.78**	-0.19	0.09
2002Q2	3.44	**3.56**	**3.60**	**-0.27**	0.03	**0.30**	0.26	-0.19	**-0.52**	0.01	0.09

(1) : Traditional restrictions

(2) : Sign restrictions

Median estimated values based on Monte Carlo integration

Bold figures are significant: median, upper and lower bands of estimates have the same sign