Should the Euro Area be Run as a Closed Economy?*

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The European Economic and Monetary Union (EMU) has created a new economic area, larger and closer with respect to the rest of the world. Area-specific shocks are thus more important in EMU than country-specific shocks used to be in the previous states, e.g. in Germany. It is thus not surprising that the models used to determine optimal monetary policy in the Euro area (for instance Smets and Wouters, 2004,) assume that this works essentially as a closed economy, hit by domestic shocks—i.e. the same assumption made in standard models of U.S. monetary policy (see e.g. Christiano et al., 1999), where all shocks are domestic with the only possible exception of energy price shocks.

This paper studies monetary policy in the Euro area looking at the variable most directly related to current and expected monetary policy, the yield on long term government bonds. We explore how the behaviour of European long-term rates has been affected by EMU and whether the response of long-term rates to monetary policy has got any closer to that consistent with a closed economy.

We find that the level of long-term rates in Europe is almost entirely explained by U.S. shocks and by the systematic response of U.S. and European variables to these shocks. The systematic component of European monetary policy responds to U.S. variables more than it does to local variables. This was true for the Bundesbank before EMU and remains true for the ECB since the start of EMU.

We also find that unpredictable fluctuations in long-term rates are driven by shocks to term premia,.not to monetary policy. This means that the ECB can affect long rates only through the systematic component of its monetary policy—which, as we have seen, mostly responds to U.S. variables. Monetary policy "shocks" induced by the ECB have virtually no effect on long rates.

Claiming that monetary policy in the Euro area can be determined as if the region were a closed economy is thus not consistent with the empirical evidence on

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the determinants of Euro area long-term rates.

1 Long rates in the Euro area: has EMU made a difference?

Figure 1 shows the evolution of Euro area and U.S. long term interest rates over the past three decades. We measure long rates in the Euro area with the yield on 10-year German benchmark government bonds: we thus abstract from credit and liquidity spreads that vary both among Euro sovereign bonds issued by different governments and between corporate and sovereign bond. Along with European long rates Figure 1 shows the evolution of U.S. long rates: the 10-year benchmark U.S. Treasury. We note two facts: (i) the correlation between European and U.S. yields has always been high (*rho* in Figure 1 indicates the coefficient of correlation between the two series), (ii) the levels of the two yields, which were different in the 1980s, have converged to the same unconditional mean since the early 1990s.

To understand why Euro area and U.S. long rates are so highly correlated and why they have converged, we decompose them into their systematic component—i.e. the response of long rates to other macro and policy variables—-and the shocks that affect them. We do so by considering the following Vector AutoRegression:

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

$$\text{where } \mathbf{y}_t = \begin{bmatrix} \mathbf{y}_t^{US} \\ \boldsymbol{\pi}_t^{US} \\ i_{t,t+1}^{US} \\ i_{t,t+120}^{US} \\ \mathbf{y}_t^{EU-GER} \\ \boldsymbol{\pi}_t^{EU-GER} \\ i_{t,t+1}^{GER} \\ i_{t,t+120}^{GER} \end{bmatrix} \quad \mathbf{A} = \begin{bmatrix} \mathbf{A}_{11} & \mathbf{0} \\ \mathbf{A}_{21} & \mathbf{A}_{22} \end{bmatrix}$$

The eight variables in $\mathbf{y}_t$ are:

- $\mathbf{y}_t^{US}$ and $\mathbf{y}_t^{EU-GER}$ are measures of the output gap computed by applying the Hodrick-Prescott filter to the log of industrial production. The filter is one-sided and it is computed recursively in real time, that is the output gap at time t uses only information available at time t . $\mathbf{y}_t^{EU-GER}$ is obtained using German industrial production up to 1998:12 and Euro area industrial production from 1999:1 onward;

- $\boldsymbol{\pi}_t^{US}$ and $\boldsymbol{\pi}_t^{EU-GER}$ are annual inflation rates (based on consumers prices). $\boldsymbol{\pi}_t^{EU-GER}$ is obtained by considering German data up to 1998:12 and the Euro area HCPI index from 1999:1 onward;

- the short term rates $i_{t,t+1}^{US}, i_{t,t+1}^{GER}$ are the policy rates: the Federal Funds rate for the U.S., the German policy rate up to 1999:1, and the Euro area overnight rates thereafter;

- the long-term rates, $i_{t,t+120}^{US}, i_{t,t+120}^{GER}$ are the yields to maturity on 10-year benchmark U.S. and German government bonds.

The lag length of the VAR is decided on the basis of standard selection criteria. Imposing $\mathbf{A}_{12} = 0$ we make the assumption that U.S. variables do not respond to Euro area variables—an assumption consistent with the evidence suggesting that the U.S. behaves by and large as a closed economy.

To study whether EMU has made a difference to long rates in the Euro area we run a simple experiment. The assumption $\mathbf{A}_{12} = 0$ is sufficient to identify the shocks orginating in the U.S. and those originating in the Euro area. We can thus run a counterfactual experiment: what would Euro area long rates look like had the region been hit only by U.S. shocks? To build these artificial interest rates we set to zero the Euro area shocks and simulate the model using only the four U.S. shocks and the systematic response of all variables to them. To allow for the possibility that parameter values differ among sub-periods, we have run the counterfactual experiment estimating the VAR over three separate sub-samples: the 1980s, the 1990, and the period: 1999-2007. The 1980s were characterized by a pegged exchange rate regime; in the 1990s European exchange rates were essentially flexible after the devaluations of 1992 and were later characterized by the tranistion to EMU; 1999-2007 is the EMU sample.

Figure 2 shows the result. The artificial rates are virtually identical to the historical rates: in other words, the level of German long-term rates is almost completely explained 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 also no visual evidence of a break between the pre-EMU and the post-EMU sample.

2 What drives long rates in the Euro area?

To better understand what determines long rates in the Euro area, we now consider the effects of monetary policy and other structural shocks—i.e. of innovations in the variables in $\mathbf{y}$. To analyze the effect of structural shocks we first need to identify them: the assumption $\mathbf{A}_{21} = 0$ is no longer sufficient, since it only allows us to distinguish between shocks originating in the Euro area and in the U.S.. Our VAR includes eight variables. We identify four financial shocks: two monetary policy and two non-monetary policy shocks, respectively in the U.S. and in the Euro area. Monetary policy shocks are deviations from the systematic response of the two central banks to macroeconomic variables. Non monetary financial shocks are —as we shall see in Figure 3 analyzing impulse responses—shocks to term premia: thus from now on we shall refer to them as "term premia shocks". We do not identify the shocks to the two macro variables, inflation and the output gap: we just consider them as macro shocks.

We obtain identification making the following assumption on the contemporaneous relations among the variables in the VAR: all macro variables react with at least a one-month lag to financial variables. Financial variables react simultaneously to macroeconomic developments. Monetary policy does not react to financial shocks in the month they happen. The recursive structure between to U.S. and the Euro area imposed on the VAR ($\mathbf{A}_{21} = 0$) is assumed to hold also for the simultaneous relation among shocks.

We impose these identification assumptions on the relation, $C\,\boldsymbol{\epsilon} = B\mathbf{u}$, between the the eight VAR residuals u and the structural shocks

$$\boldsymbol{\epsilon} = \begin{bmatrix} \epsilon_t^{US,MP} & \epsilon_t^{US,TP} & \epsilon_t^{US-macro} & \epsilon_t^{US-macro} & \epsilon_t^{EU,MP} & \epsilon_t^{EU,TP} & \epsilon_t^{EU-macro} & \epsilon_t^{EU-macro} \end{bmatrix}'$$

this implies restricting B to be a diagonal matrix (i.e. standardizing the shocks) and imposing upon C the following restrictions

$$C = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ c_{21} & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ c_{31} & c_{32} & 1 & 0 & 0 & 0 & 0 & 0 \\ c_{41} & c_{42} & c_{43} & 1 & 0 & 0 & 0 & 0 \\ c_{51} & c_{52} & 0 & 0 & 1 & 0 & 0 & 0 \\ c_{61} & c_{62} & 0 & 0 & c_{65} & 1 & 0 & 0 \\ c_{71} & c_{72} & c_{73} & c_{74} & c_{75} & c_{76} & 1 & 0 \\ c_{81} & c_{82} & c_{83} & c_{84} & c_{85} & c_{86} & c_{87} & 0 \end{bmatrix}.$$ [1]

[1]These assumptions are often used to identify U.S. monetary policy shocks (see, for example,

We study the effects of structural shocks considering the forecasting error we observe when we use our VAR to predict European long-term rates in the future. Our identification assumptions allow us to decompose the variance of these forecasting errors in six orthogonal components: monetary policy, term premia and macro shocks (a combination of shocks to inflation and output gaps) in the U.S. and in the Euro area. We compute the variance of the forecasting error at two different horizons: one-month ahead and 120-months (ten years) ahead. The exercize is repeated for three subsamples. The results are Table 1

Table 1: Variance decomposition of European 10-year rates

		U.S. shocks			**Euro area shocks**		
sample		**macro**	**MP**	**TP**	**macro**	**MP**	**TP**
79-89	1-step	*0.09*	*0.06*	*0.21*	*0.02*	*0.01*	*0.62*
	120-step	*0.35*	*0.11*	*0.24*	*0.11*	*0.05*	*0.14*
90-98	1-step	*0.03*	*0.01*	*0.11*	*0.04*	*0.01*	*0.80*
	120-step	*0.27*	*0.01*	*0.25*	*0.33*	*0.01*	*0.12*
99-07	1-step	*0.01*	*0.01*	*0.38*	*0.05*	*0.01*	*0.57*
	120-step	*0.12*	*0.06*	*0.18*	*0.30*	*0.04*	*0.30*

- the forecasting variance of long rates attributable to monetary policy (MP) shocks remains extremely small throughout the three decades. In particular it has not changed significantly since the start of EMU. This is true at both horizons;

- since the start of EMU the share of the forecasting variance (at the 10-year horizon) attributable to Euro area idiosyncratic macro and term premia shocks has increased. In the 1999-2007 sample 60% $(0.30 + 0.30)$ of the variance of the forecasting error at 10-year horizon is attributable to local non-monetary policy shocks; this share was 45% in the previous decade $(0.33 + 0.12)$.

- the 1-month ahead forecasting error is always almost totally explained by a combination of U.S. and Euro area term premia shocks. Here the share of the U.S. variable does not decrease over time.

Christiano et al. 1999) and shocks to U.S. long-term rates (see Evans and Marshall 1998 and Edelberg and Marshall 1996). The restrictions they imply satisfy the rank and order conditions for identification discussed in Amisano and Giannini (1997).

The analysis of the variance decomposition shows that when Euro area long rates deviate from their systematic component, this is because of shocks to the term premium. We shall now use our VAR to better understand such shocks.

2.1 Term premia shocks

To understand the effect on long rates of term premia shocks we decompose the nominal yield at time t on a $T-t$-year bond coming to maturity at time T, $i_{t,T}$, in the weighted sequence of expected future policy rates—which we denoted with $i^*_{t,T}$—and a term premium.

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

Equation (2) applies the linearized expectations model of Shiller (1979). It is derived from a no-arbitrage condition: expected one-period returns from holding a long-term bond must be equal to the one-period risk-free interest rate, plus a one-period term premium. For long term bonds bearing a coupon C, the one-period holding-return is a non-linear function of the yield to maturity $i_{t,T}$. Following Shiller we linearize (2) in the neighborhood of $i_{t,T} = i_{t+1,T} = \bar{R} = C$

$$E[h_{t,T} \mid I_t] = E\left[\frac{i_{t,T} - \gamma_T i_{t+1,T}}{1-\gamma_T} \mid I_t\right] = i_{t,t+1} + \phi_{t,T} \quad (3)$$

where $h_{t,T}$ is the one-period holding return of a bond with maturity date T, I_t is the information set available to agents at time t, $i_{t,t+1}$ is the short-term (one-period) risk free interest rate, γ_T is a constant arising from the linearization of (2) and which depends on the maturity of the bond. (For long-term bond such a constant can be approximated by $1/(1+\bar{R})$, since $\lim_{T\longrightarrow\infty} \gamma_T = \gamma = 1/(1+\bar{R})$). $\phi_{t,T}$ is the term premium—defined over a one-period horizon—required for holding for one period a bond with residual maturity $T-t$. Solving equation (3) forward we obtain (2) , where $TP_{t,T}$ is the term premium over the entire residual life of the bond.

To compute (2) we need forecasts of future policy rates. Denoting with $\mathbf{Z}_t = \mathbf{A}_t \mathbf{Z}_{t-1} + \mathbf{u}_t$ the stacked representation of our estimated VARs, we construct $i^{*,US}_{t,T}$, and $i^{*,EU-GER}_{t,T}$ as follows

$$i_{t,T}^{*,US} = \frac{1-\gamma_{US}}{1-\gamma_{US}^{T-t}} \sum_{j=1}^{t+120} \gamma_{US}^{j-1} e_3' \mathbf{A}_t^{j-1} \mathbf{Z}_t$$

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

and generate the term premia as residuals. The validity of our estimated term premia depends on how closely the expectations for future short term rates, constructed with our VAR, track the true agents expectations.

Figure 3 illustrates that non monetary financial shocks—to U.S. and Euro area long-term rates—are shocks to their respective term premia. The impulse responses of 10-year yields and term premia to such shocks are virtually identical, for all the three sub-samples.

2.2 Monetary policy shocks

We have learned from the variance decomposition that monetary policy shocks are not the main determinant of Euro area long-term rates. Still it is interesting to assess the response of long rates to such shocks (i.e. to deviations of the central bank from its systematic "rule") because this allows us to assess if there are any differences between the response of U.S. long-term rates to U.S. monetary policy shocks, and the response of Euro area long-term rates to policy shocks induced by the ECB (and by the Bundesbank prior to 1999). The results are in Figures 4 and 5. Figure 4 reports the responses of 10-year rates and and term premia–both in the U.S. and in the Euro area–to a U.S. monetary policy shock. Figure 5 repeats the exercize for a Euro area monetary policy shock.

- We note first—considering the reaction of U.S. long rates to a FED shock (Figure 4)—that, as observed by Roush (2007), the Expectations Theory works in the U.S. conditional upon monetary policy shocks. In fact U.S. monetary policy shocks do not generate a significant response of U.S. term premia.

- This is not the case for monetary policy shocks induced by the ECB (and by the Bundesbank prior to 1999) shown in Figure 5.

  - in the 1990-98 sample, when the Bundesbank was in charge, following a contractionary monetary innovation the bond market rallied. The impulse responses suggest that this was the result of a fall in term premia that more than compensated the increase in expected policy rates;

– this pattern reverses when monetary policy starts been run by the ECB: following a contractionary monetary innovation the bond market falls, as term premia and expected monetary policy both move in the same direction (up).

3 Conclusions

We have shown that the level of Euro area long-term rates can be reconstructed almost exactly by considering only U.S. shocks and the sytematic response of U.S. and European variables to these shocks. The systematic component of European monetary policy responds to U.S. variables more than it does to local variables. This was true for the Bundesbank before EMU and remains true for the ECB since the start of EMU. Monetary policy in the Euro area should thus not be determined using closed economy models—as is the current practice in the ECB (see, for example, Smets and Wouters 2004). We also find (i) that most of the variance of the predictive errors for Euro area long-term rates is attributable to term-premia shocks, and (ii) that following a surprise tightening by the ECB the bond market falls.

These findings have, in our opinion, two implications:

- the ECB can affect long rates only through the systematic component of its monetary policy—which, as we have seen, mostly responds to U.S. variables. When it produces a monetary policy shock the effect is small, but term premia and long rates move in the same direction (up in the case of a surprise tightening), suggesting that the ECB enjoys less credibility than the FED or the Bundesbank. The implication is that the ECB should minimize surprises;

- the ECB should study closely the relative importance of monetary policy and international asset price fluctuations in determining Euro area macroeconomic variables. Our findings that Euro area long rates depend more on asset price fluctuations than on monetary policy suggest that the ability of the ECB to affect macro fluctuations could be limited. Asset price fluctuations and their international comovements are currently absent from the main DSGE models employed at the ECB: extending them should be a priority of the bank's staff.

References

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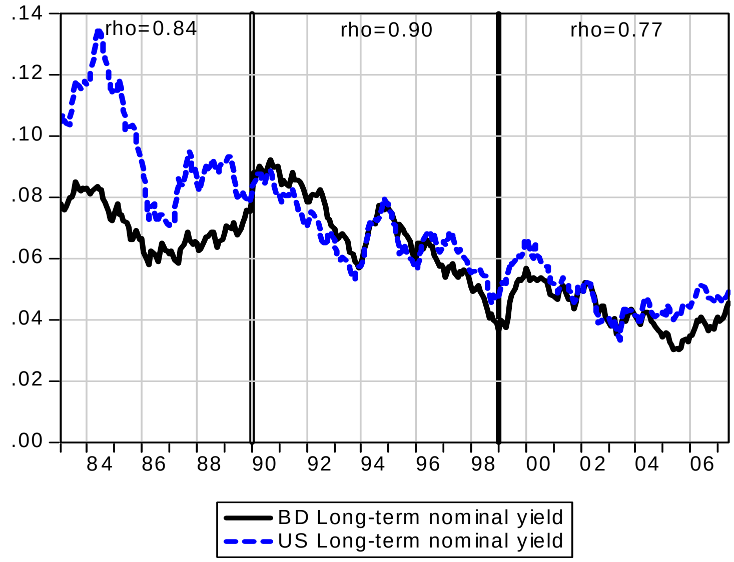

Figure 1: Yields to maturity on U.S. and German 10Y benchmark bonds

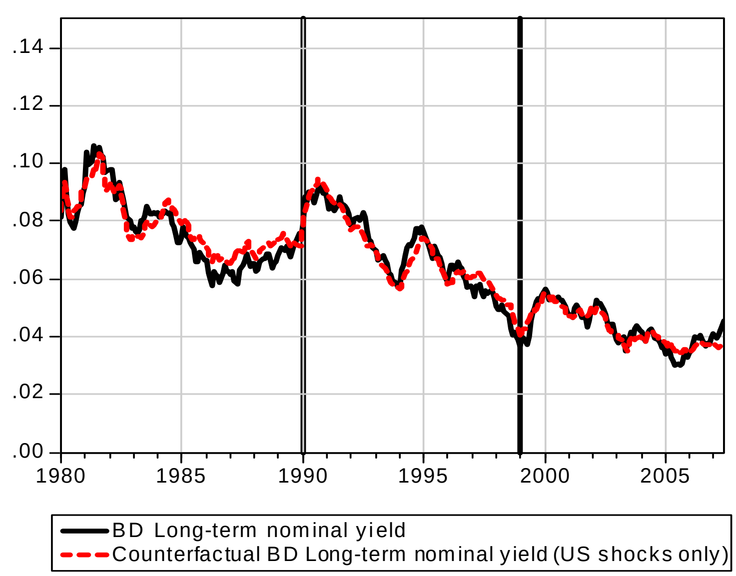

Figure 2. Counterfactual: Euro area long rates constructed using U.S. shocks only

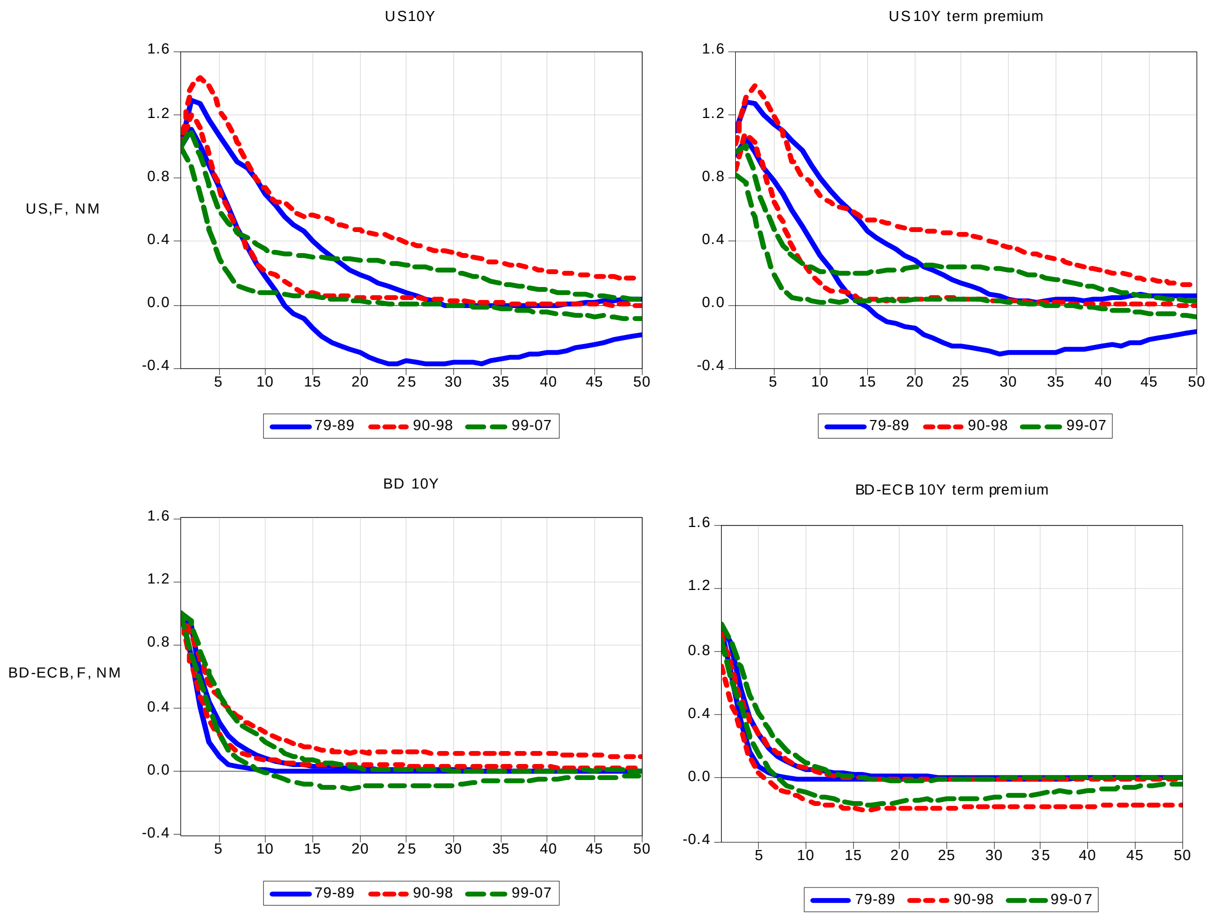

Figure 3: Financial Non-Monetary Policy Shocks are shocks to the Term Premium

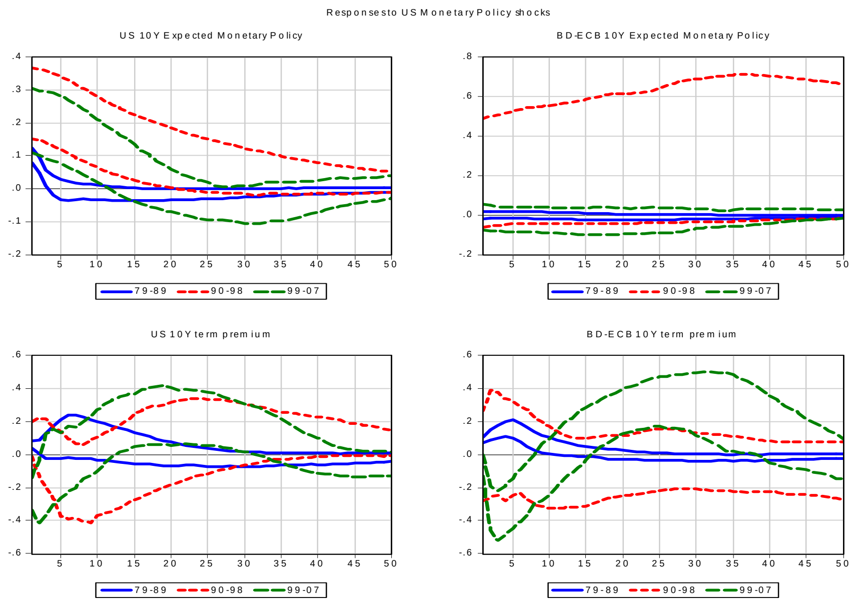

Figure 4: Responses to a FED monetary policy shock

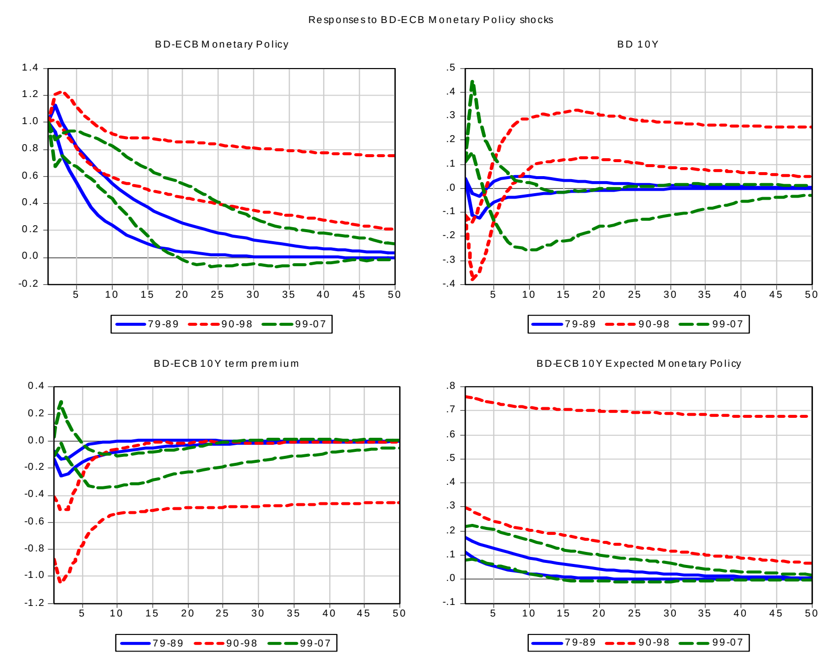

Figure 5: Responses to a Bundesbank-ECB monetary policy shock