How are monetary and financial shocks transmitted between the U.S. and the Euro Area ?*

Carlo Favero and Francesco Giavazzi†

September 2008

1 Introduction

This paper is an empirical investigation of the transmission of monetary and financial shocks between the United States and the Euro Area. We first identify monetary and financial shocks in the U.S. and in the Euro Area and we then study how financial markets (both bond and stock markets) in each region react to such shocks. By "monetary shocks" we mean innovations in the interest rates controlled, respectively, by the Federal Reserve and by the ECB that are orthogonal to innovations in other financial variables–bond and equity prices. By "financial shocks" we mean innovations in financial markets (we do not separately identify innovations in bond and stock markets) that are orthogonal to monetary innovations. We use twenty years of monthly data: ten before the start of the European Monetary Union (EMU) and ten since. This allows us to investigate whether the introduction of the euro has affected the transmission mechanism. Our main objective are: (i) to understand how many and which shocks are relevant to understand bond and stock market fluctuations in the two regions and (ii) to evaluate the importance of monetary policy shocks and ask whether their effect–or that of any other shock–has changed since the introduction of the euro.

We have asked a related question in a previous paper (Favero and Giavazzi, 2008). There, however, we only considered bond markets; stock markets were excluded. Our main findings were that (ten year) bond prices in the Euro Area are mainly explained by U.S. shocks and by the systematic response of U.S. and Euro Area variables to

*Paper prepared for 2008 ESI meeting, Basel

†IGIER-Univeristà Bocconi and CEPR; IGIER-Università Bocconi, CEPR and NBER

such shocks. Monetary policy shocks–both before and after the euro and both in the U.S. and in the Euro Area–have no effect on unpredictable fluctuations in bond prices: these are determined by innovations in term premia. Within the Euro Area systematic monetary policy by the ECB–which responds to U.S. variables both before and after the euro–was found to be much more important in the determination of long-term yields than monetary shocks originating from the central bank's decisions. Here we extend the analysis by explicitly modelling the interaction between bond and stock markets. This allows us to study if the co-movements in stock and bond markets–both within each region and across the two regions– have changed since the euro was introduced and if such patterns are consistent with a causal relation between the four markets.

The paper complements and merges different strands of literature at the interface between macro and finance. On the macro side recent efforts to understand the relation between monetary policy and asset prices in the context of DSGE models have been generally conducted in a closed economy framework (see for example Bernanke and Gertler, 2001, Nisticò, 2005). Our results show that–at least for the Euro Area–such models are seriously mis-specified and suggest what should be the minimum dimension of a model that tries to understand the interactions between Euro Area and U.S. financial markets.

The financial literature on the other hand has studied cross-country co-movement in asset prices using high frequency data (where heteroscedasticity is important) without, however, including monetary policy variables in the analysis (see for example Richards, 1999). Other papers (e.g. Barberis, 2001, Campbell and Viceira, 2002) have included included period returns of risky and safe assets in the VAR, to assess how the volatility of asset returns varies with the investment horizon, in the light of the predictability of bond, stock and bill returns. When the VAR parameters estimates are used to compute conditional volatility of real stock returns at different horizons, these papers typically find a decrease in volatility: from 45.2 per cent at the monthly horizon to 23.7 per cent at the ten-year horizon (Barberis, 2001) in the context of a simple bivariate VAR for stock market returns and the dividend-yield, and a reduction from 18 per cent at the one-year horizon to 14 per cent at the 25-year horizon in a less parsimoniously parameterized VAR for bonds, bills and stocks. International comovements in asset prices are usually not considered in this literature, even when the framework for analysis is appleid to European countries, such as France (Bec and Gollier,2007).

2 A first look at the data

We start by showing, in Figure 1, the main variables that will be used in the paper: U.S. and Euro Area monetary policy rates (Fed Funds and Eonia rates respectively), yields to maturity on 10-year benchmark government bonds in the U.S. and in Germany, and the earnings-price ratios on U.S. and German stock markets [1]. We chose the earning-price ratio as our stock market variable because we are interested in long-term yields on different assets, and the empirical evidence suggests that the earnings-price ratio is the appropriate variable to be used when investigating the arbitrage relationships between stock and bond markets (see for example the FED model of the stock market in Lander et al., 1997) [2].

Our sample extends from January 2000 to June 2008. It can thus be divided into two balanced sub-samples for the pre-EMU and the post-EMU periods. The data show a very high correlation between U.S. and German bond yields that only slightly decreases after January 1999. The correlation between the two stock markets is also decreasing when moving form the first to the second sub-sample, but its level is lower in both sub-samples. There is also evidence of a decoupling between U.S. and German stock market returns in the first part of the second sub,sample. Monetary policy rates, instead, appear to behave quite differently. The correlation between Fed Funds and Eonia rates is negative in the first sub-sample and increases sharply to 0.54 after January 1999.

When studying the relation between monetary policy and financial returns one must recognize that monetary policy affects financial returns not only via the current policy rate, but also via the expected (discounted) stream of monetary policy rates over the life of the relevant financial asset [3]. In other words, it is not (or not mainly) current monetary policy rates that move long-term yields but expected future policy rates. We shall thus start from the construction of a variable that measures expected future policy rates.

[1] All data are from Datastream. The identifiers are BDI60B, FEDFUNDS, BMBD10Y(RY), BMUS10Y(RY), TOTMKUS(PE), TOTMKBD(PE), respectively.

[2] The empirical evidence we report remains essentially unchanged if instead of the earnings- price ratio we use dividend-yields, and if instead of the German stock market we consider an indicator for the whole Euro Area market (TOTMKEM in Datastream)

[3] At least this was the standard wisdom until recently. We shall discuss in the concluding section the relevance of our results to the "new" balance sheet view of the transmission of monetary policy.

3 Results

The baseline model for our empirical analysis–including the construction of future expected policy rates–is a Vector Autoregression for a vector of variables $\mathbf{y}_t$

$$\mathbf{y}_t = \mathbf{A}_t(L)\mathbf{y}_{t-1} + \mathbf{u}_t \quad (1)$$

$$\mathbf{y}_t = \begin{bmatrix} i^{US}_{t,t+1} \\ i^{US}_{t,t+120} \\ EP^{US}_t \\ i^{GER}_{t,t+1} \\ i^{GER}_{t,t+120} \\ EP^{GER}_t \end{bmatrix}$$

The short term rates $i^{US}_{t,t+1}$, $i^{GER}_{t,t+1}$ are the policy rates: the Federal Funds rate for the U.S., the policy rate set by the Bundesbank up to 1999:1, and the Eonia overnight rate thereafter. The long-term rates, $i^{US}_{t,t+120}$, $i^{GER}_{t,t+120}$ are the yields to maturity on 10-year benchmark government bonds. EP^{US}_t and EP^{GER}_t are the earning-price ratios for the U.S. and the German stock market index. These are the data that were shown in Figure 1.

We choose the lag length of the VAR using standard criteria to find an optimal number of lags. We exclude the exchange rate from the VAR as some experimetation has shown that exchange rates tend to fluctuate independently of the variables included in our VAR: all the results reported in the paper are robust to the consideration of an extended version of the VAR that includes the change in the **bilateral** nominal (Deutsche mark/dollar and euro/dollar) exchange rate. $\mathbf{A}_t$ is denoted as time-varying because we estimate the VAR over two different samples: 1990:1-1998:12 and 1999:1-2008:6.

As we already mentioned, we use this VAR to construct expected monetary policy rates by decomposing nominal yields at time t on a bond of maturity $T-t$ and coming due at time T ($i_{t,T}$) into the weighted sequence of expected future policy rates, which we denoted with $i^*_{t,T}$, and a term premium, $TP_{t,T}$

$$\begin{aligned} i_{t,T} &= i^*_{t,T} + TP_{t,T} \quad (2) \\ &= \frac{1-\gamma}{1-\gamma^{T-t}} \sum_{j=1}^{T} \gamma^{j-1} E_t i_{t+j-1,t+j} + TP_{t,T} \end{aligned}$$

Equation (2) applies the linearized expectations model of Shiller (1979).

$\gamma = 1/(1+\bar{R}))$, where $\bar{R}$ is the steady state yield to maturity empirically approximated by the sample mean of observed yields to maturity.

Denoting with $\mathbf{Z}_t = \mathbf{A}_t\mathbf{Z}_{t-1} + \mathbf{u}_t$ the stacked representation of (1) we construct $i_{t,T}^{*,US}$, and $i_{t,T}^{*,EU-GER}$ as follows

$$
\begin{aligned}
i_{t,T}^{*,US} &= \frac{1-\gamma_{US}}{1-\gamma_{US}^{T-t}}\sum_{j=1}^{T}\gamma_{US}^{j-1}e_3'\mathbf{A}_t^{j-1}\mathbf{Z}_t \\
i_{t,T}^{*,EU-GER} &= \frac{1-\gamma_{GER}}{1-\gamma_{GER}^{T-t}}\sum_{j=1}^{T}\gamma_{GER}^{j-1}e_7'\mathbf{A}_t^{j-1}\mathbf{Z}_t \\
T &= t+120
\end{aligned}
$$

We then generate term premia as residuals. The validity of our estimated term premia thus depends on how closely the VAR-based expectations for future policy rates at different horizons track the true agents' expectations.

3.1 Dealing with for cointegration

The VAR in (2) is specified in levels. We begin our empirical investigation by using Johansen's (1995) procedure to check for the presence, in our system, of long-run cointegrating relationships, and—in case they exist—by estimating the parameters that determine them. In Table 1 we report the results for each of the two sub-samples.

[**Insert Table 1 here**]

Since as all variables included in our VAR are returns, we rule out the presence of a deterministic trend in the data. The number of cointegrating vectors appears to be the same in the two sub-samples: in each case we reject the null of at most zero cointegrating vectors, but we can never reject the null of at most one cointegrating vector. (2) can thus be re-specified as a Vector Error Correction as follows

$$\Delta \mathbf{y}_t = \mathbf{A}_{1,t}\Delta \mathbf{y}_{t-1} + \boldsymbol{\alpha}_t \boldsymbol{\beta}_t' \mathbf{y}_{t-1} + \mathbf{u}_t \tag{3}$$

$$\boldsymbol{\alpha} = \begin{bmatrix} \alpha_1 \\ \alpha_2 \\ \alpha_3 \\ \alpha_4 \\ \alpha_5 \\ \alpha_6 \end{bmatrix}, \boldsymbol{\beta} = \begin{bmatrix} \beta_1 \\ \beta_2 \\ \beta_3 \\ \beta_4 \\ \beta_5 \\ \beta_6 \end{bmatrix}$$

where the $\boldsymbol{\beta}$ coefficients determine the shape of the cointegrating relation while the $\boldsymbol{\alpha}$ coefficients determine the speed of adjustment of each variable whenever it deviates from its the long-run relationship. We find in Table 1 that the coefficients on all variables are always significant over the two sub-samples with the only exception of the coefficient on $i_{t,t+1}^{US}$ in the first sub-sample.

The cointegrating relation is not stable over the two samples: the signs of the coefficients on $i_{t,t+120}^{US}$ and $(E/P)_t^{US}$ switch before and aftre 1999. The evidence of a single cointegrating vector among the six variables suggests the presence of just five permanent shocks in our six-variable system: this means that one of the assets we consider does not have an idiosyncratic permanent component. The significance of the $\boldsymbol{\beta}$ coefficients allows to reject the presence of zero restrictions on any coefficient in each sub-sample.[4] Also all restrictions that limit the cointegrating space to any subsets of our variables (such as pairwise cointegration of the bond and stock markets across the Atlantic) appear to be inconsistent with the data.

The $\boldsymbol{\alpha}$ coefficients are more stable across the two sub-samples and consistently indicate that the variable that reacts in a stronger and more significant way to the disequilibium in $\mathbf{y}$ is the German/Euro Area monetary policy rate. This means that the most endogenous variable in the system is Bundesbank/ECB monetary policy.

Taken together, the estimates of the $\boldsymbol{\alpha}$ and the $\boldsymbol{\beta}$ coefficients suggest that while prior to 1999 the Bundesbank seems to have reacted to disequilibria between the U.S. bond and stock markets on the one side, and between the European bond and stock markets on the other, after 1999 the ECB seems to have reacted to disequilibria between the two bond markets and the two stock markets.

[4] In particular the data reject the FED model (Lander et al., 1997)) for the U.S. and the German stock markets because this model implies zero restrictions on the coefficients on all non-domestic variables and on domestic monetary policy rates.

3.2 Evidence from reduced form residuals

Given the specification of our statistical model (3), we shall now attempt to identify structural shocks and to estimate their impact on the variables in $\mathbf{y}_t$. In order to do this it is useful to start by computing the correlation of the reduced form residuals: this will allow us to check the degree of simultaneity in the system and will thus suggest the a set of identifying restrictions. Table 2 shows the correlation matrix of the reduced form residuals–the innovations in the VECM system–in each sub-sample

[**Insert Table 2 here**]

Overall the degree of simultaneity across innovations in the two sub-samples is not high: the only exceptions are the correlation between U.S. and German stock markets and U.S. and German bond markets after January 1999. Innovations in German/European monetary policy rates are never correlated with innovations in bond and stock prices; the correlation between German/European and U.S. policy rates is instead always significant but switches sign in the two sub-samples. The response of financial markets innovations to U.S. monetary policy is moderate in the first sub-sample and not significant in the second one. The correlation between innovations in stock and bond markets within each region is moderate and declines over time, again changing sign. The highest correlation is the one between innovations in the same market across the two regions: not only it is the highest, it also increases over time.

What we take away from this evidence is that the important identifying assumption is related to the causal ordering between U.S. and Euro Area financial markets. The ordering of monetary policy shocks seems less relevant: orthogonal monetary policy shocks will not differ substantially from VAR innovations, independently from the identification scheme adopted, especially for the German/Euro Area case.

3.3 A useful experiment

Before moving to impose full-fledged identification assumptions we run a useful experiment. We investigate what Euro Area financial yields would have looked like had the region been hit *only* by U.S. shocks. To do this we just need to identify U.S. shocks from local Euro Area shocks: we do so by assuming that U.S. monetary and financial variables do not contemporaneously react to German|Euro Area ones, while the symmetric restriction is not imposed.

To build these artificial yields we set to zero the Euro area shocks and simulate the model using only the three U.S. shocks and the systematic response of all variables to them. To allow for the possibility that parameters change in January 1999 we run the counterfactual experiment estimating the VAR separately over each sub-sample.

Figure 2 shows the result of our experiment. Both the artificial German bond yield and the artificial earnings/price ratio are very close to the historical rates. In other words, German asset prices are explained almost perfectly by U.S. shocks and by the systematic response of U.S. and European variables to them. This was true before EMU and continues to be true today: there is no visual evidence of a break between the pre-EMU and the post-EMU samples. In particular the decoupling of the two stock markets in the period following January 1999 is–at least to sizeable extent–also present in the counterfactual variable: thus it cannot be (at least entirely) attributed to the new importance to local shocks in EMU, but to rather do a different propagation mechanism of the same type of shocks that used to hit the two regions before EMU was formed. The lesson we draw from this exercise is that the models used to analyze monetary policy in the Euro Area should not overlook the transmission to the area of shocks which originate in the U.S., because such shocks are crucial in determining the behaviour of Euro Area variables, including the policy rule followed by the ECB.

3.4 Evidence from structural shocks

Using the evidence so far, we now try to identify monetary policy and fianancial shocks in each region and to analyze their impact on the variables in $\mathbf{y}_t$. In order to identify structural monetary shocks we make an additional assumption: we assume that monetary policy does not simultaneously react to innovations in financial markets.

To assess the reliability of this identifying assumption we compare the monetary policy shocks identified using this assumption with those identified from a different VAR: one which includes the output gap, inflation and monetary policy rates, and where we impose the traditional identifying assumption that it takes at least one period for macroeconomic variables to react to monetary policy (see e.g. Christiano et al., 1999). We find (the results are not reported here but are available) that the monetary policy shocks identified imposing these two very different assumptions are highly correlated with each other in both sub-samples. Moreover, the monetary shocks identified from our monetary-financial VAR are not correlated with the innovations in output gaps and inflation generated by the macro-money VAR. This evidence suggests that if were to use the shocks identified from our monetary-financial VAR in a standard money- macro VAR, we would obtain impulse responses identical to those generated by traditionally identified shocks.

Next we use the structural shocks estimated imposing these identifying assumptions to compute a variance-decomposition exercize and impulse response functions. Our assumptions do not allow us to identify, separately, bond market and stock market shocks. We shall thus only decompose varaince of forecasting errors into two sources: monetary policy shocks and financial shocks, which are not explicitly separated into bond market shocks or the stock market shocks.

3.4.1 Variance decomposition

Table 3 shows the results from the variance decomposition exercise, that is the share of the variance of the forecasting errors of bond and stock yields, at short (one month) and long (ten years) horizons, that can be attributed to U.S. and Euro Area monetary and financial (i.e. bond market and stock market) shocks.

Insert Table 3 here

The most striking fact in Table 3 is that German/Euro Area monetary policy shocks play essentially no role in explaining the variance of forecasting errors for either bond or stock yields, both on impact and at longer horizons. The introduction of the euro does not change this evidence.

U.S. monetary policy plays a more important role in explaining fluctuations in domestic (U.S.) financial markets, with the evidence being stronger in the first sub-sample. U.S. monetary policy is more important in determining fluctuations in the U.S. stock market than it is in determining fluctuations in the U.S. bond market, and this evidence strengthens in the second sub-sample. Also, U.S. monetary policy shocks count more than local monetary policy shocks in explaining German/Euro Area financial market fluctuations—although the impact of U.S. monetary policy shocks on German/Euro Area financial yields is limited, as such yields are mostly determined by U.S. and local financial (non-monetary policy) shocks. Interestingly, the importance of U.S. financial (non-monetary policy) shocks in explaining German\Euro Area financial variables has increased after January 1, 1999, especially for the stock market.

3.4.2 Impulse responses

We use the structural shocks constructed using our identification assumptions to analyze impulse responses. Impulse responses are reported in Figures 3 and 4. The comparison of impulse responses across the two sub-samples reveals a remarkable change in the response to U.S. monetary policy shocks. This is true for bond yields, both in the Euro Area and in the U.S., and for German/ECB policy rates. In each case the sign of the (point estimates) of the response changes between one sub-sample and the other. This is not true, however, for earning-price ratios in both regions, whose response to U.S. monetary policy shocks does not change significantly before and after 1999. There is also no change in the response to German/ECB policy shocks: in this case the absence of a structural break appears in each variable: bond yields, earning-price ratio, etc. :confidence intervals for the first and second sub-samples always overlap.

This evidence suggests that the apparent decoupling of Euro Area and U.S. stock markets after the start of EMU cannot be ascribed to a change in the response of financial variables to European monetary policy shocks. Instead the decoupling seems to be associated with a change in the response to U.S. monetary policy shocks. Bond yields respond differently before and after 1999, but the change is similar for U.S. and Euro Area yields. Instead the change in the response of stock markets differs in the Euro Area and in the U.S.: there is virtually no change in the response of U.S. earnings, while earnings in the Euro Area respond differently before and after 1999.

Finally, while the U.S. term premium always decreases following a contractionalry monetary policy shock implemented by the FED, the negative correlation between U.S. and ECB monetary policy shocks in the second sub-sample implies that after 1999 term premia in the Euro Area decrease in response to a U.S. monetary policy shock, while they used to increase in the first sub-sample.

4 Conclusions

In a previous paper (Favero and Giavazzi, 2008) we had shown that bond yields in the Euro Area are mostly driven by U.S. shocks and by the systematic response of the monetary policy of the ECB to such shocks. The present paper shows that the result is confirmed when we the analysis is extended to allow for an interaction between bond and equity markets in the two regions. This suggests that any model designed to study monetary and financial interactions between the Euro Area and the U.S. should have the following minimum structure: it should allow for five independent persistent shocks hitting, respectively, monetary policy, stock markets and bond markets in the two regions. The only variable that does not have an idiosyncratic permanent component appears to be monetary policy in the Euro Area. This fact was true before EMU, when monetary policy in what is now the Euro Area was run by the Bundesbank, and remained true after EMU was formed.

As was the case for bond yields, we find that the correlation between stock markets in the U.S. and in the Euro Area has decreased after the adoption of the euro. There is also evidence of a "decoupling" between U.S. and German stock market returns in the first part of the second sub-sample. The analysis of impulse responses suggests that this apparent "decoupling" has little to do the shift in Euro Area monetary policy from the Bundesbank to the ECB. The decoupling is not the result of a change in the response of financial variables to Euro Area monetary policy shocks. Rather it seems to be associated with a change in the response of financial yields to U.S. monetary policy shocks: bond yields respond differently before and after 1999, but the change is similar for U.S. and Euro Area yields; instead, the change in the response of stock markets is different in the Euro Area compared with the U.S.: there is virtually no change in the response of U.S. earnings to monetary policy shocks induced by the Fed, while earnings in the Euro Area respond differently to Fed shocks before and after 1999. This paper doesn't have the ambition to understand the mechanism that lies behind this difference, but it points to a fact that cries for a mechanism.

Finally our results shed some light on the new "balance sheet" view of the transmission of monetary policy. Adrian and Shin (2008) suggest that what matters for the transmission of monetary policy is the current policy rate, rather than the expected sequence of future policy rates. This is because–as the 2007-08 crisis according to the authors has shown—an important channel for the transmission of monetary policy are those financial institutions that mark their balance sheets "to market": changes in policy rates affect the economy by changing the value of the balance sheets of such institutions and thus their ability to lend–either directly or indirectly by buying securatized loans from other banks. However, as Adrian and Shin (2008) document in Figure 2 of their paper, marked-to market balance sheets become important in the transmission mechanism starting from the mid-nineties.

Our impulse responses show that, after 1999, bond yields—both in the U.S. and in the Euro Area–stop responding significantly to monetary policy shocks. However monetary policy shocks could still affect the economy as in the Adrian and Shin(2008) transmission mechanism what matters is the current monetary policy rate. Note also that the fact that monetary policy shocks are not significant in explaining asset price fluctuations does not rule out the role of systematic monetary policy.

Moreover we find that inside the Euro Area bond and equity prices do not respond to shocks induced by the ECB, while, as we mentioned, both respond to Fed shocks. It is thus the U.S. monetray policy that affects the Euro Area even when the transmission channel goes the the balance sheet of Euro Area banks.

References

[1] Adrian, T. and h. S. Shin (2008), "Financial Intermediaries, Financial Stability and Monetray Policy", presented at the 2008 Federal Reserve Bank of Kansas City Jackson Hole Symposium.

[2] Bec, F., and C. Gollier, (2007), Assets returns volatility and investment horizon: The French case, mimeo, University of Toulouse 1.

[3] Amisano, G. and C. Giannini (1997), *Topics in Structural VAR Econometrics*, Springer-Verlag.

[4] Barberis, N. (2000), Investing for the Long Run when Returns are Predictable, *Journal of Finance*, 55, 1, 225-264.

[5] Bernanke, B. S. and M. Gertler (2001), " Should Central Banks Respond to Movements in Asset Prices?, "*American Economic Review,-Papers and Proceedings*, 91, 253-257.

[6] Bonfiglioli A. and C. Favero.,"Explaining co-movements between stock markets: The case of U.S. and Germany", *Journal of International Money and Finance*, 24 (2005), 1299-1316.

[7] Campbell, J.Y., and L.M. Viceira, (2002), *Strategic asset allocation,* Oxford University Press, Oxford.

[8] Favero C. and F. Giavazzi (2008), "Should the Euro area be run as a Closed Economy?" *American Economic Review-Papers and Proceedings,* 98(2), pp. 138-45.

[9] Johansen, S. (1995). *Likelihood Based Inference on Cointegration in the Vector Autoregressive Model.* Oxford: Oxford University Press.

[10] Nisticò, S. (2005), "Monetary Policy and Stock Price Dynamics in a DSGE Framework", LUISS Lab on European Economics, Working Paper 28.

[11] Richards A.J. "Comovements in national stock market returns: Evidence of predictability, but not cointegration." *Journal of Monetary Economics*, 36 (1995), 631-654.

[12] Shiller, R. (1979), "The Volatility of Long Term Interest Rates and Expectations Models of the Term Stucture", *Journal of Political Economy,* 87, 1190-1219.

Table 1: Cointegration analysis							
1990-1998	Johansen Max Eigenvalue (intercept in CV, no trend in the data)						
	number of CV	Eigen	Max Eigen Stat	0.05 CV	Prob		
	at most 0	0.463	67.06	40.95	0.0000		
	at most 1	0.250	31.12	34.806	0.1291		
	Cointegrating vector and adjustment coefficients						
		$i^{US}_{t,t+1}$	$i^{US}_{t,t+120}$	$(E/P)^{US}_t$	$i^{GER}_{t,t+1}$	$i^{GER}_{t,t+120}$	$(E/P)^{GER}_t$
	β	0.075 0.25	-3.34 0.75	1.44 0.53	1	-0.94 0.58	2.15 0.40
	α'	-0.02 0.009	-0.025 0.012	-0.001 0.01	-0.053 0.008	-0.001 0.01	-0.07 0.024
1999-2008	Johansen Max Eigenvalue (intercept in CV, no trend in the data)						
	number of CV	Eigen	Max Eigen Stat	0.05 CV	Prob		
	at most 0	0.375	53.02	40.95	0.0014		
	at most 1	0.258	33.81	34.806	0.0653		
	Cointegrating vector and adjustment coefficients						
		$i^{US}_{t,t+1}$	$i^{US}_{t,t+120}$	$(E/P)^{US}_t$	$i^{GER}_{t,t+1}$	$i^{GER}_{t,t+120}$	$(E/P)^{GER}_t$
	β	-0.72 0.11	3.68 0.51	-0.62 0.22	1	-3.18 0.38	0.75 0.16
	α'	0.059 0.02	-0.05 0.03	-0.019 0.02	-0.067 0.01	0.015 0.029	-0.13 0.079

Table 2.1: Correlation of VAR innovations 1990-1998

	$i^{US}_{t,t+1}$	$i^{US}_{t,t+120}$	$(E/P)^{US}_t$	$i^{GER}_{t,t+1}$	$i^{GER}_{t,t+120}$	$(E/P)^{GER}_t$
$i^{US}_{t,t+1}$	*1*					
$i^{US}_{t,t+120}$	*0.31* (3.33)	*1*				
$(E/P)^{US}_t$	*0.28* (2.95)	*0.38* (4.16)	*1*			
$i^{GER}_{t,t+1}$	*−0.28* (−3.11)	*0.07* (0.76)	*−0.09* (−0.98)	*1*		
$i^{GER}_{t,t+120}$	*0.06* (0.62)	*0.39* (4.40)	*0.24* (2.50)	*0.06* (0.66)	*1*	
$(E/P)^{GER}_t$	*0.06* (0.68)	*0.04* (0.48)	*0.42* (4.45)	−0.07 (−0.07)	*0.36* (3.98)	*1*

t-stat for the null $\rho = 0$ within brackets

Table 2.2: Correlation of VAR innovations 1999-2008

	$i^{US}_{t,t+1}$	$i^{US}_{t,t+120}$	$(E/P)^{US}_t$	$i^{GER}_{t,t+1}$	$i^{GER}_{t,t+120}$	$(E/P)^{GER}_t$
$i^{US}_{t,t+1}$	*1*					
$i^{US}_{t,t+120}$	−0.03 (−0.33)	*1*				
$(E/P)^{US}_t$	*0.06* (0.62)	*−0.19* (−2.04)	*1*			
$i^{GER}_{t,t+1}$	*0.35* (3.94)	*−0.10* (−1.15)	*−0.04* (−0.49)	*1*		
$i^{GER}_{t,t+120}$	*0.001* (0.01)	*0.64* (8.83)	*−0.31* (−3.45)	*0.02* (0.31)	*1*	
$(E/P)^{GER}_t$	*0.009* (0.096)	*−0.23* (−2.51)	*0.72* (11.02)	−0.13 (−1.47)	*−0.28* (−3.15)	*1*

t-stat for the null $\rho = 0$ within brackets

Table 3: Variance decomposition of 10-year rates and Earning\Price ratio

sample			**US-MP**	**US-F,NMP**		**EU-MP**	**EU-F,NMP**
90-98							
$i^{US}_{t,t+120}$	1-step		9.5	90.5		0	0
	120-step		14.8	73.3		0.4	11.5
$(E/P)^{US}_t$	1-step		7.6	92.4		0	0
	120-step		42.4	55		0.3	2.3
$i^{GER}_{t,t+120}$	1-step		0.3	16.7		0.3	82.7
	120-step		5	29		2	64
$(E/P)^{GER}_t$	1-step		0.4	19.2		0.6	79.8
	120-step		12.7	42.7		1.6	43
99-08							
$i^{US}_{t,t+120}$	1-step		0.1	99.9		0	0
	120-step		2.6	90.3		3.6	3.5
$(E/P)^{US}_t$	1-step		0.3	99.7		0	0
	120-step		21.6	77.1		0.3	1
$i^{GER}_{t,t+120}$	1-step		0.0001	45		0.6	54.4
	120-step		4.4	40		0.9	54.7
$(E/P)^{GER}_t$	1-step		0.008	53.3		1.3	45.4
	120-step		3.5	58		0.4	38.1

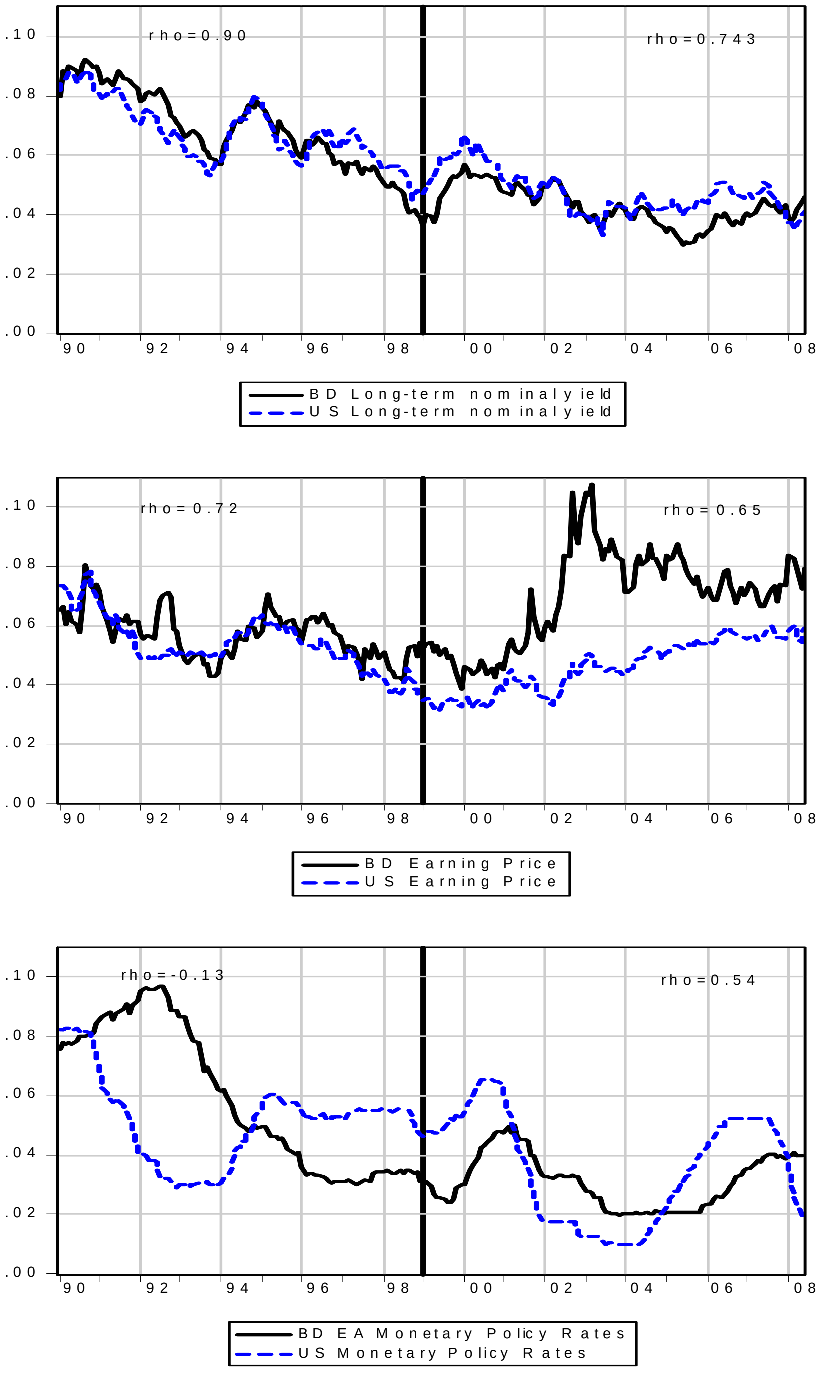

Figure 1: monetary policy and asset prices in US and the euro area

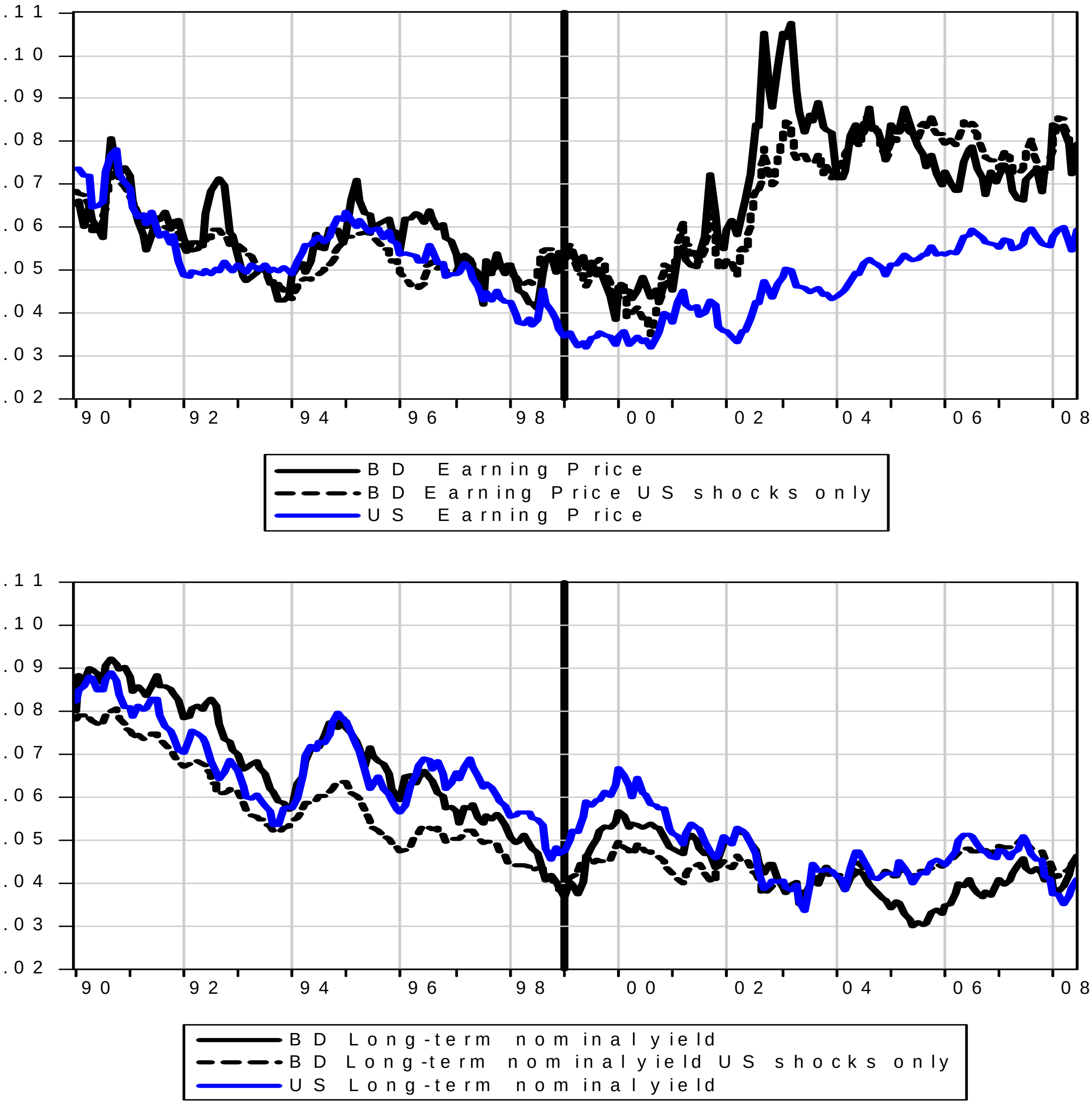

Figure 2: A counterfactual experiment

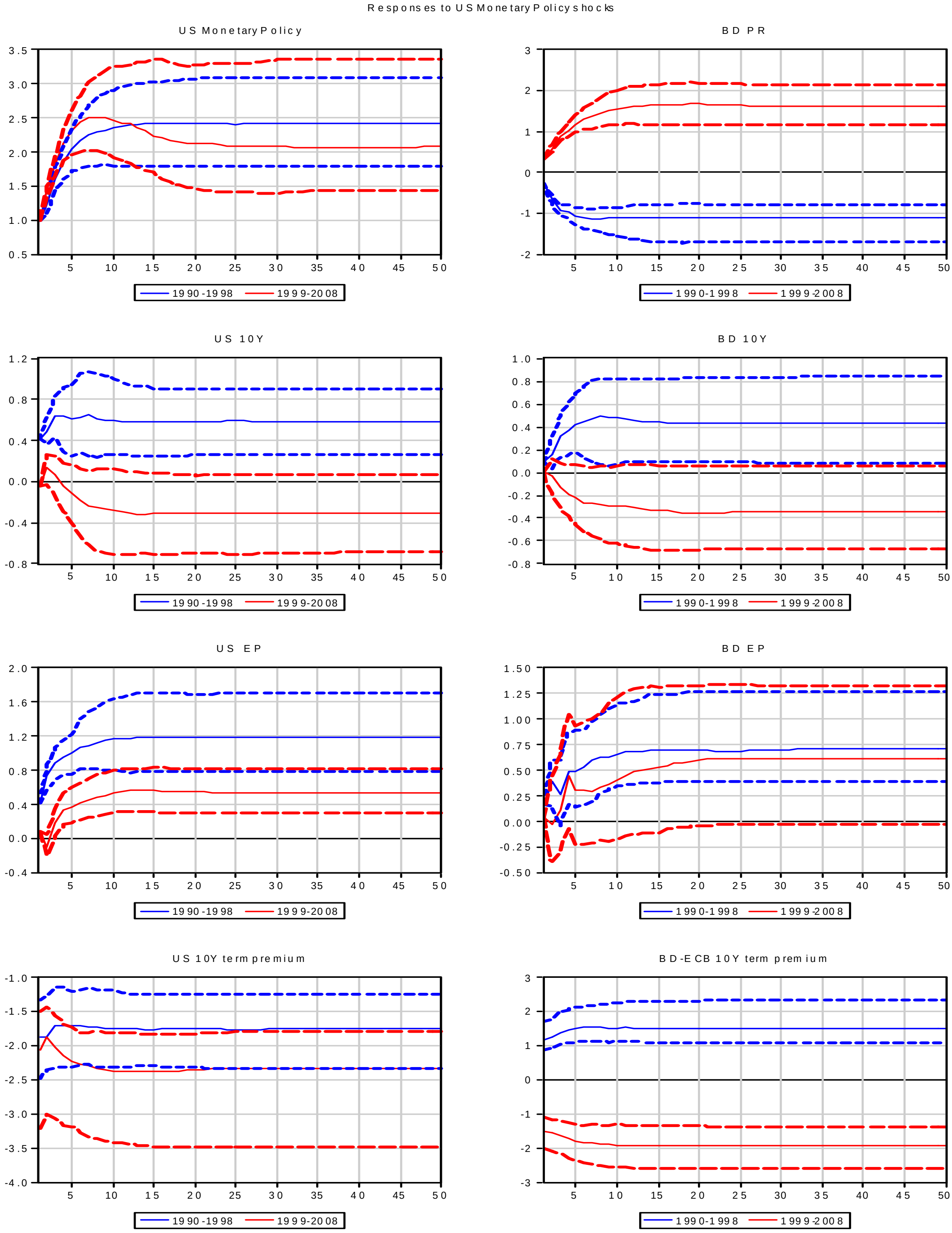

Figure 3: Impulse Responses to US monetary policy shocks

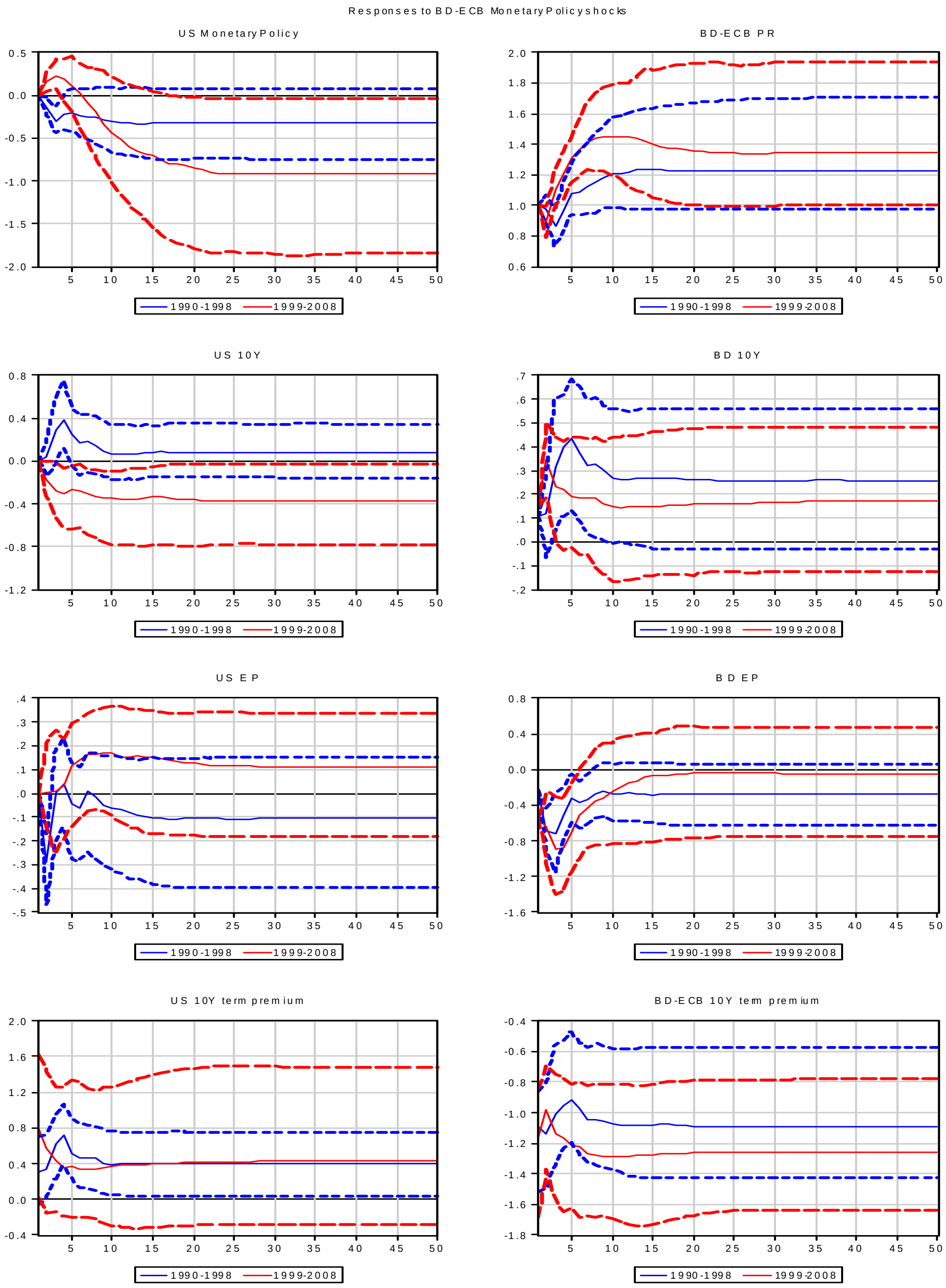

Figure 4: Impulse Responses to BD-ECB monetary policy shocks