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Sources of unemployment fluctuations in the USA and in the Euro Area in the last decade

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Abstract

The aim of this paper is to investigate the role played by macroeconomic shocks in shaping unemployment fluctuations, both in the USA and in the Euro area, in the recent, European Monetary Union, period. The task is accomplished by estimating a VAR model which jointly considers US and European variables. We identify the structural disturbances through sign restrictions on the dynamic response of variables. Our results show that there are real effects of monetary policy shocks and of non-monetary policy, financial shocks in both economic areas. Moreover, a significant role is also exerted by business cycle, adverse aggregate demand shocks. Not surprisingly, in the last decade an important role has been played by financial shocks.

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1. Introduction

In the last decade two recessions have affected the global economy and, also as a consequence of the particular virulence of the last downturn, the rate of unemployment has greatly increased, both in the USA and in the Euro area.

Moreover, the recent recession experienced by industrialized countries has confirmed the relevance for the world economy of the macroeconomic events affecting the US economy.

Indeed, this US influence casts serious doubt on the possibility for the European Central Bank (ECB) to conduct its monetary policy free of the influence exerted by Federal Reserve System's choices. In reality, in the first ten years of European Monetary Union (EMU), both the direction and the magnitude of monetary policy interventions in the Euro area has been systematically anticipated by the US central bank (cf. Ribba 2012).

In this paper we aim to study, in a structural vector autoregressive (VAR) context, the joint dynamics of a set of US and European macroeconomic variables. In particular, we want to empirically investigate the dynamic response of unemployment, in the USA and in the Euro area, to a small number of identified macroeconomic shocks. The set of identified macroeconomic shocks includes monetary policy, financial and aggregate demand shocks.

We identify the selected group of shocks by imposing sign restrictions on the dynamic responses of the variables. In doing so, we utilize the approach to structural VAR identification recently proposed by Uhlig (2005) and further developed in Mounfort and Uhlig (2009). The central idea of the approach is to impose sign restrictions, for a certain number of periods, on the response of a set of macroeconomic variables to specific shocks.

A feature of this approach to structural VAR modelling is that although the sign restrictions are derived by appealing to some economic model, the identification strategy implies that a minimal set of information is utilized in order to recover the structural disturbances of the dynamic system.

In this empirical investigation which covers the sample period 1999:1 - 2009:12, we want to address, essentially, the following three questions: (a) Do monetary policy shocks as well as financial shocks exert real effects and, in the case of a positive answer, are they persistent? (b) What are the effects on unemployment and inflation of the identified macroeconomic shocks? (c) Are movements in the European variables dominated by shocks external to the Euro area and, more specifically, by US macroeconomic shocks?

We identify three US macroeconomic shocks: an adverse business cycle shock, a contractionary monetary policy shock and a financial shock.

A financial shock is identified as an unexpected increase in the spread between the 3-month Eurodollar deposits rate and the 3-month treasury bill rate. The differential between the two rates is usually small, around 30 basis points, but it rises, as shown by the events of the period 2007-2008, in the presence of increasing risks of banking default and related problems in the credit market (cf. Bijapur 2010).

In addition to these shocks, external to the Euro area, we identify two macroeconomic shocks which are specific to EMU: a business cycle and a monetary policy shock.

For all the structural disturbances, the responses are restricted for three periods. Since we use monthly data, this amounts to an horizon of one quarter.

To anticipate some results obtained in the present investigation, monetary policy shocks are one of the forces driving unemployment fluctuations in the short run. Hence the conclusion is that there is no evidence of monetary neutrality in the US economy and in the Euro area even in the last ten years.

Another important result, worth emphasizing, obtained in the empirical investigation

concerns the significant and persistence effects exerted on EMU inflation and unemployment by US monetary policy shocks.

Moreover, it seems that the identified financial shock may have played a primary role in explaining movements in both inflation and unemployment.

2. The Identification Strategy

Let us start with the following reduced-form vector autoregressive (VAR) representation:

$$A(L)X_t = e_t \quad [1]$$

where X_t is a $n \times 1$ vector of covariance stationary macroeconomic variables, $A(L)$ is a matrix polynomial in the lag operator L, with $A(0) = I$, and e_t is the $n \times 1$ vector of error terms, such that $E(e_t) = 0$ and $E(e_t e_t') = \Sigma_e$.

Given the assumption of covariance stationary variables included in X_t, it is then possible to obtain the reduced-form moving average representation of [1]:

$$X_t = C(L)e_t \quad [2]$$

where $C(L) = A(L)^{-1}$ and $C(0) = I$.

Representations [1] and [2] do not allow a structural economic interpretation of the interaction among variables. The usual assumption in the VAR literature is that the $n \times 1$ vector, η_t, of the structural shocks contains orthonormal variables, *i.e.* $E(\eta_t \eta_t') = I$. There is a relation between the vector of error terms and the structural shocks which is given by $e_t = B\eta_t$. Given orthonormal innovations, this relation also implies:

$$BB' = \Sigma_e \quad [3]$$

The structural moving-average representation is then given by:

$$X_t = C(L)BB^{-1}e_t = B(L)\eta_t \quad [4]$$

Since C(0)=I, it is easily seen that B contains the contemporaneous, structural coefficients of the model.

Hence the general problem concerning identification attains the selection of enough restrictions, possibly supported by some economic model, to be imposed on matrix B. Note that since the covariance matrix Σ_e contains $n(n+1)/2$ free elements, by virtue of its symmetry, one needs $n(n-1)/2$ additional restrictions in order to obtain exact identification of the model.

In Sims (1980) it is assumed that B is lower triangular and hence, in this case, B is the Cholesky factor of Σ_e. Indeed, this identification scheme implies the imposition of a recursive structure.

In order to explain the methodology adopted in the present paper for identification of the macroeconomic structural disturbances, let us note that a general result in structural VAR analysis is that if we select B as the Cholesky factor of Σ_e, then any other orthogonalization can be obtained as an orthonormal transformation of B, *i.e.* alternative orthogonalizations consistent with the reduced form [2] can be recovered by postmultiplying B for a non-singular matrix V such that $VV' = I$.

In particular, in the present paper we aim to select a matrix D whose columns are represented by the identified impulse vectors. The task is accomplished by selecting a matrix V which exhibits orthonormal columns and such that the sign restrictions on the impulse responses are satisfied. It will be then possible to build a new matrix, $D = BV$, whose columns are the identified impulse vectors.

The selected structural representation is given by:

$$X_t = D(L)\epsilon_t \qquad [5]$$

In the present study we estimate a VAR model which includes eight macroeconomic variables and identify only $m = 5$ structural shocks. Thus, we have $m < n$. The shocks, and the associated impulse vectors, are then selected by discarding those vectors which do not satisfy the imposed sign restriction. Moreover the horizon, k, of the imposed restrictions is 3 periods.

Since we estimate five structural shocks, an important implication is that we leave unidentified some structural disturbances. Hence, the VAR prediction errors can be represented in the following way:

$$e_t = D_1\epsilon_t^{USBC} + D_2\epsilon_t^{USMP} + D_3\epsilon_t^{USFin} + D_4\epsilon_t^{EUBC} + D_5\epsilon_t^{EUMP} + \tilde{D}'\tilde{\epsilon}_t \qquad [6]$$

Where ϵ^{USBC} denotes the US business cycle shock, ϵ^{USMP} the US monetary policy shock, ϵ^{USFin} the financial shock. Moreover, ϵ^{EUBC} and ϵ^{EUMP} denote, respectively, the Euro area business cycle shock and the Euro area monetary policy shock. With each structural shock is associated the appropriate impulse vectors D_i. Instead, there are $n-m$ shocks which are left unidentified and that are collected in the vector $\tilde{\epsilon}$. Clearly this implies that this unidentified set of shocks is associated with the remaining $n-m$ columns of matrix D which are contained in $\tilde{D}'$.

To sum up: we start by selecting the Cholesky orthogonalization and then build an orthonormal transformation on the Cholesky factor, consistent with the imposed sign restrictions on the impulse responses.

In Uhlig (2005) only the monetary policy shock is identified and hence the problem consists in selecting a single impulse vector. In the presence of a number of structural shocks greater than one, the shocks selected by imposing the sign restrictions are mutually orthogonal, by construction. Nevertheless, in the approach of Mountfort and Uhlig (2009), which we follow in the present paper, they are ordered sequentially.

An important, and to some extent limiting, feature of this agnostic approach to identification is that one can only identify a set of structural forms satisfying the sign restrictions imposed on the responses of variables. In other words, there is a set of impulse vectors which is consistent with the imposed restrictions.

However, a possible strategy aimed at circumventing this problem consists in adopting a penalty function approach. In this case there are additional criteria on which it is possible to rely in order to select the impulse vectors[1].

3. Empirical Specification and Imposed Sign Restrictions

We estimate an eight variable VAR for the sample period 1999:1 2009:12.

For the USA the list of macroeconomic variables include: a measure of the cyclical component of the rate of unemployment, the rate of inflation measured by the annual change in the Consumer Price Index (CPI), the federal funds rate and the spread between the three months rate on eurodollar deposits and the three months treasury bill rate.

As for the Euro area the list of variables includes: the cyclical component of the rate of unemployment, the rate of inflation measured by the annual change in the Harmonized Consumer Price Index and the European overnight interest rate (Eonia).

The first difference of the (log) bilateral euro-dollar exchange rate, defined in terms of units of US dollars for one unit of the European currency, is also included in the VAR model[2].

Since we are interested in studying the fluctuations at business cycle frequencies in the rate of unemployment[3], we separate a cyclical from a trend component in overall unemployment. The cyclical component of unemployment is obtained by applying the Hodrick-Prescott filter to the series.

In this paper we measure the stance of monetary policy for the US economy with the Federal Funds rate.

Instead, for the Euro area, we use the Euro area overnight rate (Eonia).

As far as the financial, non-monetary sector is concerned, the selected variable is the differential between the 3-month eurodollar deposit rate and the 3-month US treasury bill rate.

The sign restrictions which are imposed for structural identification are reported in table 1. We restrict the responses of the indicated variables to the identified shocks for three periods, *i.e.* for one quarter.

[1]See Uhlig (2005) and Mountford and Uhlig (2009). A clear presentation of the methodology is also given in Mountford (2005). In the present paper the impulse vector related to the US business cycle shock is chosen under minimization of a criterion function which penalizes negative responses of US unemployment and positive responses of US inflation at horizons of three months. Instead, the impulse vector associated with the monetary policy shock penalizes, for the same horizon, negative responses of the US interest policy rate, positive responses of the US rate of inflation and positive responses (depreciations) of the bilateral euro-dollar exchange rate. Similar penalty functions, related to Euro area variables, characterize the Euro area shocks. Instead, the impulse vector associated with the financial shock penalizes negative responses over three periods of the spread between the Eurodollar Deposit rate and the Tbill rate.

[2]Data concerning the CPI, the unemployment rate and the Federal Funds rate, are obtained by the FRED database: http://research.stlouisfed.org/

The monthly series of the 3-month Eurodollar Deposits rate is compliled by the Federal Reserve. The series is taken from the Fed site: http://www.federalreserve.gov/

From the same source was obtained the nominal exchange rate, defined as US dollars per currency unit. Overall inflation for the Euro area is obtained from the Harmonized Consumer Price Index (HCPI). The series concerning the HCPI and the unemployment rate for the Euro area were taken from the Eurostat site: ec.europa.eu/eurostat

Instead, the series for the Eonia rate was taken from the ECB web site, at http://www.ecb.int/stats/

[3]In a very recent paper, Karanassou *et al.* (2010) provide a comprehensive survey of theoretical and empirical studies concerning the short-run and long-run unemployment-inflation tradeoff.

Table 1. Sign Restrictions and Identification of Structural Shocks[a]

	Structural shocks				
VAR Variables	US BC	US MP	US Fin	Euro BC	Euro MP
US unemployment rate	+				
US inflation rate	−	−			
Eurodollar Dep. - T-bill spread			+		
Federal Funds rate		+			
Euro area unemployment rate				+	
Euro area inflation rate				−	−
Eonia rate					+
Exchange rate		−			+

a: The five structural shocks are: US business cycle shock (US BC); US monetary policy shock (US MP); US financial shock (US Fin); Euro area business cycle shock (Euro BC); Euro area monetary policy shock (Euro MP).

The business cycle shock, *i.e.* an unexpected and adverse event on the aggregate demand side, provokes an increase for three periods of the unemployment rate and a decrease, over the same horizon, of the rate of inflation. The traditional AD-AS textbook scheme supports this prediction that is consistent with a large class of economic models.

Although we are considering the dynamic interaction of large open economies, we do not restrict at any horizon the responses of the variables concerning the foreign economy since we want to impose only a minimal set of restrictions on the impulse responses. Of course, we expect that as a consequence of the US business cycle shock the Euro area unemployment increases and that the rate of inflation decreases, by virtue of the transmission of the recessionary effect induced by the US shock.

As far as the contractionary US monetary policy shock is concerned, by construction, it is associated with an increase in the Federal Funds rate, a reduction in the US rate of inflation and an appreciation in the exchange rate. Instead, the response of the other variables and, in particular of the unemployment rate in both areas, is not restricted.

It is well known that the traditional VAR literature on monetary policy is plagued by the presence of some puzzling results concerning, in particular, the response of prices to monetary tightening. In particular, structural shocks recovered in VARs with Wold causal ordering usually exhibit a response of price to monetary policy shocks with wrong sign: prices increase in response to a contractionary shock (see *e.g.* Christiano *et al.* 1999).

The methodological proposal advanced by Uhlig (2005) consists in eliminating in *a-priori* way this puzzle, by imposing a response of prices consistent with the prevailing theoretical views on the effects of monetary policy while leaving free the response of real variables. The central idea is that once the monetary policy shock has been properly identified, one can concentrate on studying the dynamic effects on real variables.

The response of the (rate of change of) nominal exchange rate is also restricted by requiring a temporary appreciation as a consequence of the contractionary monetary shock.

Scholl and Uhlig (2008) have applied the sign restriction methodology to the exchange rate responses to monetary policy shocks and have found that a persistent appreciation remains a feature of the data.

The restrictions imposed on the responses of Euro area inflation rate to an unexpected increase in the Eonia mirror those selected for the United States. After all, although subject to strong US influence, the Euro area remains a large open economy.

As for the financial shock, we impose a positive innovation for three periods on the spread between the government bond rate and the corresponding market rate, without imposing further restrictions on the other variables included in the VAR estimation.

As for lag length selection, both the Schwartz and the Akaike criterion suggest one lag for the estimated VAR.

4. The Dynamic Effects of the Identified Macroeconomic Shocks

Figures 1 to 5 report the results attaining the dynamic responses of each variable to the identified macroeconomic shocks[4].

The US business cycle shock causes a persistent decrease in the inflation rate, both in the US and in the Euro area. It is worth recalling that only the response of inflation in the United States is restricted for the first three months following the shock. Moreover, this external demand shock causes a significant increase in the Euro area cyclical unemployment. Thus, as a consequence of shocks which hit the aggregate demand, we observe the typical movements in opposite direction between inflation and unemployment at the business cycle horizons. This feature is common to both the economic areas.

As far as the policy rates are concerned, there is a fall in the Federal Funds rate following the negative demand shock. Moreover, in response to this adverse US business cycle shock, there is a quick reduction in the policy rate also in the Euro area. Indeed, the profile of monetary policy response in the two economies is very similar. Another feature which is worth stressing is that, according to the impulse-response functions, there is a significant, negative contemporaneous effect on the short-term rates.

This adverse aggregate demand shock also causes a temporary depreciation of the bilateral exchange rate and a persistent decrease in the spread between the three months Eurodollars deposits and the Treasury Bill rate.

The response of the variables to the US monetary policy shock deserves some attention. There is an immediate increase in the cyclical unemployment and the effects of this structural shock are persistent since after around four years it is still significant. The response of unemployment is similar in the two economies. However, it seems that at horizons of one to two years unemployment decreases as a consequence of the monetary tightening and this is difficult to rationalize.

It is worth stressing that ambiguous effects of contractionary monetary policy shocks on output have been also detected by Uhlig for the US economy (2005). Unclear results also characterize the work by Rafiq and Mallick (2008) concerning the three largest Euro area countries. In this last research a sign restriction approach is also adopted.

The response of inflation is reasonable: it decreases for at least three quarters after the shock. Let us recall that only the response for the first quarter is restricted being negative.

It is interesting to analyze the response of the Euro area overnight rate. For around six months it is not significant but for the subsequent eighteen months the Euro area policy rate moves toward an increase, thus following the direction of the Federal Funds rate.

A first important conclusion is that US monetary policy matters even for EMU inflation

[4]The confidence bands were generated from 500 draws using the Monte Carlo Integration approach seggested by Sims and Zha (1999). The procedure is included in the RATS manual for drawing error bands (see Doan, 2007). Figures 1-5 report the median responses together with the 16th and 84th percentiles.

and unemployment, *i.e.* a contractionary US monetary policy shock causes a persistent increase in unemployment and a significant decrease in inflation in the Euro area. In fact these results seem to be consistent with some recent empirical findings concerning the leading international role played by the Federal Reserve Systems in the conduct of monetary policy (cf. Ribba 2012).

Moreover, and as a whole, the magnitude and the persistence of the dynamic effects exerted by US macroeconomic shocks on European macroeconomic variables also help to clarify that the leadership of the US central bank is a natural consequence of the pre-eminent role played by the US business cycle in shaping the evolution of the world business cycle and, in particular, the European one.

Some interesting results also emerge from the analysis of the response of variables to the financial shock: the adverse financial shock is deflationary, causes a significant increase in unemployment and induces a movement of the policy rate in the opposite direction. Once again, the results are very similar for the two economic systems.

It is worth recalling that we impose a restriction only on the sign of the financial shock, leaving unrestricted the dynamic responses of all the other included variables.

As for the response of the exchange rate, there is a temporary appreciation of the national currency. This result is not surprising since it implies that as a reaction to negative financial events and in the presence of credit risks there is an increase in the demand for dollars.

Hence, as expected, the recent business cycle evolution in the two economic areas has had an important driver in the turmoils affecting the financial sector.

Figures 4 and 5 display the responses of the eight variables to Euro area business cycle shocks and monetary policy shocks.

After a negative demand shock there is a decrease in the short-term interest rate in the Euro area which lasts around one year. Moreover, there is a gradual depreciation, i.e. the unit of dollars for one unit of euro reduces. The response of Euro area inflation is restricted for three periods, but the reduction in the inflation rate, following the increase in the unemployment rate, persists and is significant over one year.

As far as the responses of US variables are concerned, the impact effect on inflation is negative, i.e. the demand shock affecting the Euro area contributes to a reduction of inflation in the US economy but is characterized by limited persistence.

The Federal Funds rate seems to follow the response of the Eonia rate, by initially decreasing, but after around one year it begins to increase.

There are significant and persistent effects exerted by the Euro area business cycle shock on the US cyclical unemployment. Yet the contemporaneous response exhibits a wrong sign, since there is a reduction in the US unemployment. Nevertheless, at a horizon of 4 to 10 months unemployment increases.

The monetary policy shock originating in the Euro area exhibits real effects since there are significant responses both in the Euro area and in the US unemployment. Once again there is a wrong sign in the impact response of the variables since cyclical unemployment decreases in both areas as a consequence of a contractionary monetary policy shock. However, after 10 months the unemployment rate begins to increase and this effect is persistent, lasting for around two years.

5. Concluding Remarks

In this paper we have investigated the sources of business cycle fluctuations in the United States and in the Euro area in the last decade. We have estimated and identified a

structural VAR by imposing sign restrictions on the impulse-responses of macroeconomic variables.

Our main findings are that monetary policy shocks exerted real effects in both economic areas and that financial turmoils have played an important role in determining the deflationary evolution of the last recession.

Our results confirm the importance of considering US macroeconomic variables when analyzing the European economy, given the significant effects displayed by US shocks. In other words, the decoupling has not yet materialized in the dynamic interaction between the European macroeconomic variables and the US ones.

Nevertheless, to some extent, the reverse is also true since there are significant effects exerted on US inflation and unemployment by monetary policy shocks and demand shocks originating in the Euro area. Indeed, this should not be a surprising result, given the weight of the Euro area economy in the global context.

An important implication of this result is that empirical investigations, in particular those aiming to study the dynamic effects of monetary policy shocks, which take the US as a closed economic system may fail in a proper identification of structural disturbances.

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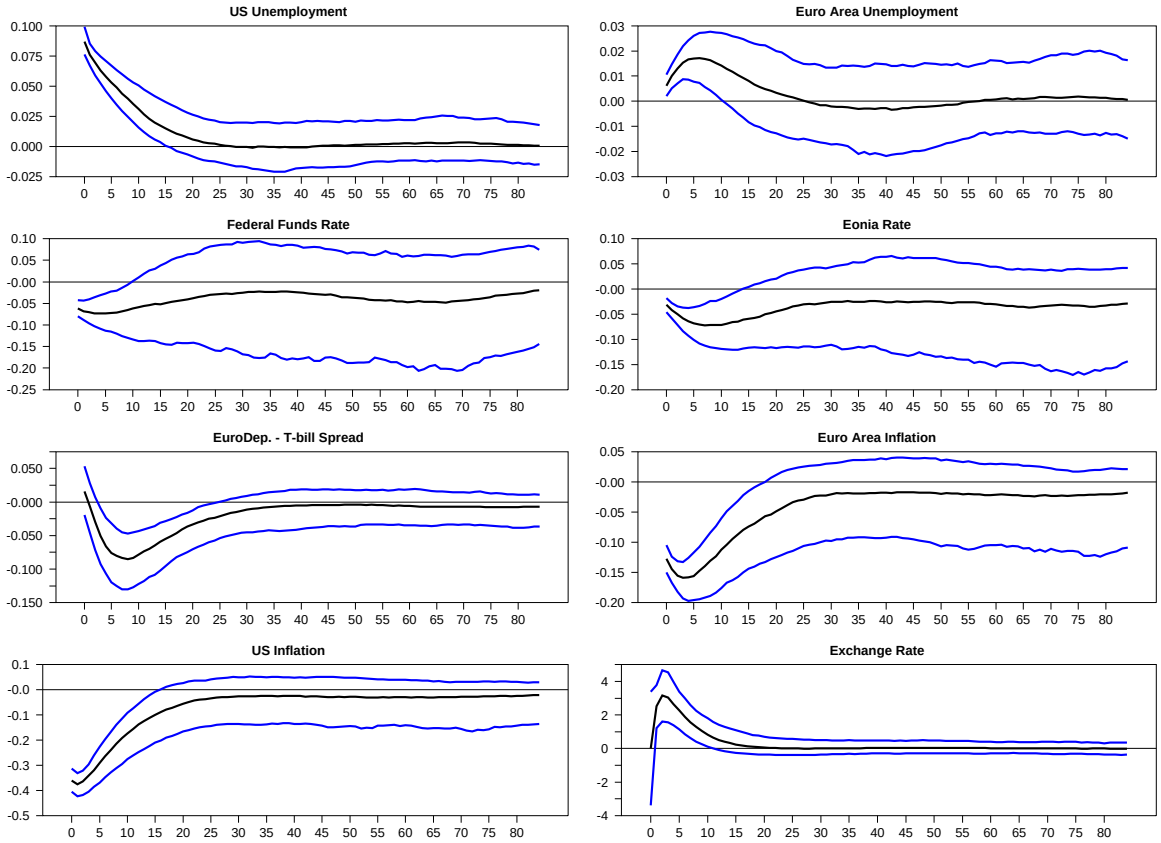
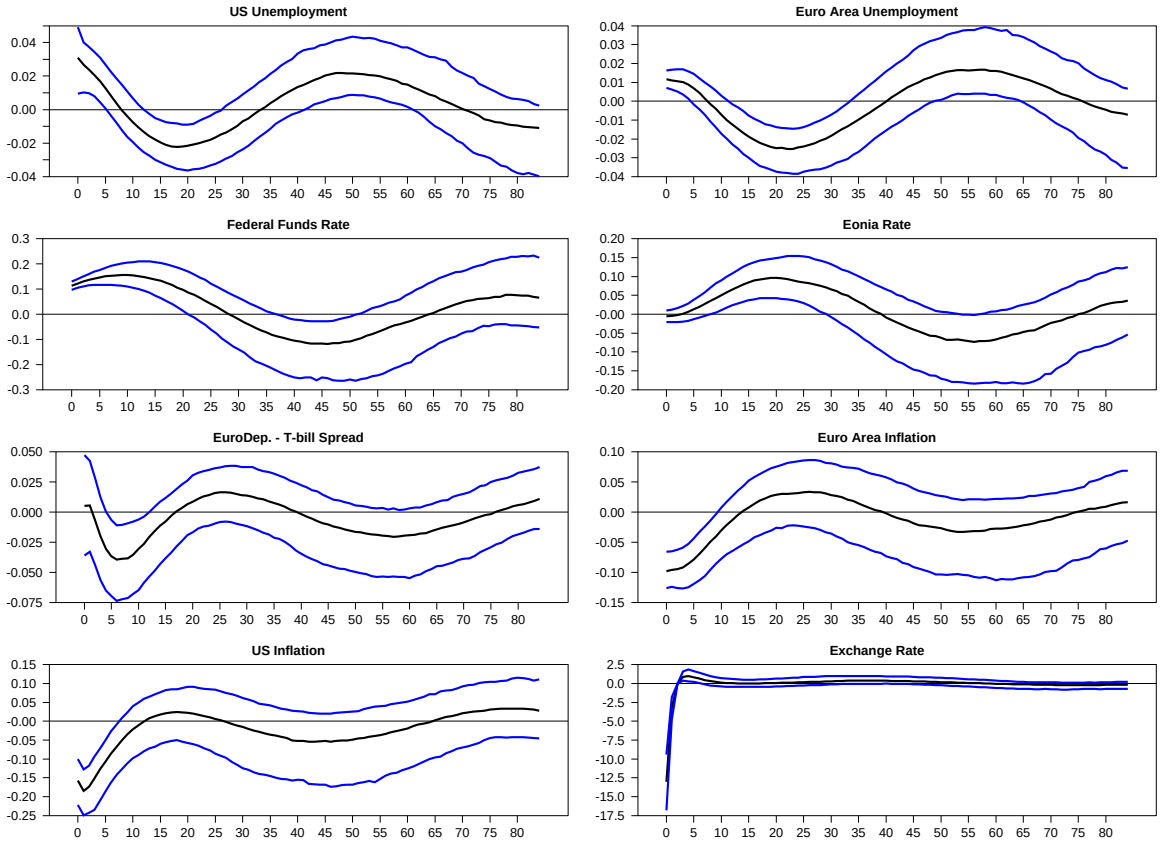


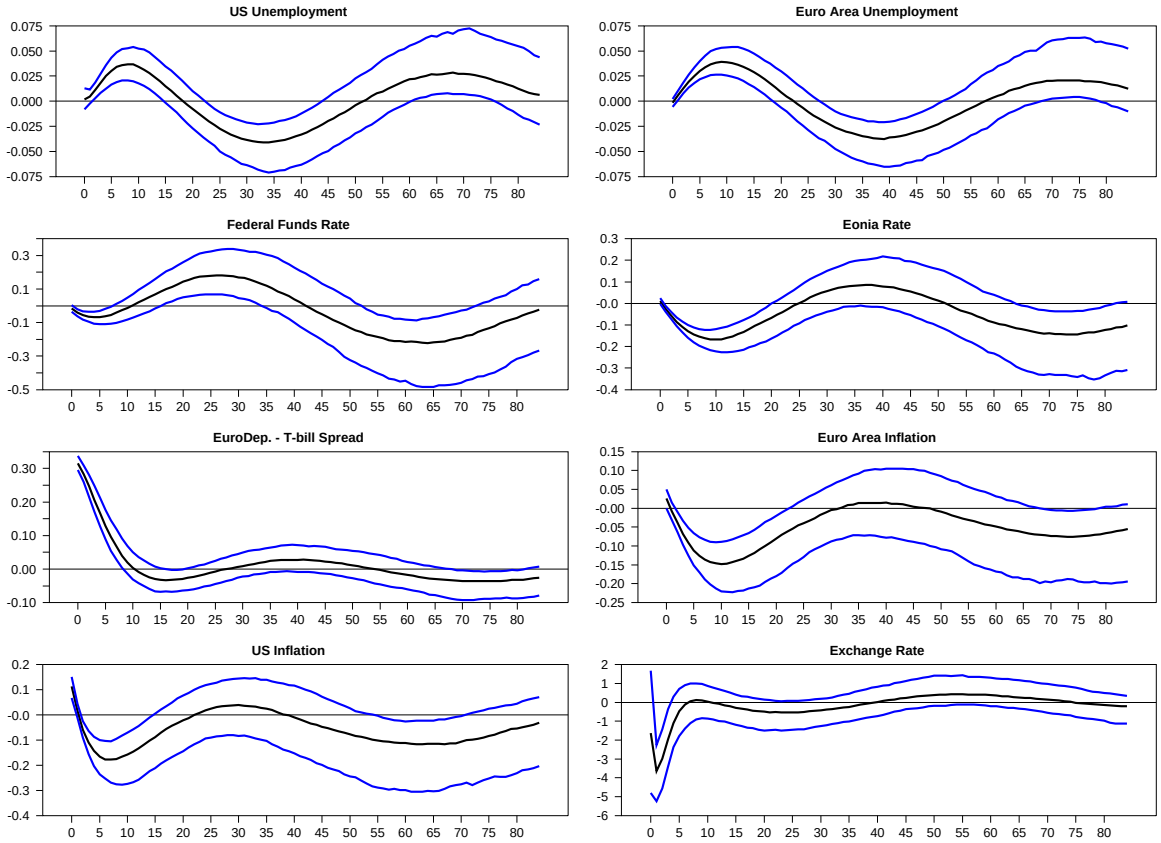
Responses to US Business Cycle Shock

FIGURE 1



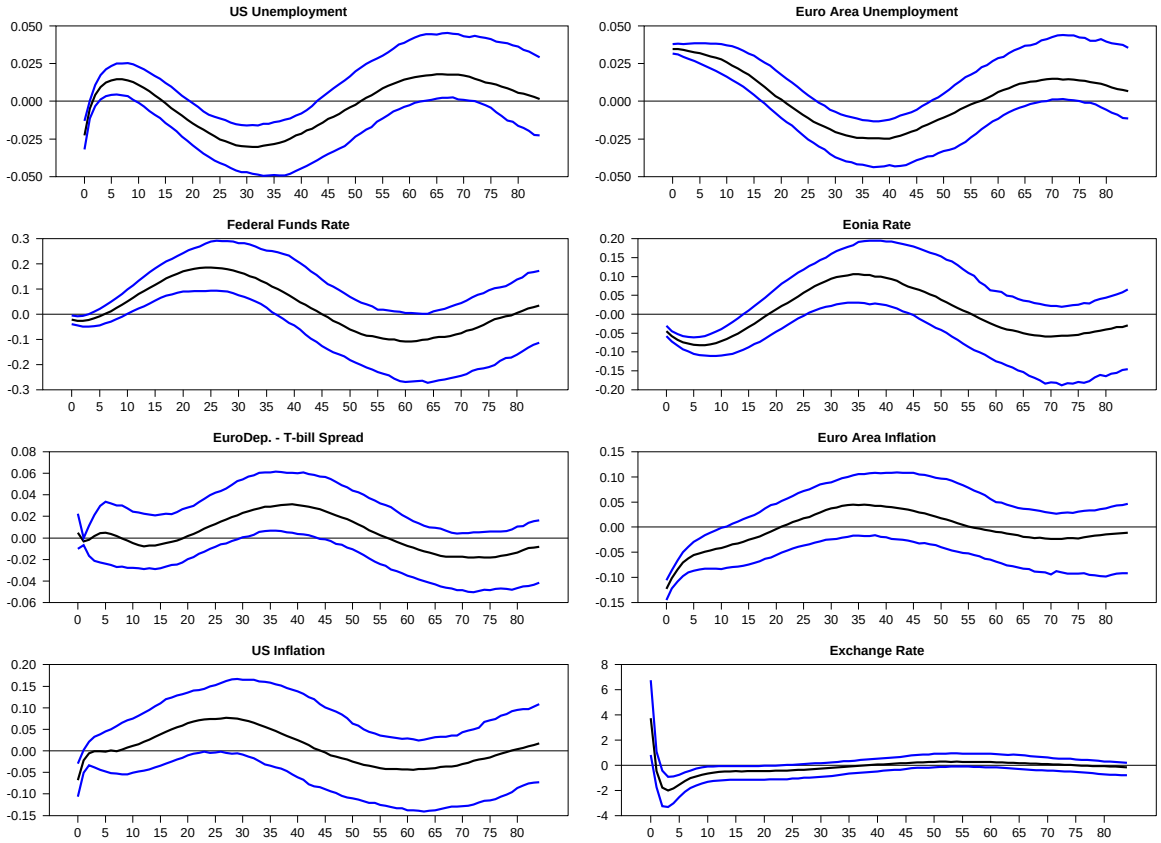
Responses to US Monetary Policy Shock

FIGURE 2



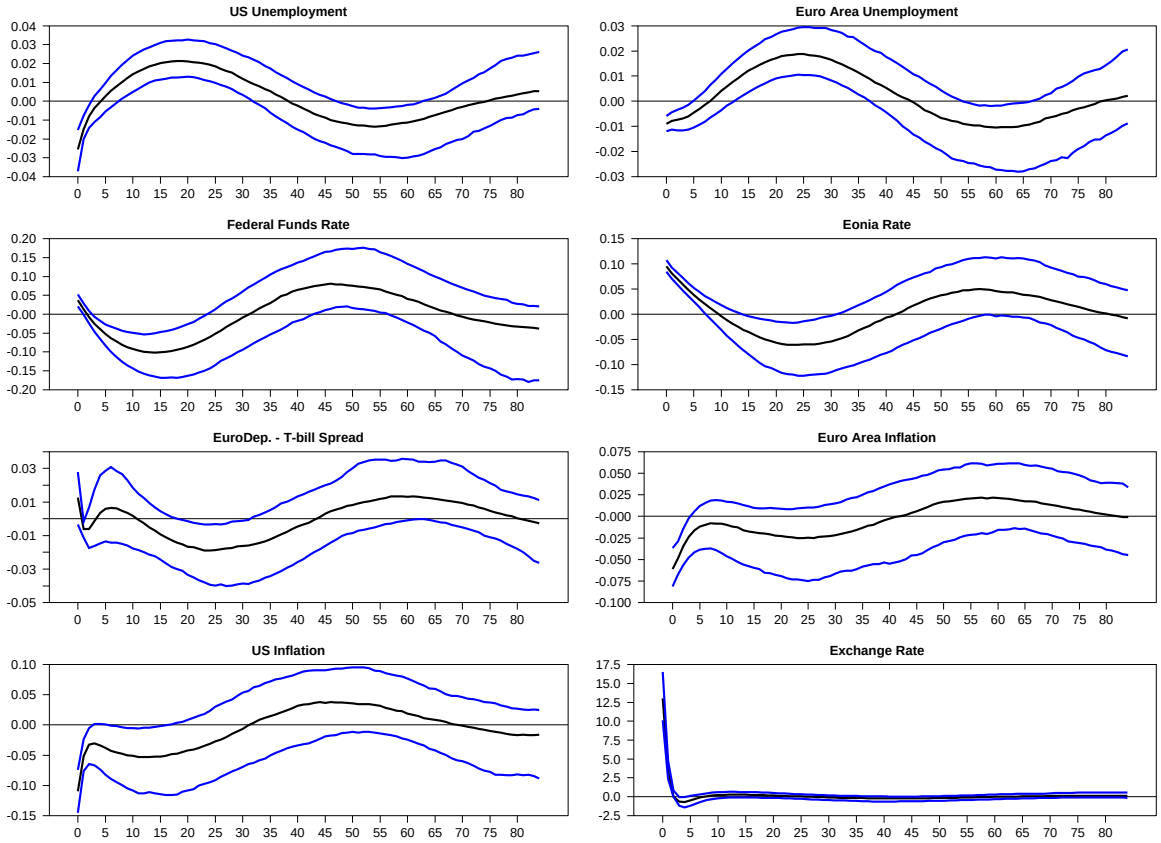
Responses to Financial Shock

FIGURE 3



Responses to Euro Area Business Cycle Shock

FIGURE 4



Responses to Euro Area Monetary Policy Shock

FIGURE 5