UNIVERSITEIT
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FACULTEIT ECONOMIE
EN BEDRIJFSKUNDE

HOVENIERSBERG 24
B-9000 GENT
Tel. : 32 - (0)9 – 264.34.61
Fax. : 32 - (0)9 – 264.35.92

WORKING PAPER

The relative importance of symmetric and asymmetric shocks and the determination of the exchange rate

Gert Peersman [1]

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[1] Ghent University, Department of Financial Economics

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The Relative Importance of Symmetric and Asymmetric Shocks and the Determination of the Exchange Rate*

Gert Peersman

Ghent University

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Abstract

This paper shows how sign restrictions can be used to identify symmetric and asymmetric shocks in a simple two-country structural VAR. Specifically, the effects of symmetric and asymmetric supply, demand and monetary policy shocks as well as pure exchange rate shocks are estimated. The results can be used to deal with two issues. First, it is possible to estimate the relative importance of symmetric, asymmetric and pure exchange rate shocks across two countries or areas, which provides information about the degree of business cycle synchronization. Second, it is also possible to evaluate the relative importance of these shocks in determining exchange rate fluctuations, which can deliver answers to questions like 'Is the exchange rate a shock absorber or source of shocks?'. Evidence is provided for the UK versus the Euro area and compared with the US as a benchmark.

JEL classification: C32, E42, F31, F33

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1 Introduction

A lot of questions in the international business cycle literature are still unresolved. In particular, the Optimal Currency Area (OCA) debate is still open and very topical. Consider, for instance, the entry of a large number of ascension countries to the European Union that also might join the Eurozone relatively soon. On the other hand, Sweden and the United Kingdom recently decided not to enter or, at least, to postpone the introduction of the Euro. In this paper, we deal with two important issues of the OCA-literature. In the context of a single currency, the resemblance of the business cycle of the participating countries is a major concern. Differences in cyclical situations and underlying shocks can complicate monetary policy. A single stance of monetary policy is then not optimal for the individual countries. Some degree of synchronization of the cycles is required. It is therefore important to know the relative importance of symmetric (common) and asymmetric shocks across members of a currency area. The latter question is also very relevant in the context of the recent (more) general literature on international business cycle synchronization across industrialized countries.

A related question is the role of the exchange rate in the economic adjustment process. An independent flexible exchange rate can be considered as a mechanism which reacts to fundamental asymmetric or idiosyncratic shocks in order to help to stabilize output and inflation variability. The loss of its independent monetary policy and a flexible exchange rate might be a substantial cost for a country joining a monetary union. A different situation, however, arises if the foreign exchange market fails to offer any stabilization benefit. It may even be that the exchange rate is an independent source of shocks and imbalances to the economy are driven by irrational movements in financial markets rather than economic fundamentals (Buiter, 2000). In reality, exchange rates are very volatile and the uncovered interest parity condition fails in econometric estimations. Generally, it is important to know what is driving the exchange rate and whether the exchange rate is an efficient shock absorber or source of shocks.

This paper provides new empirical evidence on both issues simultaneously using a simple two-country structural vector autoregression (SVAR) framework. Structural VARs have become a basic analytical tool for a large part of modern macroeconomics, in particular the analysis of shocks. As a consequence, VARs are often used to analyze the above mentioned questions. Bayoumi and Eichengreen (1993) apply this method to compare the correlations of supply and demand shocks across European countries and US states. Their work has been extended or updated by Chamie et. al. (1994), Erkel-Rousse and Mélitz (1995) and Artis (2003) among others. A crucial problem in this literature is that these papers only focus on the structural shocks not taking into account the propagation mechanism. The global business cycle is determined by the interaction between the two. In addition, spill-over effects across countries are completely ignored. Countries constituting a monetary union mostly have close trade linkages. Even asymmetric shocks could then rapidly be transmitted to the other countries to become effectively 'common' or symmetric shocks (Bergman and Hutchison, 1998). In this paper, we take this problem into account by estimating the effects of symmetric and asymmetric shocks. Specifically, respectively symmetric and asymmetric supply, demand and monetary policy shocks are identified as well as pure exchange rate shocks. The shocks are identified in a way that spill-over effects are possible.[1]

Structural VARs are also often used to determine the role of the exchange rate, i.e. a shock absorber or source of shocks. Most of these studies, however, disagree in their results. Clarida and Gali (1994), Funke (2000) and Chadha and Prasad (1997) find an important role for the exchange rate acting as a stabilization mechanism. On the other hand, Artis and Ehrmann (2000), Canzoneri et. al. (1996) and Farrant and Peersman (2004) find that the exchange rate seems mostly to reflect shocks originating in the foreign exchange market itself. A shortcoming of most of these papers is that the VARs are estimated in relative variables, e.g. relative output, relative prices and the interest rate differential. This implies that the same propagation mechanism in both countries or areas is assumed, which can bias the results. Artis and Ehrmann (2000) estimate a one-country open economy VAR without relative variables. The latter can also generate biased results,

[1] The shocks should not be confused with common and idiosyncratic shocks from dynamic factor models developed by Forni et. al. (2000), which can be considered as an alternative to SVARs. They define common shocks as shocks affecting all variables in the system while idiosyncratic shocks are shocks with an exclusive impact on a specific variable. See Forni et. al. (2003) for a comparison between factor models and VARs.

in particular when there is an important role for symmetric shocks. Consider, for instance, a positive demand shock. If this is an asymmetric shock, output and inflation rise and there is an appreciation of the exchange rate. However, if this shock is symmetric, output and prices still rise but the exchange rate remains more or less constant. In this case, if a one-country VAR is estimated, the symmetric shock will partly be identified as a positive demand shock but also partly as a negative pure exchange rate shock (depreciation). As a result, there is an overestimation of the weight of exchange rate shocks. Indeed, Artis and Ehrmann (2000) find a substantial role for exchange rate noise. We take these points seriously and estimate a two-country VAR without relative variables. Moreover, we disentangle symmetric shocks from asymmetric shocks and analyze the role of both in determining the exchange rate.

In order to identify the shocks, we use a form of sign restrictions. Sign restrictions are introduced by Faust (1998), Uhlig (1999) and Canova and De Nicoló (2002) to identify monetary policy shocks and extended by Peersman (2004b) to a larger set of shocks. Farrant and Peersman (2004) are the first to apply this approach to identify pure exchange rate shocks. We elaborate their method by making a distinction between symmetric and asymmetric shocks. The former are identified as shocks that generate an effect which has the same sign in both areas under investigation. Asymmetric shocks have the opposite impact in both areas. The methodology is applied to the United Kingdom (UK) versus the Euro area (EA), but can easily be extended to other countries as well. The issues are directly reflected in the five economic tests, announced by the UK government, that would need to be met to become a member of the Euro area. As a benchmark, we compare the results versus the United States (US).

The rest of the paper is structured as follows. Section 2 briefly explains the methodology and the empirical model. Results are reported in Section 3. A distinction is made between the analysis of impulse response functions in Section 3.1, the relative importance of symmetric and asymmetric shocks in Section 3.2 and the factors driving exchange rate fluctuations in Section 3.3. Finally, Section 4 concludes.

2 Methodology

The methodology we use is an extension of the work by Farrant and Peersman (2004). They estimate the effects of supply, demand, monetary policy and exchange rate shocks on the exchange rate using an SVAR with sign restrictions. The advantage of their procedure is that no zero constraints have to be imposed to identify the shocks. The restrictions are much more general and easier to implement when economic theory only provides qualitative rather than quantitative information about the effects of shocks. In addition, restrictions which are often used implicitly, by checking whether the impulse responses look 'sensible', are used explicitly for identification. The restrictions they use are derived from a stochastic two-country open macro model with sticky prices developed by Clarida and Gali (1994), based on Obstfeld (1985) and Dornbusch (1976). All variables represent home relative to foreign levels. The restrictions, i.e. the signs of the impulse response functions in the short-run can be summarized in the following matrix, where $y - y^*$ is relative output, $p - p^*$ relative prices, $i - i^*$ relative interest rate and q the real exchange rate.[2]

	$y - y^*$	$p - p^*$	$i - i^*$	q
relative supply	$\geqslant 0$	$\leqslant 0$	$\leqslant 0$	?
relative demand	$\geqslant 0$	$\geqslant 0$	$\geqslant 0$	$\leqslant 0$
relative monetary policy	$\leqslant 0$	$\leqslant 0$	$\geqslant 0$	$\leqslant 0$
exchange rate	$\geqslant 0$	$\geqslant 0$	$\geqslant 0$	$\geqslant 0$

The intuition of these restrictions is very appealing and consistent with a large class of other conventional theoretical models if we take into account the monetary policy strategy in the countries under investigation, i.e. developed countries. Because the restrictions are imposed as $\leqslant$ or $\geqslant$, a zero contemporaneous reaction is still possible. A positive relative supply shock has a positive effect on relative output, a negative effect on relative prices and there is a fall in the nominal interest rate differential. Whilst a depreciation of the real exchange rate is expected in the long run, the short-run effect is uncertain in the Clarida and Gali (1994) model. Moreover, a positive supply shock may be accompanied by an upward shift in the aggregate demand curve if there is a rise in domestic real wealth

[2] A rise in q is a depreciation of the real exchange rate.

and consumers have a home bias in consumption.[3] As a consequence, no restriction is imposed on the reaction of the real exchange rate and the data determines the sign of this response. After a positive relative demand shock, relative output, relative prices and relative interest rate all rise. In addition, there is an appreciation of the real exchange rate which should act as a stabilizer. A restrictive relative monetary policy shock leads to a fall in relative output and prices and an appreciation of the exchange rate. Finally, a pure depreciation of the exchange rate causes output and prices to increase and the central bank reacts by increasing the interest rate in order to offset the inflationary pressures. Farrant and Peersman (2004) impose the restrictions to be binding the first four quarters after the shocks for output and prices and one quarter for the interest rate differential and real exchange rate.

Clarida and Gali (1994) and Farrant and Peersman (2004) estimate the model in relative variables, which implies that also relative shocks are identified. However, this does not provide any information about the relative importance of these shocks for the country as a whole. It is, for instance, perfectly possible that relative shocks explain only a very small proportion of total output fluctuations in a certain country. In addition, it is implicitly assumed that the propagation mechanism of the shocks is symmetric in both countries, which is questionable. We therefore extend the model to two countries with level variables and make a distinction between symmetric and asymmetric shocks. The variables that are used in the VAR are: domestic output (y_t), prices (p_t) and nominal interest rate (i_t), foreign output (y_t^*), prices (p_t^*) and nominal interest rate (i_t^*) and the real bilateral exchange rate (q). In order to identify the shocks, we introduce the following

[3] See Detken et al. (2002) or Bayoumi and Eichengreen (1994).

restrictions:

	y	p	i	y^*	p^*	i^*	q
symmetric supply	$\geqslant 0$	$\leqslant 0$	$\leqslant 0$	$\geqslant 0$	$\leqslant 0$	$\leqslant 0$	?
symmetric demand	$\geqslant 0$	$\geqslant 0$	$\geqslant 0$	$\geqslant 0$	$\geqslant 0$	$\geqslant 0$	?
symmetric monetary policy	$\leqslant 0$	$\leqslant 0$	$\geqslant 0$	$\leqslant 0$	$\leqslant 0$	$\geqslant 0$	?
asymmetric supply	$\geqslant 0$	$\leqslant 0$	$\leqslant 0$	$\leqslant 0$	$\geqslant 0$	$\geqslant 0$	?
asymmetric demand	$\geqslant 0$	$\geqslant 0$	$\geqslant 0$	$\leqslant 0$	$\leqslant 0$	$\leqslant 0$	$\leqslant 0$
asymmetric monetary policy	$\leqslant 0$	$\leqslant 0$	$\geqslant 0$	$\geqslant 0$	$\geqslant 0$	$\leqslant 0$	$\leqslant 0$
exchange rate	$\geqslant 0$	$\geqslant 0$	$\geqslant 0$	$\leqslant 0$	$\leqslant 0$	$\leqslant 0$	$\geqslant 0$

These restrictions are consistent with the theoretical model derived in Clarida and Gali (1994) and Farrant and Peersman (2004) as demonstrated above. We only introduce a distinction between symmetric and asymmetric shocks. A symmetric positive supply shock is a shock which has a positive effect on output and a negative effect on prices and the nominal interest rate in both countries simultaneously. After a positive symmetric aggregate demand shock, both countries experience a rise in output, prices and the interest rate. A symmetric restrictive monetary policy shock (rise in the nominal interest rate) has a negative effect on output and prices in both countries. The way we define the shocks takes into account the potential spill-over effects across both countries because of trade linkages. Idiosyncratic or asymmetric shocks could then rapidly be transmitted to the other country and become effectively common or symmetric shocks. This is what matters for countries sharing a currency union. Consider, for instance, an asymmetric shock in country A. If this shock is largely transmitted to country B through trade, a common monetary policy stance is still efficient for both countries. Because we estimate the model with separate variables for both countries, it is still possible that a symmetric shock has different effects in terms of magnitude in country A compared to country B or a different propagation. Accordingly, it is possible to check whether monetary policy has historically reacted differently to symmetric shocks in both countries by comparing the responses of i and i^*. This is also the reason why it is impossible to impose a restriction on the response of the real exchange rate after symmetric shocks. If the reaction of output, prices and the interest rate is the same in both countries, we do not expect the exchange rate to move. A reaction of the exchange rate, however, is possible if the magnitude of the reaction of these variables is different between the two countries. The data will determine this response.

The identification of asymmetric supply, demand and monetary policy shocks is again similar as in Farrant and Peersman (2004). We define an asymmetric shock as a shock which has the opposite effect, in terms of sign, in both countries. For instance, a positive asymmetric demand shock in country A has a positive effect on output, prices and the interest rate in country A, there is an appreciation of the real exchange rate and, output, prices and the interest rate in country B fall.[4] Finally, a pure positive exchange rate shock (depreciation in country A), has a positive effect on output, prices and nominal interest rate in country A, while there is a fall in all three variables in country B.

A crucial aspect of this method is the implicit timing allowed for the spill-over effects. In order to have an optimal monetary policy stance for both countries in a currency union, spill-overs have to be quick. If we impose the restrictions to be contemporaneously binding, only immediate spill-over effects of asymmetric shocks are considered as symmetric shocks. In contrast, if we only introduce the restrictions after a number of lags, sluggish spill-over effects are also considered as symmetric shocks. The robustness for alternative values will be discussed in Section 3, where we present the results.

3 Results

In this section, we present the estimation results. We provide empirical evidence for the UK versus the Euro area. The synchronization of the business cycles and the role of the exchange rate are two important issues in the assessment of the UK government to enter the Euro area. As a benchmark, we compare the results with a two-country VAR for the UK and the US. The analysis can easily be extended to other countries as well. The sample period for all estimations is the post Bretton Woods period, 1974-2002.[5] Consider

[4] Or output, prices and the nominal interest rate in country B, at least, do not rise because we use $\leqslant$ and $\geqslant$ restrictions.

[5] Estimations for shorter sample periods are available upon request but do not alter the main conclusions of the paper.

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 $(n\times1)$ matrix of constants, 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 domestic output (y_t), prices (p_t) and nominal interest rate (i_t), foreign output (y_t^*), prices (p_t^*) and nominal interest rate (i_t^*) and the real bilateral exchange rate (q). We estimate this VAR-model in levels. By doing the analysis in levels we allow for implicit cointegration relationships in the data, and still have consistent estimates of the parameters (Sims et. al., 1990).[6] Lag length is determined by standard likelihood ratio tests and AIC information criterion which turns out to be two for EA-UK and US-UK.

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:

$$R_{j,t+k}^{pq} \gtrless 0 \tag{2}$$

Following Uhlig (1999) and Peersman (2004b), we use a Bayesian approach for estimation and inference.[7] Our prior and posterior belong to the Normal-Wishart family used in the RATS manual for drawing error bands. Because there are an infinite number of admissible decompositions for each draw from the posterior when using sign restrictions, we use the following procedure. To draw the "candidate truths" from the posterior, we take a joint draw from the posterior for the usual unrestricted Normal-Wishart posterior for the VAR parameters as well as a uniform distribution for the rotation matrices. We then construct impulse response functions. If the impulse responses to an individual shock are consistent with the imposed conditions for this shock, the results for the specific shock are accepted. Otherwise, the draw is rejected, which means that this draw receives zero prior weight. Based on the draws kept, we calculate statistics and report the median responses, together with 84th and 16th percentiles error bands. For output and prices, the time period over which the sign constraints are binding, k, is set equal up to four quarters. For interest rates and the real exchange rate we only impose a restriction during

[6] Indeed, we cannot reject the existence of a cointegration relationship in all estimates reported in this paper.

[7] For a full explanation of the methodology, see Peersman (2004b).

one quarter because these are financial variables. More specifically, basic estimates are done with $k = 0, \ldots, 4$ for output and prices and $k = 0, 1$ for the interest rate and real exchange rate. We also discuss the results for a higher starting value of k (i.e. $k = 2, \ldots, 4$ for output and prices and $k = 2$ for interest rate and real exchange rate), which implies a longer period for spill-over effects to take place.

The estimation results can deliver us some policy relevant conclusions. We first perform an impulse response analysis in Section 3.1, which provides us information about the plausibility of the estimations and allows us to compare the responses across both countries. The relative importance of symmetric and asymmetric shocks is discussed in Section 3.2 using variance decompositions of output in both countries. We also make a historical analysis of the contribution of all shocks to output fluctuations. Section 3.3 describes the contribution of all shocks in determining the exchange rate.

3.1 Impulse response analysis

Impulse response functions are reported in Figures 1 and 2 for respectively EA-UK and US-UK. For each draw from the posterior, we also draw an impulse response function for the output, prices and interest rate differentials. This provides us additional information about the relative impact of each shock. Moreover, an insignificant reaction of the interest rate differential indicates that no asymmetric monetary policy reaction was required in both countries during the sample period, i.e. there is no cost of giving up an independent monetary policy. The figures report the median of the posterior (full black lines) together with 84th and 16th percentiles error bands (dotted lines) for the basic estimation results, i.e. estimations with contemporaneous imposed sign conditions. The grey lines are the impulse response functions (median of the posterior) with restrictions that are only binding two lags after the shocks, i.e. a longer period for spill-over effects is allowed.

After a symmetric supply shock, there is a persistent effect on output and prices and a temporary reaction of the nominal interest rates. The output and price effects are in the short-run significantly greater in the UK than the Euro area. This is not the case when we consider the effects of a symmetric supply shock in the US and UK, shown in Figure 2. This faster reaction in the UK and US might be a reflection of a more flexible economy and faster propagation mechanism in these countries.[8] However, we do not find a relevant different historical reaction of monetary authorities in both countries because the interest rate differential is not significantly different from zero, i.e. symmetric supply shocks would not have complicated a single stance of monetary policy. The latter is not the case after a symmetric demand shock. A higher interest rate shift is found for the UK because of a significant stronger short-run impact on output and prices. In the US-UK VAR, however, we do not find a different effect on output and interest rates after a symmetric demand shock. On the other hand, there are no significant differences after a symmetric monetary policy shock. Both countries experience a similar u-shaped reaction of output and a permanent fall of prices after a restrictive monetary policy shock. For all three symmetric shocks, as expected, we do not find a noticeable reaction of the real exchange rate.

The impulse response functions to an asymmetric supply, demand and monetary policy shock are reported in respectively the fourth, fifth and sixth row of Figures 1 and 2. Obviously, we do find a substantial asymmetric reaction in both countries and a different required monetary policy stance. We also find a significant reaction of the real exchange rate. Somewhat surprising, although only slightly significant, we find an appreciation of the real exchange rate after a positive asymmetric supply shock. This rather perverse effect, often also found for other currencies, is also found in Detken et al. (2002) and Farrant and Peersman (2004) for the Euro area. The output effects do also not seem to last very long. Variance decompositions, reported in Section 3.2, however, indicate that asymmetric supply shocks are relatively unimportant in explaining output fluctuations. Consistent with expectations, we find a considerable reaction of the real exchange rate after an asymmetric aggregate demand and monetary policy shock. There is a significant appreciation after a positive asymmetric demand shock and after a restrictive asymmetric monetary policy shock. Finally, after an exogenous depreciation of the real exchange rate, there is a temporary effect on output in both countries and a permanent effect on relative prices. The real exchange rate, however, returns to baseline after a number of quarters indicating that there is a permanent shift in the nominal exchange rate.

[8] See also Peersman (2004a) for a comparison of propagation mechanisms across countries.

Most of these results are very consistent with the impulse response functions in the US-UK. In addition, the results are also very robust with respect to the time period over which the restrictions are binding. If we allow a longer period for the spill-over effects to take place (grey lines in Figures 1 and 2), impulse response functions are very close to the results when we introduce contemporaneous constraints. The only relevant exception is the reaction of the real exchange rate to an asymmetric demand shock for the US-UK, which is much smaller in the very short-run. To summarize, most impulse response functions behave very plausible. We notice a monetary policy reaction which is greater in the UK compared to the Euro area after a symmetric demand shock.

3.2 The relative importance of symmetric and asymmetric shocks

Variance decompositions The forecast error variance decompositions of output in both countries are reported in Table 1. We only report the median estimates of the posterior distributions at a horizon of respectively 0, 4 and 20 quarters.[9] Based on these decompositions, we can measure the relative importance of all shocks. When the relative contribution of symmetric shocks is very high, synchronization of the business cycle is high and the cost for the UK to join the Euro area is relatively small. In contrast, if there is an important role for asymmetric shocks, giving up an independent monetary policy might be very costly.

Consider first the EA-UK VAR results. In the very short-run (0-4 quarters after the shocks), there is a major role for symmetric shocks in explaining the UK business cycle: around 75 percent of the forecast error variance. 19 percent is explained by asymmetric shocks and 5 percent by exchange rate shocks. Taking into account that exchange rate shocks and asymmetric monetary policy shocks will disappear in a monetary union, there is only around 10-13 percent left which is explained by asymmetric supply and demand shocks. In the long-run (after 20 quarters), however, this share rises to 20-25 percent depending on the horizon of the imposed conditions. The relative contribution of pure exchange rate shocks also rises to around 15 percent after 20 quarters. If we consider

[9] Full results are available upon request. The median of the posterior when the restrictions are only imposed 2 lags after the shocks are reported between parenthesis.

Euro area output, the contribution of asymmetric shocks is much larger, being more than 50 percent in the very short-run and still almost 30 percent in the long-run. Comparing the results with the US-UK VAR, we find a lower contribution of asymmetric shocks in the long-run, which means a higher synchronization of the cycles in the US and UK.[10] For the latter two countries, however, we find an important role for asymmetric demand shocks in explaining output fluctuations in the short-run. As we will discuss in Section 3.3, these shocks will mainly be accommodated by the exchange rate. In sum, we find that symmetric shocks with the Euro area are very important in explaining the UK business cycle. The contribution of asymmetric shocks, however, cannot be ignored in the long-run. In addition, the UK cycle seems to be more synchronized with the US. The contribution of asymmetric shocks is much smaller in these two countries.

Historical decompositions Figures 3 and 4 show the historical contributions of all shocks to the output levels in all areas as percentage points deviations from baseline obtained from respectively the EA-UK and US-UK VARs. This means that output can be written as the sum of a deterministic component (baseline) and the contribution of current and past shocks. For reasons of legibility, we only show the median estimates.

The early 80's recession in the UK and Euro area was mainly driven by negative symmetric supply and demand shocks. This recession, however, was much more severe and lasted longer in the UK because of a substantial contribution of negative idiosyncratic demand and pure exchange rate shocks. Also at the beginning of the 90's, the slowdown was stronger in the UK because of negative asymmetric demand and exchange rate shocks. In addition, there was an important role for asymmetric supply shocks and too restrictive monetary policy during the ERM period of the UK. The new-economy period between 1995 and 2000 was, as expected, to a large extent determined by positive symmetric supply shocks. Moreover, there were also considerable positive effects of symmetric demand shocks and stimulating monetary policy. These results are consistent with the findings of Peersman (2004b). The new-economy was also clearly more an Anglo-Saxon phenomenon. The contribution of symmetric supply shocks is much larger in the US-UK VAR.

[10] The contribution of symmetric shocks is around 75 percent in the long run for the US-UK. In contrast, this is only 53-57 percent in the EA-UK VAR.

3.3 The determination of the exchange rate

Variance decompositions Table 2 decomposes the variance of the exchange rate into the contribution of symmetric and asymmetric supply, demand and monetary policy shocks, and pure exchange rate noise for respectively the EA-UK and US-UK. The contribution of exchange rate shocks reflects the role of the exchange rate as a source of shocks. If this contribution is high, there is little role for the exchange rate as a stabilization mechanism. We find a very high contribution of exchange rate noise in the very short run, explaining 45 percent of Sterling-Euro fluctuations within one quarter. This contribution is still substantial in the long run, i.e. 18 percent after twenty quarters. When we only impose the restrictions from lag 2 after the shocks onwards, the contribution is somewhat lower at 14 percent in the very short-run and 15 percent after five years. These values are much higher than the original Clarida and Gali (1994) results and even slightly higher than the Farrant and Peersman (2004) results. On the other hand, the contribution of pure exchange rate shocks is still remarkably lower than the results obtained in Artis and Erhmann (2000). Somewhat surprising, the contribution of symmetric shocks to the exchange rate is more than 30 percent. For the US-UK VAR, the results are very similar. We notice a major role for asymmetric demand shocks in the long-run. These explain 35 percent of exchange rate variability after 20 quarters, which should stabilize the large output effects obtained in the very short-run (see Section 3.2) Generally, we find a significant role for the exchange rate acting as a source of shocks in the EA-UK and the US-UK VAR.

Historical decompositions Historical contributions of all shocks to the Euro-Sterling and Dollar-Sterling exchange rates are presented in Figure 5. We notice a considerable role for asymmetric and pure exchange rate shocks in explaining Sterling fluctuations over time against the Euro and Dollar. Focusing on the most recent period, the appreciation of Sterling against the Euro between 1996 and 2001 was mainly the result of asymmetric demand shocks and exchange rate shocks. A similar story emerges for the US versus the UK. Both shocks had a significant upward effect on the real Dollar/Sterling exchange rate.

4 Conclusions

Several countries will probably join EMU in the near future or are facing the choice to join the Eurozone. The traditional starting point for this issue is the theory of Optimum Currency Areas. According this theory, the member countries of a currency area should experience similar movements of the business cycle. Differences in cyclical situations can complicate monetary policy. A single stance of monetary policy is then not optimal for the individual countries. Therefore, an important part of the costs to join the Euro area or other currency areas depends on the synchronization of the business cycles, i.e. the relative importance of symmetric and asymmetric shocks. A related question is the role of the exchange rate as a stabilization mechanism against asymmetric shocks. The latter is often considered as being an important source of independent shocks rather than an adjustment mechanism.

In this paper, we have provided evidence for the UK versus the Euro area on both topics. The results are compared versus the US as a benchmark. To do so, we have estimated two-country structural VAR models. Symmetric supply, demand and monetary policy shocks are identified as well as asymmetric supply, demand, monetary policy and exchange rate shocks. We propose an identification strategy which is based on recent sign restrictions. The results indicate a very important role for common shocks with the Euro area in explaining output fluctuations in the UK. The relative importance of asymmetric supply and demand shocks, however, cannot be ignored. Both shocks explain about 20 percent in the long-run, which is economically significant. The degree of synchronization seems to be higher with the US. Moreover, we find a significant stronger reaction of the UK policy rate after a symmetric demand shock. On the other hand, we find a considerable role for the exchange rate as an independent source of shocks. Exchange rate disturbances against the Euro explain around 15 percent of UK output fluctuations and almost 20 percent of the exchange rate in the long-run.

In interpreting the results, some caution is required. It is not possible to say how data generated from a period when the economies operate under a given regime will change when a new monetary regime is established, i.e. the introduction of the Euro. An extension of this paper could be an application to current members of the Eurozone some time after the introduction of the Euro, once enough data is available. Related extensions are analyzing other countries who have joined the European Union recently and might introduce the Euro relatively soon such as a large number of ascension countries.

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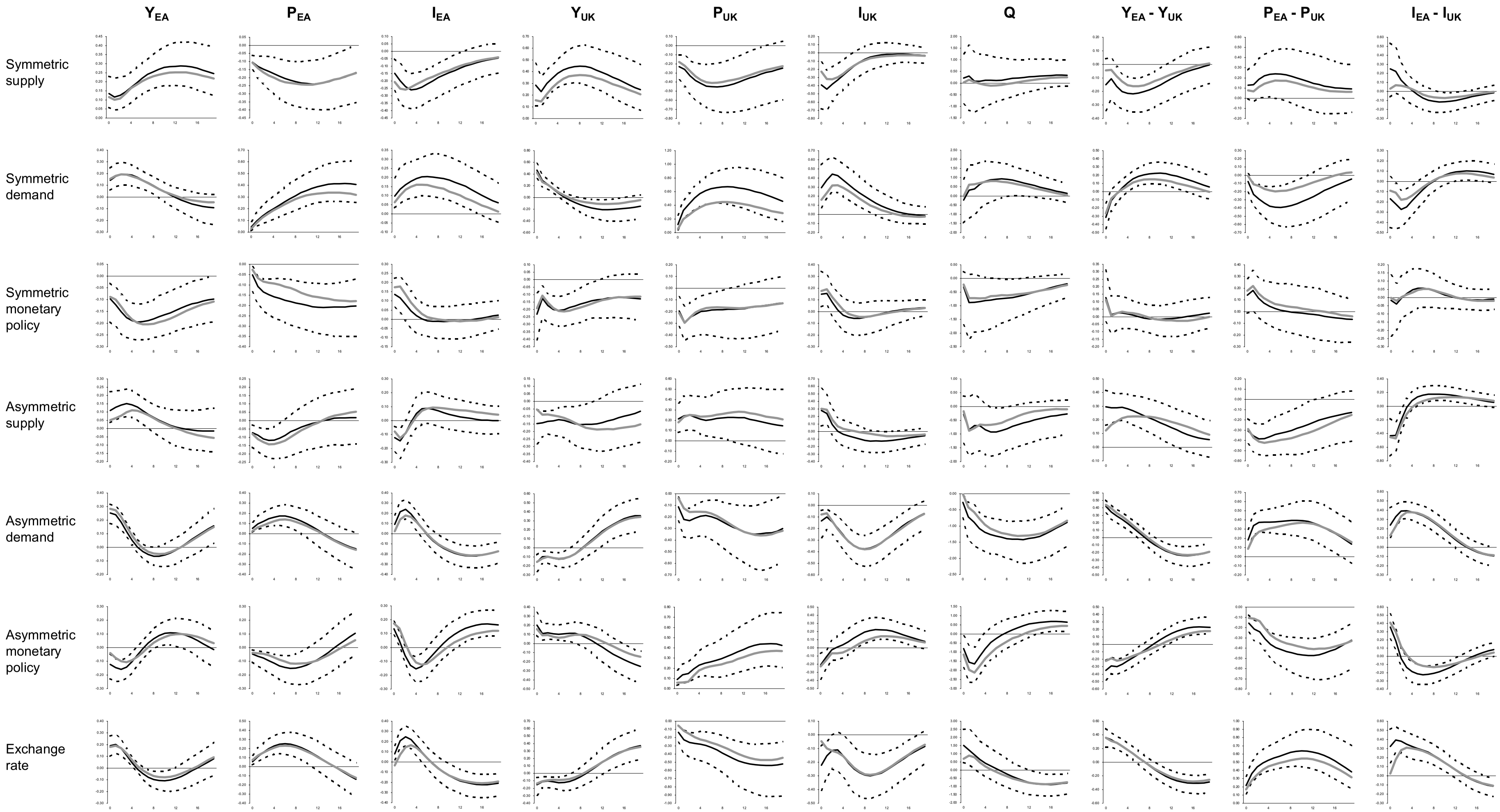
Figure 1 - Euro area / United Kingdom - Impulse response functions



Note: Median impulse responses from the posterior with 16th and 84th percentiles error bands. Grey line is median impulse response when restrictions are only imposed 2 lags after the shocks

Figure 2 - United States / United Kingdom - Impulse response functions

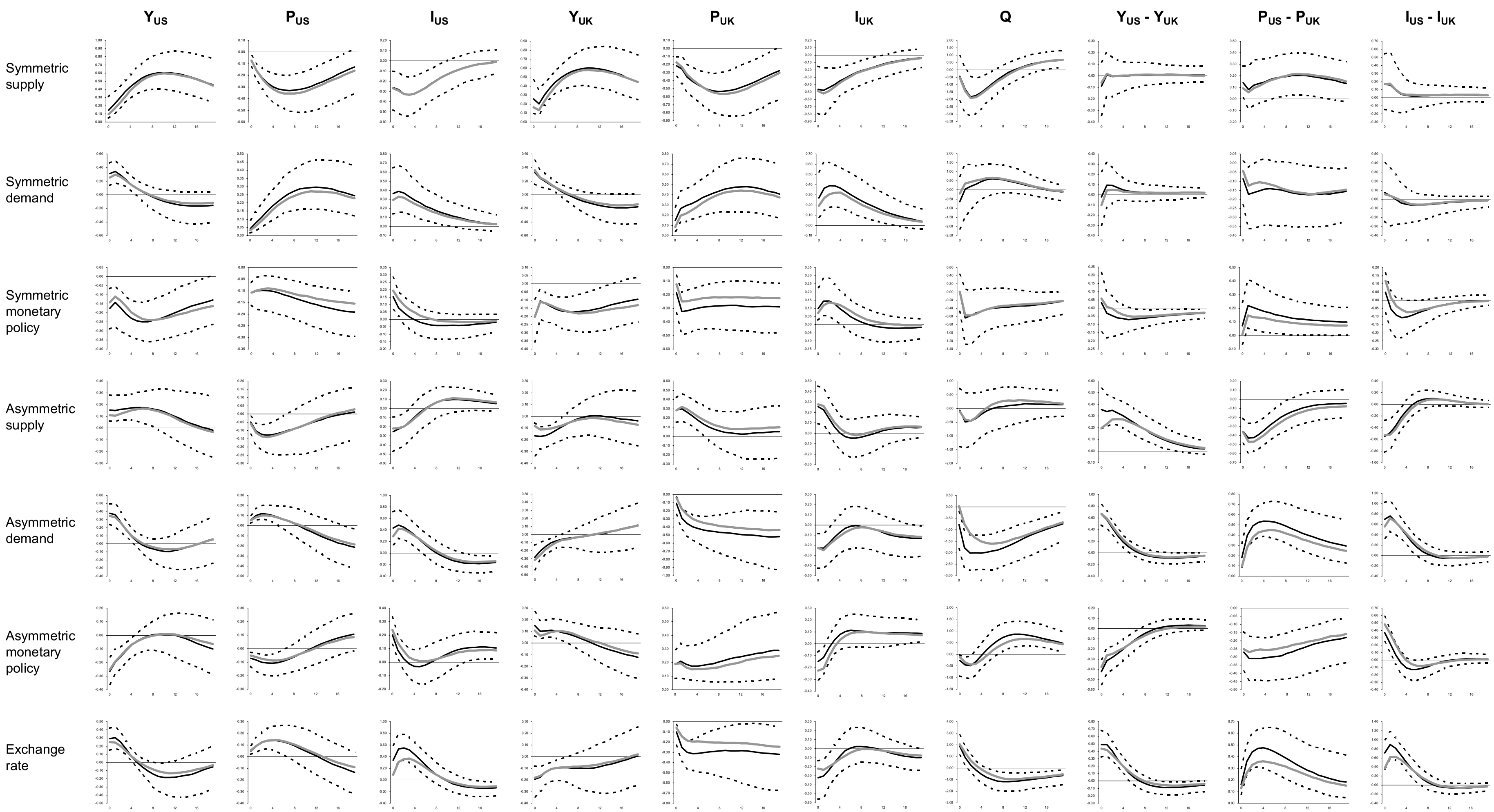


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Figure 3 - Euro area / United Kingdom - historical decompositions of output

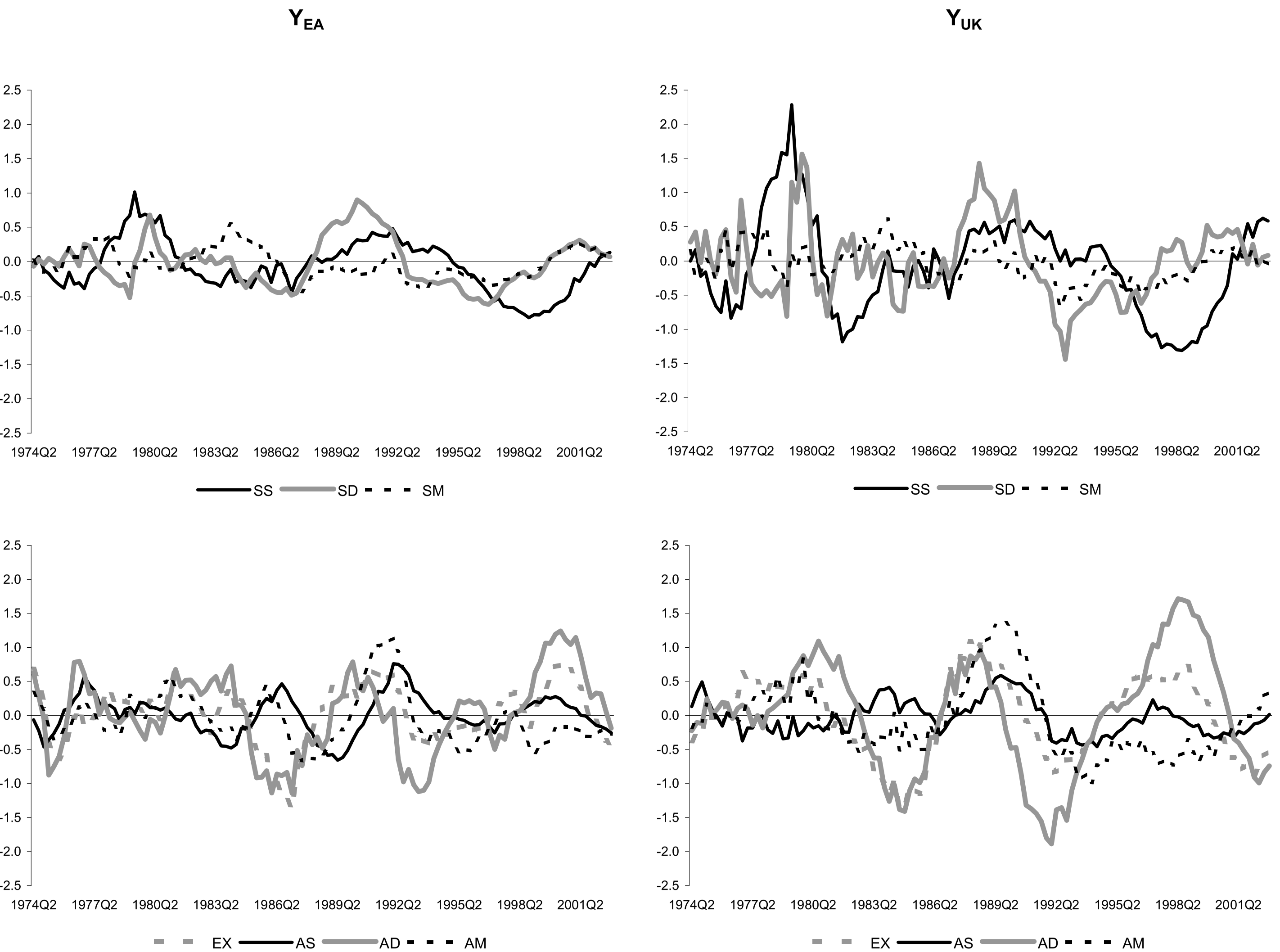


Figure 4 - United States / United Kingdom - historical decompositions of output

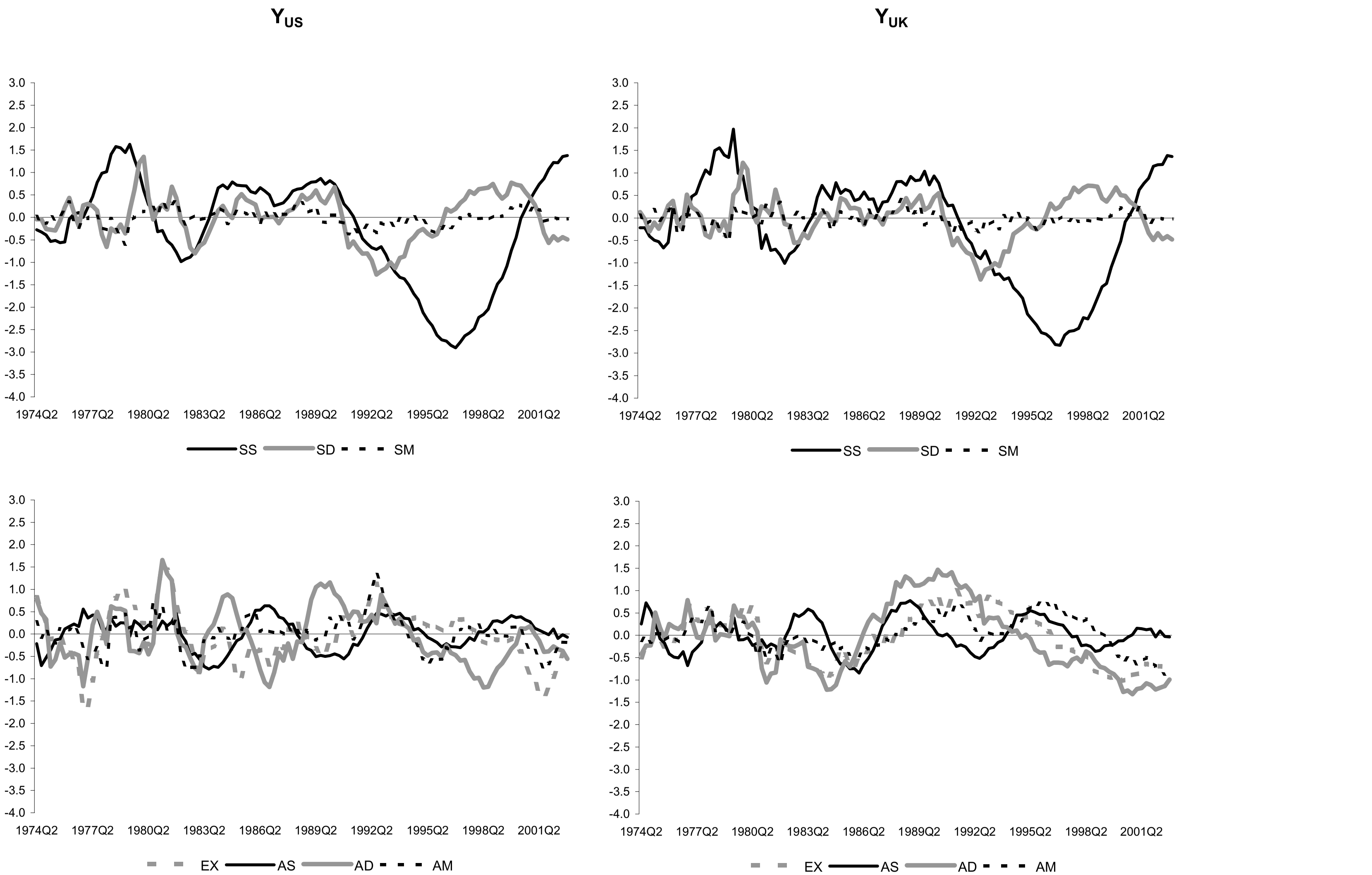
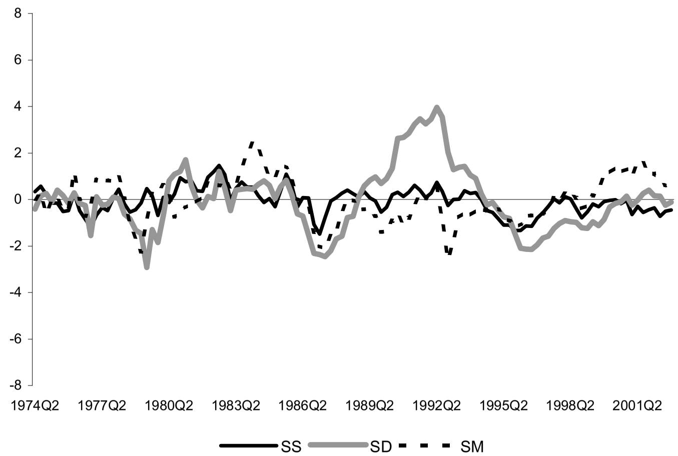
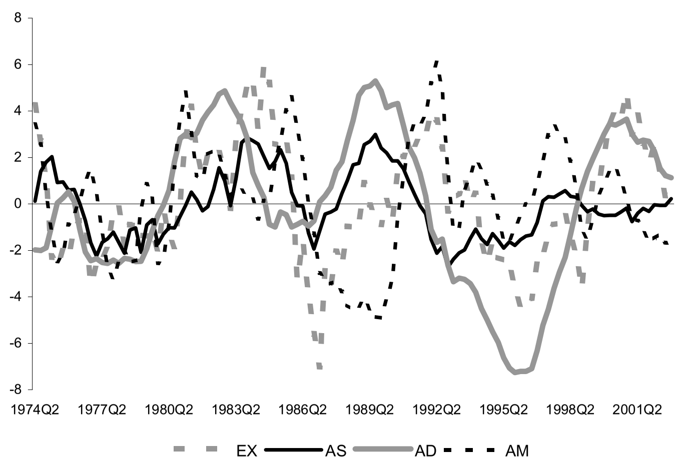


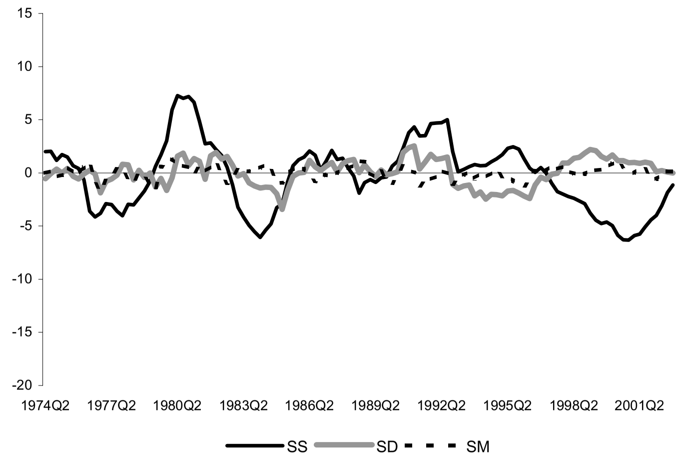
Figure 5 - Historical decompositions of the exchange rate

EA - UK





US - UK



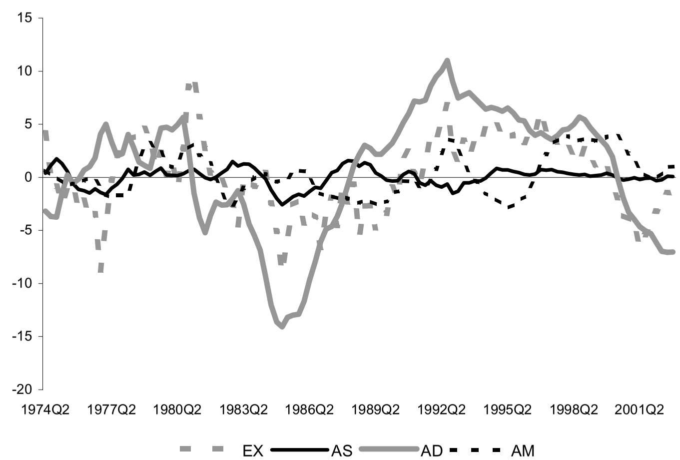


Table 1 - Forecast error variance decomposition of output

Euro area - United Kingdom VAR

	EA output			**UK output**		
	0 quarters	4 quarters	20 quarters	0 quarters	4 quarters	20 quarters
Symmetric shocks	**28 (28)**	**44 (44)**	**62 (63)**	**76 (77)**	**75 (76)**	**57 (53)**
supply	10 (8)	12 (11)	35 (32)	18 (9)	35 (26)	36 (32)
demand	12 (15)	19 (20)	12 (12)	47 (56)	26 (33)	12 (11)
monetary policy	5 (5)	13 (13)	15 (18)	12 (12)	14 (16)	9 (10)
Asymmetric shocks	**52 (52)**	**43 (41)**	**28 (28)**	**19 (17)**	**19 (19)**	**29 (32)**
supply	7 (3)	11 (6)	8 (7)	5 (2)	7 (5)	7 (9)
demand	37 (47)	20 (30)	11 (14)	5 (8)	6 (8)	13 (16)
monetary policy	9 (3)	11 (5)	8 (7)	9 (8)	7 (6)	9 (6)
Exchange rate shocks	**20 (19)**	**13 (15)**	**10 (9)**	**5 (6)**	**6 (6)**	**14 (15)**

United States - United Kingdom VAR

	US output			**UK output**		
	0 quarters	4 quarters	20 quarters	0 quarters	4 quarters	20 quarters
Symmetric shocks	**32 (29)**	**52 (50)**	**70 (73)**	**56 (56)**	**65 (63)**	**75 (76)**
supply	5 (5)	25 (24)	52 (55)	17 (9)	39 (31)	60 (59)
demand	21 (18)	19 (19)	10 (9)	28 (36)	17 (23)	10 (10)
monetary policy	6 (6)	9 (8)	8 (9)	11 (11)	8 (9)	6 (7)
Asymmetric shocks	**50 (54)**	**34 (37)**	**21 (20)**	**34 (35)**	**26 (28)**	**18 (17)**
supply	5 (4)	7 (6)	7 (7)	7 (4)	9 (5)	6 (5)
demand	31 (33)	19 (22)	9 (9)	21 (27)	12 (18)	7 (8)
monetary policy	15 (17)	8 (9)	4 (4)	6 (4)	5 (4)	5 (4)
Exchange rate shocks	**18 (17)**	**14 (12)**	**9 (7)**	**10 (9)**	**9 (9)**	**7 (7)**

Note: median values of the posterior, normalised to sum to 100; median when restrictions are only imposed 2 lags after the shocks in parenthesis

Table 2 - Forecast error variance decomposition of the exchange rate

	EA - UK			**US - UK**		
	0 quarters	4 quarters	20 quarters	0 quarters	4 quarters	20 quarters
Symmetric shocks	**34 (40)**	**38 (33)**	**31 (31)**	**33 (27)**	**42 (54)**	**31 (38)**
supply	12 (13)	11 (9)	9 (9)	16 (16)	27 (35)	18 (23)
demand	14 (17)	15 (14)	12 (12)	16 (10)	12 (13)	9 (10)
monetary policy	7 (10)	12 (11)	9 (10)	1 (1)	4 (6)	4 (5)
Asymmetric shocks	**21 (47)**	**47 (59)**	**50 (54)**	**15 (12)**	**44 (29)**	**50 (43)**
supply	7 (8)	12 (12)	11 (10)	6 (5)	6 (8)	7 (8)
demand	1 (2)	13 (7)	25 (24)	9 (6)	36 (18)	35 (28)
monetary policy	13 (37)	22 (40)	15 (21)	1 (1)	2 (3)	8 (7)
Exchange rate shocks	**45 (14)**	**15 (8)**	**18 (15)**	**52 (60)**	**14 (17)**	**19 (18)**

Note: median values of the posterior, normalised to sum to 100; median when restrictions are only imposed 2 lags after the shocks in parenthesis

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