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The Impact of Conventional and Unconventional Monetary Policy on Expectations and Sentiment

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Abstract

This paper offers, evidence on the effect of ECB's conventional and unconventional monetary policy on economic expectations in Euro-area countries during the US and EU crisis. We employ a range of research methodologies in a sample of nine Eurozone countries and combine expectations/sentiment indicators with a set of macroeconomic and financial variables. We find that ECB's conventional monetary policy (and Fed's monetary policy stance) has a positive and significant effect on economic expectations for Core Eurozone countries and a weak effect on Peripheral Eurozone countries. ECB's unconventional policy measures, however, have a negative effect on Core countries' economic expectations. This result is robust to different methodologies (PVAR, QVAR, FAVAR) and different datasets. Overall, our findings highlight the importance of monetary policy in the determination of economic expectations.

JEL Classification: E52, G02;
Keywords: Unconventional Monetary Policy, Sentiment, Economic Expectations

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1. Introduction

The main aim of the European Central Bank (ECB) is to maintain price stability; in addition it contributes to the stability of the financial system within the Euro-area by monitoring developments in the banking and financial sectors. The main instrument of monetary policy by central banks is their influence over money market interest rates, which affect expectations of future official interest rates, the actions of economic agents, and ultimately the evolution of output and prices. As the ECB itself acknowledges, the expectations transmission channel of monetary policy has gained importance during the recent decades. For instance, a high degree of central bank credibility can have a strong impact on price developments by guiding economic agents' expectations, and thus "….understanding the transmission mechanism is crucial for monetary policy" (p.61, The Monetary Policy of the ECB, 2011; http://www.ecb.europa.eu).

Furthermore, as Lutz (2015) argues, there is a necessity to understand the relationship between investor sentiment and monetary policy since central banks are contemplating the use of monetary policy tools in order to tackle the volatility associated with asset bubbles and financial crises. Indeed, during the recent financial crises in the US and the EU, official policy rates approached the zero lower bound and, as a result, central banks in developed economies resorted to unconventional monetary policy mechanisms in order to tackle financial market volatility and preserve financial stability (see, Gambacorta et al., 2014; Fawley and Neely, 2013).

This paper examines the effect of ECB's unconventional and conventional monetary policy during the EU crisis on economic expectations.[1] For monetary policy to achieve the target of price stability it has to affect expectations, in other words, affect consumer and economic confidence. We ask whether ECB's monetary policy during the recent crises does that, since previous studies on unconventional policies focus on the Fed and US data. Lutz (2015), for example, studies the effect of Fed's conventional and unconventional monetary policy on investor sentiment and finds that during conventional policies a surprise drop in the fed funds rate has a positive impact on investor sentiment that lasts several months; unconventional monetary policy shocks have a similar impact on economic sentiment. Also, Gambacorta et al. (2014) examine the macroeconomic effects of unconventional monetary policy and find a positive effect on economic activity following exogenous increases in central bank balance sheets. We also examine the effect of the Fed's monetary policy stance on economic expectations in the Euro-area and sentiment spill-overs from the US to the Euro-area.

The paper contributes to the relevant literature on the effects of monetary policy. For example, Bernanke and Kuttner (2005) find that the Fed's monetary shocks have a significant impact on expected excess equity returns and suggest that investors may overreact, or be very sensitive, to monetary shocks. This result is consistent with Kurov (2010), who finds that the Fed's monetary policy decisions have a significant effect on US investor sentiment, or with Bekaert et al. (2013) who document a relationship between investor risk aversion and monetary policy. Neuenkirch (2013)

[1] Many previous studies document the effect of economic agent expectations on economic activity, economic and investment behavior, and asset prices (see, among others, Benhabib et al., 2016; Chen, 2011; Hwang, 2011; Bachmann and Sims, 2012; Baker and Wurgler, 2007; Brown and Cliff, 2004; Fisher and Statman, 2003; Neal and Wheatley, 1998).

focuses on the effect of central bank communication on monetary policy transmission and finds that it has a similar influence on expectations about inflation as that of actual target rate changes. Neuenkirch (2013) argues that communication has become an important tool for central bankers, since regular information releases about monetary policy can affect rate expectations before actual rate changes.

For the empirical analysis, we use a range of methodologies where we combine sentiment indicators with a set of monetary, macroeconomic and financial variables. For the investigation of the conventional monetary policy effect on investor's expectations, a panel VAR setting is employed, which allows us to combine the traditional VAR modelling with a panel-data approach that allows for unobserved individual heterogeneity (see, Love and Zicchino, 2006). In order to study the effects of ECB's unconventional monetary stance we use a Qual VAR model (Dueker, 2005), which combines the binary information of the unconventional monetary announcements with an otherwise standard VAR; i.e. it allows the use of unconventional policy announcements as an endogenous factor of the system. In other words, the Qual VAR model allows us to derive the latent propensity of ECB's unconventional monetary. In order to robust the results concerning the unconventional monetary policy effects, we also employ a Factor-Augmented VAR (FAVAR) model (Bernanke et al., 2005), that combines the standard VAR analysis with factor analysis and utilizes a large number of informative macroeconomic and financial time series used by investors and policymakers. As an indicator for unconventional monetary policy in the FAVAR model we use the latent propensity of ECB's unconventional monetary stance produced by the Qual VAR model. It is the first paper that uses the latent propensity for ECB's unconventional monetary stance deriving from a Qual

VAR model (Dueker, 2005) as a monetary instrument, combining this way, the Qual VAR and FAVAR methodologies. Our sample consists of nine Eurozone countries that we group in two sub-samples denoted for simplicity as the "Core" countries and the "Peripheral" countries. We measure the expectations of economic agents in the Euro-area with the Economic Sentiment Indicator (ESI), which is a composite index with five sectoral confidence indicators as constituents, compiled by the European Commission.

We find that ECB's conventional monetary policy (and Fed's monetary policy stance) during the EU crisis has a positive and significant effect on economic expectations for Core Eurozone countries and a weak effect on Peripheral countries. Moreover, the Main Refinancing Operations rate appears to be the single most important net sender of shocks to the Peripheral countries, while for the Core countries it is the second most important net receiver. Our results, however, indicate that the effect of ECB's unconventional measures on expectations was less efficient compared to the effect of conventional measures. More specifically, in contrast to previous results on the Fed unconventional policy, ECB's unconventional measures had a negative effect to the expectation variation in most Core countries.

Our findings of a positive effect of conventional policy on sentiment are consistent with previous findings, however, the finding of a negative effect of unconventional policy on sentiment is not. Lutz (2015) finds that Fed's unconventional monetary policy shocks have a similar impact on economic sentiment as conventional policies (see also, Fratzscher et al., 2013, 2014). An explanation for the differences in the results may be the different nature of unconventional policies the two central banks

followed after 2010. For example, one should make the distinction between the subprime crisis in the US (2007-2009) during which the reaction of the Fed and the ECB was similar, and the EU crisis that erupted in 2010 where there have been important differences in the policies employed. More specifically, as Gros et al. (2012) point out, while the Fed (and the Bank of England) responded with QE policies signaling a strong will to undertake credit risk, the ECB responded with an approach that could be described as 'credit easing'; that is, the massive response to the crisis with the Long Term Refinancing Operations (LTROs) and the Securities Markets Programme (SMP) was also targeted at minimizing ECB's own risk (p. 5). It must also be noted that while at the time the focus in the US was on the economic cycle and economic recovery, in the Euro area increased uncertainty about a Greek default, the effective isolation from the inter-bank market of some Peripheral country banking systems, and the restoration the monetary policy transmission mechanism, was the priority (for a detailed discussion see Gros et al., 2012).

These results have implications for policy makers. For instance, a prolonged period of low interest rates reduces the efficiency of the main policy instrument used by central banks, which may have to rely increasingly to non-standard measures to deal with future financial crises. Of particular interest to policy makers could be the finding that the formation of economic expectations following a monetary policy shock is not uniform among Eurozone countries: expectations seem to be more affected in Core rather than Peripheral Eurozone countries. Understanding these effects can help design more efficient policy tools. The rest of the paper is organized as follows: section 2 briefly reviews unconventional monetary policy actions, section 3 presents

the data and the testing methodologies, section 4 presents the results, whilst section 5 concludes the paper.

2. A Brief Review of Unconventional Monetary Policies

The significance and the strength of the subprime crisis in the US (2007-2008) and the financial crisis in the EU (2010-2013) led to unchartered territory for major central banks, which responded by adopting non-standard monetary policy actions (see, for a review, Fawley and Neely, 2013). Initially, the ECB, together with other central banks from developed economies, responded by reducing its key interest rates and as a result the main refinancing rate was reduced to 1% (a decrease of 325 bp between October 2008 and May 2009). In addition to rate cuts, the ECB implemented the Enhanced Credit Support (ECS) that mainly consisted of an extension of the maturity of liquidity provision in Longer-Term Refinancing Operations (LTROs), Supplementary Long Term Refinancing Operations (SLTROs), and "Very" Long Term Refinancing Operations (VLTROs); a fixed rate full allotment tender procedure where, in contrast to standard procedures, financial institutions in the euro-area had unlimited access to central bank liquidity at the main refinancing rate; currency swap agreements that allowed the provision of liquidity in foreign currencies during the crisis; collateral requirements that involved an extension of the eligible collateral accepted in refinancing operations; a covered bond purchase programme.[2]

[2] For instance, in March 2008 the ECB introduced 6-month SLTROs, in May 2009 the ECB announced for the first time 12-month SLTROs (in the largest 12-month auction the ECB allotted around 442 billion euro), in December 2011 the ECB announced two "very" long term refinancing operations (VLTROs) with a 3-year maturity. Towards the end of 2009 the ECB initiated the phase-out of many elements of this policy.

By March 2010 when the EU crisis started to unfold, however, the ECB, in an attempt to inject liquidity and restore the monetary policy transmission mechanism announced the Securities Markets Programme (SMP)[3], i.e. direct purchases of government bonds (Greek, Portuguese and Irish) in secondary markets (often on a daily basis without a predetermined public target in terms of price or quantity, depending on market conditions). Within SMP all purchases were fully neutralized through liquidity-absorbing operations. In August 2011, the ECB extended the SMP to Italian and Spanish Government bonds; by early 2012, the ECB held around 220 billion euro of sovereign bonds. The SMP became "dormant" in early 2012 and was officially deactivated in September 2012. In September 2012, in the midst of fears of a euro area break-up, the ECB announced the introduction of a new policy instrument, the Outright Monetary Transactions (OMTs). The OMTs consist of purchases of government bonds with a maturity of up to three years, issued by countries under a European Stability Mechanism (ESM) macroeconomic adjustment programme or a precautionary programme (Enhanced Conditions Credit Line).

On the other side of the Atlantic, the Fed responded to the subprime crisis with Quantitative Easing (QE): before the crisis the Fed held between $700 billion and $800 billion of Treasury notes on its balance sheet; by late November 2008 it started buying $600 billion in mortgage-backed securities (QE1), by March 2009 it held $1.75 trillion of bank debt, mortgage-backed securities, and Treasury notes, and by June 2010 it held $2.1 trillion. In November 2010, the Fed announced a second round of Quantitative Easing (QE2), buying $600 billion of Treasury securities by the end of

[3] Note that Falagiarda et al. (2015), in a study on non-euro area EU countries, argue that, for the SMP announcements, portfolio rebalancing and signalling channels were important in policy transmission, while for the Outright Monetary Transactions (OMT) the confidence transmission channel reduced redenomination risk.

the second quarter of 2011. A third round of Quantitative Easing (QE3) was announced on 13 September 2012, i.e. a $40 billion per month open-ended bond purchasing program.

3. Data and Testing Methodology

For the empirical analysis we employ monthly data on sentiment indicators, macroeconomic aggregates, and financial variables (see, among others, Lutz, 2015), for the period between May 2007 and October 2012. All data are obtained from EIKON and Bloomberg. More specifically, our sample consists of nine Eurozone countries that we group in two sub-samples denoted for simplicity as the "Core" countries (Germany, France, Netherlands, Belgium and Austria) and the "Peripheral" countries (Spain, Portugal, Italy, and Greece). For these countries we collect data on Industrial Production (IP), Stock Returns (Stock_Ret, main equity indexes), Unemployment (Unemploym), Consumer Prices (HICP), and Trade Balance (Tradebal). To measure ECB's conventional monetary policy we employ the Main Operations Refinancing rate (MROr) and to measure Fed's monetary policy stance we employ the shadow Fed funds rate (Wu and Xia, 2016).[4]

As a proxy for Economic expectations/sentiment in the Eurozone countries (US) we employ monthly observations on the ESI (Michigan Consumer Sentiment Index, MCSI). The ESI is compiled within the Joint Harmonised EU Programme of Business and Consumer Surveys and is a composite indicator made up of five sectoral confidence indicators (industrial, services, consumption, construction, retail trade)

[4] Note that when the fed funds rate is above its zero lower bound the fed funds rate is equal to the shadow funds rate.

with different weights. Previous empirical work shows that sentiment indexes contain information that is not already reflected in other macroeconomic variables (see, among others, Carroll at al., 1994; Acemoglu and Scott, 1994; Matsusaka and Sbordone, 1995; Bachmann and Sims, 2012; Barsky and Sims, 2012). The MCSI is a consumer confidence indicator published by the University of Michigan and is typically employed in empirical studies to measure expectations and consumer optimism and pessimism, or as a predictor of asset returns (see, among others, Barsky and Sims, 2012; Lemmon and Portniaguina, 2006; Fisher and Statman, 2003). For the empirical analysis we use the indexes in first differences.

3.1. The Impact of Conventional Monetary Policy: A PVAR approach

For the empirical analysis we employ a panel Vector Autoregressive (PVAR) model with monthly data on sentiment indicators, macroeconomic aggregates and financial variables (see, among others, Lutz, 2015). In this setting, all variables in the system are treated as endogenous, while allowing for unobserved individual heterogeneity. Thus, we are able to combine the traditional VAR model with a panel-data approach based on the PVAR routine written by I. Love (Love and Zicchino, 2006). We first specify a first-order seven-variable VAR model:

$$Z_{i,t} = \gamma_o + \gamma_1 Z_{i,t-1} + f_i + u_t \quad i = 1,....,N \quad t = 1,...T \tag{1}$$

where $u_t \sim i.i.d.\ (0,\Sigma)$ and f_i expresses the time invariant fixed effects.

In (1), the PVAR shown, does not allow for dynamic interdependencies and cross sectional heterogeneities, since γ_o and γ_1 are the same across all units, or for static interdependencies since we assume that $cov(u_{it}, u_{jt}) = 0$, for $i \neq j$ (see Love and

Zicchino, 2006; Canova and Ciccarelli, 2013; Grossmann et al., 2014). The evidence presented from this analysis is mostly based on the results from the impulse-response functions and the variance decompositions. Furthermore, we use a Cholesky decomposition of the variance-covariance matrix of residuals, since the actual variance-covariance matrix of the errors is highly unlikely to be diagonal. In this case, it becomes difficult to isolate shocks to one of the VAR errors, i.e. we have to decompose the residuals in a way that they become orthogonal. Here, to identify monetary policy shocks, we follow Christiano et al. (1999) recursive ordering. We use a Cholesky decomposition based on the following ordering of variables for the model: *IP, HICP, MROr, Stock_Ret, Unemploym, Tradebal, ESI.* We considered alternative orderings, but the change in ordering does not affect our analysis and conclusions. We allow for individual heterogeneity in levels by introducing fixed effects, however, simple-mean differencing will provide biased estimators, as fixed effects are correlated with the regressors due to lags of the dependent variables. In order to avoid that, we follow Love and Zicchino (2006) and introduce the forward mean-differencing procedure of Helmert transformation. Since, dependent and lagged variables remain orthogonal we can estimate the coefficients by using system GMM. To analyze the impulse response functions we calculate the standard errors of the impulse-response functions and generate confidence intervals using Monte Carlo simulations with 200 replications. Therefore, whenever the zero line lies outside the confidence bands there is evidence of a statistically significant response to the shock inflicted.

We also apply the methodology of Diebold and Yilmaz (2009, 2012) in order to measure the intensity of the spillover effects from shocks to each one of the variables.

This methodology relies on Generalized Impulse Response Functions (Pesaran and Shin, 1998), which permits the calculation of a spillover matrix. The rows of this matrix reveal the individual impact, over a number of periods, of a shock to one variable (impulse variable) on each one of the other variables (response variables) in the system as well as the total sum of the impacts on all the variables (sum out). Accordingly, the columns of the matrix show the impact received of an individual variable from shocks on each one of the other variables as well as the total received impact (total in). The matrix facilitates the identification of the variables, which are responsible for the instability caused in the system.

3.2. The Impact of Unconventional Monetary Policy: A Qual VAR approach

In order to capture the effect of unconventional policy measures we first construct a binary variable which takes the value of one in the month of a monetary policy announcement and zero otherwise. One important issue is that these announcements have to be sufficiently unexpected and significant enough. We identify these announcements by focusing only on ECB announcements related to unconventional policy measures (SLTROs, SMP, OMT) that were covered in the front page of the Financial Times on the following day (see for details, Fratzscher et al., 2014; Fratzscher et al., 2013). This alleviates the concern that announcements were not important or were simply expected. The dates are presented in the Appendix A. Since this is a binary variable, we employ as a testing methodology a Qual VAR (see, Dueker, 2005), which is based on the single-equation dynamic ordered probit model of Eichengreen et al. (1985) and Dueker (1999). This model is more suitable to combine the binary information of the unconventional monetary announcements with

an otherwise standard VAR; i.e. it allows the use of unconventional policy announcements as an endogenous factor of the system. Within this setting, all of the covariates in the model constitute the same vector autoregressive system, and in order to produce multi-step forecasts only the dependent variable's own history is needed (see, Meinusch and Tillmann, 2016; Assenmacher-Wesche and Dueker, 2010; Tillmann, 2014; Bordo et al., 2008; Amstad et al., 2008). The continuous latent variable deriving from the model mirrors the propensity to unconventional monetary policy, and results after the estimation of the dynamic probit model through Markov Chain Monte Carlo (MCMC) techniques.

More specifically, consider a latent variable y^* as shown in equation (2) to determine unconventional monetary policy measures. It is defined as an autoregressive process of order ρ depending on a constant δ, its own lagged values and a set of lagged explanatory variables X_{t-P}; φ and β are vectors of the coefficients; e_t is a random error term following standard normal distribution and $t = 1,\ldots, T$ is the time index:

$$y_t^* = \delta + \sum_{l=1}^{\rho} \varphi_l y_{t-l}^* \sum_{l=1}^{\rho} \beta_l X_{t-l} + e_t, \qquad e_t \sim N(0,1). \tag{2}$$

The binary variable y_t takes the value one if unconventional policy actions occur in period t and zero otherwise. With the use of equation (2), the value of the binary variable y_t takes the form:

$$y_t = \begin{cases} 0 & if\ y_t^* \leq 0 \\ 1 & if\ y_t^* \geq 0 \end{cases} \tag{3}$$

The second component of the model, is a VAR (ρ) process for the dynamics of k regressors:

$$Y_t = \mu + \sum_{l=1}^{\rho} \Phi^l Y_{t-l} + \nu_t, \qquad \nu_t \sim N(0, \Sigma) \tag{4}$$

with a $k \times 1$ vector $Y_t = (X_t, y_t^*)'$. $k-1$ time series of observed macroeconomic data constitute the X_t while y_t^* complements a vector of the latent variable. The set of VAR coefficients are shown as:

$$\Phi^l = \begin{bmatrix} \Phi_{XX}^{(l)} & \Phi_{Xy^*}^{(l)} \\ \Phi_{y^*X}^{(l)} & \Phi_{y^*y^*}^{(l)} \end{bmatrix} \tag{5}$$

In (4) μ is a $k \times 1$ vector of constants and ν_t comprises the $k \times 1$ error vector and the covariance matrix of the errors is Σ. The complete Qual VAR system derives from the linear relation between the latent variable (the ECB's propensity for unconventional measures in our case) and the regressors.

Dueker (2005) and Assenmacher-Wesche and Dueker (2010) show that the model can be estimated by MCMC techniques, in particular via Gibbs Sampling, which is able to generate posterior samples by sweeping through each variable (or block of variables) to sample from its conditional distribution, while the rest variables remain fixed to their current values. Gibbs Sampling implements the joint estimation of the VAR coefficients Φ, the covariance matrix of the VAR residuals Σ and the latent variable y_t^*. The draws are generated from the iterative algorithm (for more details, see Dueker, 2005; Assenmacher-Wesche and Dueker, 2010). In a second step, the

Kalman Smoothing is implemented from which we obtain the mean and the variance of the states, e.g. the latent variable, conditional on its past and future values and on the rest data. The Smoother uses initial values, collected from the binary data for the latent variable and from OLS estimates for the coefficients given the binary data. Then, a latent variable, which is based on the first two moments, is drawn from the truncated Normal for each period. In the third step, the VAR model is estimated, using the sampled time series of the latent variable and OLS estimates for Φ and Σ, denoted by $\hat{\Phi}$ and $\hat{\Sigma}$.

The above information and the assumed Jeffrey's prior, conduct a draw for Σ from the inverted Wishart distribution with $T - k$ degrees of freedom. T mirrors the number of observations, k the number of explanatory variables and $(T\hat{\Sigma})^{-1}$ describes the covariance from OLS:

$$\Sigma \sim IW\left\{\left((T\hat{\Sigma}\right)^{-1}, T - k\right\} \tag{6}$$

Since the variance of the latent variable is equal to one, we equally adjust the appropriate element in Σ and normalize the other elements in the corresponding column. After adding the OLS estimates mean to a draw following a multivariate Normal distribution with a covariance matrix which stands for the Kronecker product, draws for Φ ,given Σ ,derive of the draw for Σ and $(Y'Y)^{-1}$:

$$\Phi \sim N\left\{\widehat{\Phi}, \Sigma \otimes (Y'Y)^{-1}\right\} \tag{7}$$

For a sufficiently large number of iterations, the draw from either conditional distribution represents actually a draw from the joint posterior distribution. As in Dueker (2005), we run the Gibbs sampling for 10,000 iterations from which the first 5,000 are discarded to allow for convergence towards the posterior distribution. Draws of the VAR coefficients that were not satisfying stationarity were rejected and resampled. From the resulting sample the mean of the latent variable, the VAR coefficients and the variance were derived. The binary index enters the Qual VAR as y_t {0, 1} and together with the remaining variables in the X_t vector are used to derive the ECB's latent propensity to unconventional monetary policy measures, y_t^* (ystar). The model also includes variables that capture the Eurozone business cycle, the financial markets' response on ECB's unconventional monetary policy stance, and expectations (IP, HICP, Stock_Ret, Unemploym, Tradebal, ESI). We conclude to a seven-variable Qual VAR model i.e.: IP, HICP(CPI), ystar, Stock_Ret, Unemploym, Tradebal, ESI (MCSI).

Nevertheless, in order to keep our model as parsimonious as possible, we tested the results after adopting a five-variable model as follows: IP, HICP(CPI), ystar, Stock_Ret, ESI(MCSI). The results remained qualitatively the same (available upon request). The model is estimated in first differences in order the variables to be stationary and thus consistent with the assumptions in the MCMC estimations, as well as with the concept of the latent variable reflecting the propensity to unconventional measures. The recursive ordering we follow is according to Christiano et al. (1999), while alternative orderings produce qualitatively the same results. As lag selection criteria are not defined for binary data we choose to use three lags in our Qual VAR system, which is appropriate for a short sample according to Meinusch and Tillmann,

(2016). We also implement multivariate Q-tests which confirm the absence of serial correlation in the residuals of each estimated model.

3.3. The Impact of Unconventional Monetary Policy: A FAVAR approach

In order to robust the results regarding the effect of ECB's unconventional monetary policy on investor sentiment, we also employ a structural Factor-Augmented Vector AutoRegression (FAVAR) model (Bernanke, Boivin, and Eliasz (BBE; 2005) and Boivin, Giannoni, and Mihov (BGM; 2009)) in a large dataset of monthly time series of nine EU counties. The FAVAR model is quite advantageous, as it employs a large number of informative macroeconomic and financial time series used by investors and policymakers, by combining the standard VAR analysis with factor analysis. After identification, structural IRFs can be produced for all variables in the dataset. Thus, with the use of the FAVAR model, the potential omitted variable issues mostly seen in standard VAR models can be prevented (e.g. the ‘‘price puzzle" of Sims, 1992).

Most of the studies adopting a FAVAR approach to investigate monetary transmission are related to the US (see e.g. Bernanke et al., 2005; Stock and Watson, 2005; Favero et al., 2005; Belviso and Milani, 2006; Boivin et al., 2009; Boivin and Giannoni, 2008; Lutz, 2015; Gabriel and Lutz, 2015), while only few are based on the monetary policy effects in the euro-area. Examples of studies related to the euro-area are McCallum and Smets (2007), who employ a FAVAR model in order to capture the effects of monetary policy shocks on real wages and employment in individual countries and the euro area as whole as well, or Eickmeier (2009), who investigates comovements and heterogeneity in the euro area based on a structural dynamic factor

model of Forni and Reichlin (1998). Also Blaes (2009), adopting the FAVAR model of BBE, studies the transmission of monetary policy in the euro area for the period 1986 to 2006, while Boivin et al. (2008), employ the FAVAR approach of BBE and investigate potential differences in the monetary transmission of individual euro area countries.

Our paper differentiates from the existing literature, as its focus is on the unconventional monetary transmission studying the effect of a common unconventional monetary policy shock of the various euro area countries, in contrast to Normandin (2006) who employs separate VARs for different counties. Similar to BBE and BGM who study the effect of the fed funds rate on unemployment, output, and prices by employing a FAVAR model, we use the FAVAR model in order to study the effect of ECB's unconventional monetary policy stance on investor sentiment in Europe. Moreover, as discussed above, it is the first paper that uses the latent propensity for ECB's unconventional monetary stance deriving from a Qual VAR model (Dueker, 2005) as a monetary instrument, combining this way, a Qual VAR and a FAVAR model. A brief description of the FAVAR model is presented in Appendix D.

The monetary policy shocks are identified using a Cholesky identification scheme, under the assumption that the monetary policy variable comes last at the ordering, meaning that it affects the unobserved factors, F_t, with only one lag. The lag length of three is selected in our FAVAR model, with the results being robust to alternative lag lengths. Although Bai and Ng (2002) provide a criterion to choose the number of factors, BBE state that the decision of the number of the factors in the model comes

through the exploitation of the sensitivity of the results to an alternative number of factors. We follow BBE and use three factors in our model. Nevertheless, the effect of monetary policy remains qualitatively the same by the use of five factors or even after further increases in the number of factors. Our monetary policy instrument, is the latent propensity for ECB's unconventional monetary stance, y^*(ystar), deriving from the Qual VAR model. As the Qual VAR model was estimated for each of the nine countries separately, a principal component analysis to the country specific latent propensities was conducted, in order to produce a latent propensity for ECB's unconventional monetary stance for the euro area as a whole, in order to be used in the FAVAR model.[5] Our dataset includes a large number of macroeconomic indicators chosen from the following categories: real output and income; employment; prices; exchange rates; interest rates; stock prices; money aggregates; consumption; labor cost; sentiment indicators; and some foreign variables (VIX, VSTOXX, S&P500). Our dataset consists of a balanced panel of 328 monthly time series for nine euro-area countries from May 2007 to October 2012. The dataset includes 35 country-specific variables for each of the nine countries in our sample and 13 common variables (see Appendix C, for a description of the variables).

As we intended to work with a balanced panel of monthly series, we had to disaggregate some quarterly series into monthly ones, using the cubic spline interpolation.[6] All variables - with the exception of interest rates - are transformed in logs and, if necessary, differentiated to induce stationarity. All "informational" series used to compute the factors were standardised to have mean zero and unit variance, in

[5] The latent propensity for ECB's unconventional monetary stance for the euro area was produced after PCA analysis for both Qual VAR models (5-variable and 7-variable Qual VAR models). The results from the FAVAR model remained qualitatively the same.

[6] This approach has been used in many previous studies for this type of transformations (see, among others, Bernanke, et. al. 1997; Abbate, et.al. 2016; Lescaroux and Mignon, 2009).

order to overcome the impair factor extraction issue due to the different scales of the time series.

4. Results

In Table 1, Panel A, we present descriptive statistics for the main variables. The panel unit root tests of Im-Pesaran-Shin (2003; IPS test) suggest that we strongly reject the null hypothesis of a unit root, for all sample variables (available upon request). The next step is the lag selection for the PVAR model. In order to decide on the lag structure we use the overall coefficient of determination (CD). The results are presented in Table 1 (Panel B) and indicate that the optimal lag structure is one lag. Nevertheless, in order to enhance a 7–variable VAR model with richer dynamics, we choose a panel VAR model with three lags (apart from Peripheral countries for the 2007-2010 period and Core and Peripheral countries for the 2010-2012 period, where due to fewer observations than parameters, the lags are two). In Panel C (Table 1) we report evidence on the stability properties of the estimated PVAR model, which requires the moduli of the eigenvalues of the dynamic matrix to lie within the unit circle, which is the case in our estimated model (see also, Figure 1).

[INSERT TABLE 1 ABOUT HERE]

[INSERT FIGURE 1 ABOUT HERE]

To identify monetary policy shocks, we follow Christiano et al. (1999). We use a Cholesky decomposition based on the following ordering[7] of the variables: IP, HICP, MROr, Stock_Ret, Unemploym, Tradebal, ESI. Note that we also employ alternative orderings such as the monetary shock identification of Bloom (2009) (e.g. Stock_Ret,, HICP, MROr, IP, Unemploym, Tradebal, ESI), while we also estimate a 5-variable panel VAR (excluding trade balance and unemployment). The results (available upon request) remain qualitatively the same. We focus and present results on the underlying moving average (MA) representation of the VAR model, i.e. the impulse response functions (IRFs) and the associated Forecast Error Variance Decompositions (FEVDs). These two combined, convey information on how each variable responds to a surprise change (a shock) to another variable in the system.

4.1. The effect of ECB's Conventional Policy on Eurozone expectations

This sub-section presents results obtained with the Panel VAR model on the effect of Conventional Policy (proxied by the Main Refinancing Operations rate, MROr) on expectations. Table 2 presents the results from the ESI FEVDs, i.e. the percentage of sentiment variance that is explained by each variable. Panel A presents results for the full sample and Panel B (C) for the period 2007-2010 (2010-2012). Note that we perform variance decomposition analysis for all variables; however, we concentrate and report here only the results for sentiment. We find that for the full sample period (Panel A) the MRO rate contributes 5.46% to the variance of sentiment for all Eurozone countries, 9.8% to the Core countries, and 2.3% for the Peripheral countries. During the 2007-2010 (2010-2012) period the MRO rate contributes 5.51%

[7] Lutkepohl and Poskitt (1991) argue that the ordering of the variables makes little difference when the residual correlation is small.

(3.89%) to the variance of sentiment for all Eurozone countries, 9% (16.74%) for the Core countries, and 7.14% (1.92%) for the Peripheral countries. Equity market returns seem to also be an important contributor to sentiment variance: between 2007 and 2010 equity returns contribute approximately 28.55% to sentiment variance for the Eurozone countries. The important result that emerges from this Table is that during the EU crisis (2010-2012) ECB's conventional monetary policy appears to contribute to about 16.74% to Core countries economic expectations variance, while it contributes to only about 1.92% to Peripheral countries economic expectations variance.

[INSERT TABLE 2 ABOUT HERE]

4.2. The effect of Fed's conventional monetary policy on Eurozone expectations

This sub-section presents results obtained with the Panel VAR model on the effect of Fed's monetary policy stance on Eurozone expectations. The results are presented in Table 3, which is organized in the same way as Table 2. The shadow Fed funds rate is used to capture the effect of Fed's conventional monetary policy stance and is listed first in the Cholesky ordering as the most exogenous in the system. Following Dees et al. (2007), we are implicitly assuming that the US economy affects but does not respond to developments in other economies. Alternative orderings produced qualitatively the same results. As can be seen in Table 3, during the full sample period (Panel A) the Fed policy accounts for 2.75% of Eurozone expectations variance (4.11% to the Core countries sentiment variance and 2.71% to Peripheral countries sentiment variance). For the 2007-2010 period, these percentages rise to

approximately 5%, 7%, and 5%, respectively. In other words, Fed's monetary policy stance also seems to affect to some extent expectations in the Eurozone.

[INSERT TABLE 3 ABOUT HERE]

4.3. Sentiment Spill-Over Effects between the US and the Eurozone

The results, so far, indicate that conventional ECB monetary policy seems to have a significant effect on the expectations of Core countries but a much smaller effect on the expectations of Peripheral countries. Fed's monetary policy stance also seems to affect to some extent expectations in the Eurozone. A related interesting issue is whether there are sentiment spill-over effects from the US to the Euro-area. This sub-section presents results obtained with the Panel VAR model on the effect of US expectations on Eurozone expectations. Table 4 reports FEVD results on the contribution of US expectations (captured by MCSI) to the sentiment variance of Eurozone. The MCSI is listed after the ECB monetary policy stance to the Cholesky ordering, assuming that the US sentiment does not have a contemporaneous effect on EU monetary developments but only a delayed one. Alternative orderings were tested and produced qualitatively the same results. On average, US sentiment contributes anything between of 1% and 8% (approximately) to the variance of European sentiment, depending on the period and sample. An interesting result that emerges from this Table is that, during the US crisis, economic sentiment in the US contributes to about 7.97% to Core country expectations variance while it contributes to only 1.01% Peripheral country economic sentiment.

[INSERT TABLE 4 ABOUT HERE]

4.4. Further tests: spillover matrices and variable ordering

This sub-section presents further results on conventional ECB monetary policy (MRO) on Core and Peripheral countries during both the US and the EU crisis. More specifically, Table 5 presents the spillover matrices of Diebold and Yilmaz (2009, 2012); within this framework forecast error variance decompositions are invariant to variable ordering. Panels A and B present results for the US crisis for the Core and Peripheral countries, respectively, while Panels C and D present results for the EU crisis for the Core and Peripheral countries, respectively. One way to read the Table is to focus on the *Sum Out* and *Sum In* columns and rows, which show the aggregate impact of shocks sent to and received from the other variables in the system. For instance, the results for the Peripheral countries in Panel B (*Sum Out* column) indicate that during the financial crisis (US) the amount of shocks sent by the MRO rate to all other variables is the biggest compared to all other variables in the system (120.23) with economic sentiment being the second (112.29). This holds also for the Peripheral countries during the sovereign debt crisis (EU, Panel D) where the MRO rate is the variable with the biggest impact (155.12) followed by trade balance (141.27) and economic sentiment (138.38). The results for the Core countries during the US financial crisis which are presented in Panel A (*Sum Out* column), indicate that the amount of shocks sent by the MRO rate to all other variables is also first compared to all other variables in the system (77.51).

[INSERT TABLE 5 ABOUT HERE]

When we consider the net contribution of each variable (*Net* row) we can see that, during the US crisis, the MRO rate is a net sender of shocks for both the Core countries (Panel A, 9.8) and especially for the Peripheral countries (Panel B, 60.3). During the EU crisis in Core countries (Panel C) the MRO rate appears to be the second most important net receiver of shocks (-20.36) while the economic sentiment is the second most important net sender (29.43). These results suggest that during the EU crisis the MRO rate appears to be the single most important net sender of shocks to the Peripheral countries, while for the Core countries it is the second most important net receiver. The ESI is the second most important net sender of shocks to both Core and Peripheral countries. These results are consistent with the notion that monetary policy and economic expectations have been significant contributors to the outcome of the US and EU financial crisis.

4.5. Impulse Response Functions (IRFs)

Figure 2 and Figure 3 present orthogonalized Impulse Response Functions (IRFs) and the 95% error bands generated by Monte Carlo simulation (200 repetitions) obtained with the Panel VAR model on the effect of Conventional Policy (proxied by the Main Refinancing Operations rate, MROr) on expectations. More specifically, Figure 2 presents the IRFs for the Eurozone, Core, and Peripheral countries, during the full sample period and the two sub-periods discussed above. Figure 3 presents IRFs on the response of the ESI variable to a shock in ECB Main Refinancing Operations rate (MROr) at a country level.

Our attention should lie with the Core countries mainly, since for these countries we detected a significant effect according to the FEVDs (see Table 2). Figure 2 indicates that during the full sample period a contractionary monetary shock leads to a statistically significant decrease in the Core countries sentiment that lasts for 2-4 months after the policy shock. For the 2007-2010 period, a one standard deviation positive shock to the monetary policy rate, causes a decrease to Core countries sentiment, two months approximately after the policy shock. During the EU sovereign debt crisis (2010-2012), the Core economic sentiment declines to almost 0.7 percentage points, following a monetary contraction after about 1 month, with a statistically significant effect. The country specific responses to a monetary shock (Figure 3) confirm this finding. In other words, a decrease in ECB rates has a positive effect on economic expectations, a result consistent with previous findings on Fed conventional policy.

[INSERT FIGURE 2 ABOUT HERE]

[INSERT FIGURE 3 ABOUT HERE]

Next we examine, the response of Eurozone economic sentiment (ESI) to a shock in Feds conventional monetary policy (proxied by the shadow Federal Funds rate), obtained with the Panel VAR model. As can be seen in Figure 4, a contractionary US monetary policy shock causes a decline in the Core countries economic sentiment, which touches a maximum three months after the US policy shock. Overall, the results in this sub-section suggest that both ECB's conventional monetary stance and Fed's monetary stance had a positive effect on economic expectations/sentiment in Core countries.

[INSERT FIGURE 4 ABOUT HERE]

4.6. Unconventional Monetary Policy – A Qual VAR approach

This section presents the results for ECB's unconventional monetary policy on economic expectations. More specifically, we employ the Qual VAR model discussed in sub-section 3.2 in order to derive the ECB's latent propensity to unconventional monetary policy measures, (ystar), based on our initial binary variable. We then employ this continuous variable in our Panel VAR model for all variables and country groups in a panel data set.[8] Figure 5 presents this variable for each country, i.e. the estimated latent propensity to unconventional monetary policy measures for each one of the sample countries. During the announcement dates (shaded areas) this series is required to be positive (Meinusch and Tillmann, 2016). The ECB's latent propensities appear very similar for countries, an expected result since ECB's monetary stance is common. The sharp increases underline their magnitude.

[INSERT FIGURE 5 ABOUT HERE]

Table 6 presents the FEVD results for the different country groups after running a panel VAR with 1, 2 and 3 lags (Panel A, B and C, respectively). The results indicate that unconventional measures had a significant effect to economic sentiment especially in the Core countries, where 12.8%, 12.6% and 10.6% of the total variance is explained, with 1, 2 and 3 lags respectively. Unconventional policy shocks account

[8] Note that we also try alternative Cholesky orderings and the results remain qualitatively the same. We first adopt a standard approach (Christiano et al., 1999) such as IP, HICP, ystar, Stock_Ret, Unemploym, Tradebal, ESI, and then try another approach (Bloom, 2009) as follows: Stock_Ret, HICP, ystar, IP, Unemploym, Tradebal, ESI. We report here results for the former, however, alternative results are available upon request.

for a less sizable portion of economic expectations in Peripheral countries, with a total contribution of 2.41%, 4.7% and 7.94% to the total variation, with 1, 2 and 3 lags, respectively. Note that equity market returns seem to also be an important contributor to sentiment variance.

[INSERT TABLE 6 ABOUT HERE]

The Impulse Response Functions (IRFs) from this model are presented in Figure 6. More specifically, in Figure 6, Panel A presents the response of the ESI to an unexpected increase in the ECB's propensity to unconventional monetary policy measures by one standard deviation for each country group, which is obtained from a Panel VAR specification, while Panel B presents the response of the ESI for each country separately. The results in Panel A suggest that an increase in the ECB's propensity to unconventional monetary policy decreases investors' sentiment: more specifically, for the first and second month, following the monetary policy impulse, the Core countries investors' expectations experience a decrease of approximately 0.7 percentage points. The results in Panel B indicate that in Belgium, Austria, France and the Netherlands, a monetary policy shock decreases expectations during the first two months, while in Germany, Spain, Italy, and Greece expectations turn positive 2-4 months after the monetary policy shock. Overall, the results in this sub-section indicate that ECB's unconventional monetary policy has a negative and significant contribution to the expectation variation in Core countries, while it has a positive effect on peripheral countries and Germany.

[INSERT FIGURE 6 ABOUT HERE]

4.7. The US case

In this section, for comparative purposes, we investigate how Fed's unconventional monetary policy affected expectations (proxied by the MCSI) in the US. The methodology, i.e. the estimation of the Qual VAR is the same as in the previous sub-section, and the binary variable of QE announcements is also constructed in a similar manner as above, and according to Fratzscher et al. (2013) and Fratzscher et al. (2014) (see Appendix B). Our results of the FEVDs to a latent propensity to QE shock are presented in Table 6 (Panel D) and indicate that an impulse to unconventional policy explains 6.8% in expectations total variation. The Fed's latent propensity to QE and the IRFs are presented in Figure 7. The IRFs indicate that unconventional policies raise US expectations: during the first two months after the QE shock a rise in consumer sentiment of 1.2 percentage points is detected. These results are consistent with the results of Lutz (2015).

[INSERT FIGURE 7 ABOUT HERE]

4.8. Unconventional Monetary Policy and Expectations: a FAVAR approach

This section reports the effect of ECB's unconventional policy on Eurozone economic expectations, employing the FAVAR model presented in sub-section 3.4. In Table 7, we report only the results for the Economic Sentiment Indicator for each sample country (the rest of the results are available upon request). The last column of Table 7 reports the R^2 of the common component for each of the variables of interest, that is

the fraction of the variance of the country-specific ESI that is explained by the common factors F_t and R_t. The second and third columns show the Forecast Error Variance Decomposition at the 10-month horizon and at the 20-month horizon, respectively. It is clear that the contribution of the policy shock in the Core countries' ESI is of greater importance than the one of the Peripheral countries. For instance, an unconventional monetary policy shock explains in a 10-month horizon 8.03%, 4.05%, 4.44%, 4.87 and 4.27% of the ESI variance for Germany, Austria, Belgium, France, and the of the Netherlands, respectively. In contrast, an unconventional monetary policy shock explains in a 10-month horizon 3.1%, 1,4%, 2.4% and 3.3% of the ESI variance for Spain, Italy, Portugal, and Greece, respectively. The results remain qualitatively the same after a 20-month horizon (third column). Looking at the R^2 of the common component, we note that the factors explain a sizeable fraction of the Core countries ESI, while for the Peripheral countries ESI the R^2 is quite low. More specifically, the R^2 in the Core countries varies from 50% to 67% while the R^2 in the Peripheral countries varies from 24% to 35%.

[INSERT TABLE 7 ABOUT HERE]

[INSERT FIGURE 8 ABOUT HERE]

Figure 8 shows the estimated impulse responses (IRFs) for the Economic Sentiment Indicators for each sample country. Note here that less confidence should be placed on the IRFs of variables with low R^2 (see BBE) and low FEVDs, as well, i.e. these of the peripheral countries. The IRFs in Figure 8 indicate that the pattern is similar for all Core countries; the response of investor sentiment to an unexpected increase in the ECB's latent propensity to unconventional measures is negative for the first five

months, when it eventually turns positive for almost two to four months until it becomes insignificant. Thus, it can be argued that in the short-term the ECB's unconventional monetary policy stance had a negative impact on investors' expectations, while in the medium and longer term this effect became positive. Overall, the FAVAR methodology, which employs a significantly richer data environment and provides a more comprehensive and complete picture of the effects of policy innovations on economic expectations, produces results consistent with the results obtained in previous sub-sections.

5. Conclusion

This paper examines the effect of ECB's conventional and unconventional monetary policies during the EU crisis on economic expectations. We employ a range of research methodologies (PVAR, QVAR, FAVAR) and a sample of nine Eurozone countries. We combine expectations/sentiment indicators with a set of macroeconomic and financial variables such as equity prices, industrial production, unemployment, trade balance and consumer price indexes. The results indicate that ECB's conventional monetary policy (and Fed's monetary policy stance) has a positive and significant effect on economic expectations for Core Eurozone countries, and a significantly weaker effect on Peripheral countries. In addition, during the US financial crisis, we detect sentiment spill-over effects from the US to the Core Eurozone countries. Moreover, during the EU crisis, the MRO rate appears to be the single most important net sender of shocks to the Peripheral countries, while for the Core countries it is the second most important net receiver. As regards to unconventional measures, we find that they have a significant effect to the variation in

expectations especially for the Core countries. Also, in the short-term the ECB's unconventional monetary policy stance had a negative impact on investors' expectations, while in the longer term the effect becomes positive.

These results are consistent with the notion that monetary policy and economic expectations have been significant contributors to the outcome of the US and EU financial crisis. Our results, however, indicate that the effects of ECB's unconventional measures were less efficient than conventional measures on expectations. That is, in contrast to the Fed, ECB's unconventional policies had a negative short-term impact on economic expectations. As discussed in the introduction, this finding can perhaps be explained by the different nature of unconventional strategies the two central banks followed after 2010 and the different challenges they faced. Given the absence of any mechanisms that can tackle the side effects of this strategic divergence, empirical evidence that sheds light on the effects of non-standard policies is crucial in understanding its effectiveness.

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APPENDIX A: Press coverage of ECB actions

Date	Event	Financial Times Headline	Headline Article	Front page	VIX	Dummy
28/3/2008	6 month SLTROs	*US sends in back-up for Iraqi offensive*	No	No	-0.17	AN_SLTROs
4/9/2008	Roll over of the outstanding 6 month SLTROs	*US stock s suffer on fear for economy*	No	No	2.6	AN_SLTROs
15/10/2008	6 month SLTROs and other measures	*Fresh squall rattles mark ets*	No	No	14.12	AN_SLTROs
7/5/2009	12 month SLTROs and other measures (including covered bond purchases)	*Us banks must add $74.6bn in equity*	No	text	0.99	AN_SLTROs
4/6/2009	Details for the purchase programme of covered bonds	*Obama appeal to muslims*	No	No	-0.84	
10/5/2010	SMP and other measures	*Markets rally on EU bail-out*	main text	-	-12.11	AN_SMP
30/6/2010	Completion of covered bond purchases	*EU bank bonus rules sow confusion*	No	No	0.41	
4/8/2011	SLTROs and other measures	*Stock markets plunge worldwide*	main text	-	8.28	
7/8/2011	SMP reactivation	*Traders braced for more turmoil*	main text	-	16	AN_SMP
6/10/2011	12 month SLTROs and covered bond purchases	*ECB raids policy cupboard*	title	-	-1.54	AN_SLTROs
8/12/2011	36 month VLTROs and other measures	*European banks' shortfall at €115bn*	-	-	1.92	
26/7/2012	Mr. Draghi's Speech "Whatever it takes"	*Nomura axe falls on top staff*	No	title	-1.81	AN_OMT
6/9/2012	Details for the OMT	*ECB signals resolve to save euro*	title	-	-2.14	AN_OMT

Notes to Appendix A

Column "Event" describes the policy announcement; "Financial Times Headline" indicates the title of the "top story" on the front page of the Financial Times; "Headline Article" indicates where the ECB action is mentioned in the top story on the front page of the Financial Times (title, subtitle or main text); "Front page" indicates where the ECB action is mentioned on the front page of the Financial Times, if not in the "top story" (title, subtitle or main text). "VIX" indicates the change in the VIX on the day of the announcement; "dummy" indicates the impulse dummy capturing announcements effects in the baseline analysis.

APPENDIX B: Press coverage of FED actions

Date	Event	Financial Times Headline	Headline Article	Front page	VIX	Dummy
25/11/2008	LSAPs announced	*Fed adds $800bn to boost borrowing*	title	-	-3.80	AN_QE1
1/12/2008	Bernanke first suggestion of extending QE to Treasuries	*Evidence of deep recession mounts*	main text	-	13.23	
16/12/2008	First suggestion of extending QE to Treasuries by FOMC	*US Fed slashesrates to near zero*	main text	-	-4.39	AN_QE1
28/1/2009	Fed stands ready toexpand QE and buy Treasuries	*Economic pain to be 'worst for 60years'*	main text	-	-2.59	AN_QE1
18/3/2009	QEs expanded	*Fed purchase plan stuns investors*	title	-	-0.74	AN_QE1
27/8/2010	Bernanke suggests role for additional QE	*Fed ready to boost economy*	title	-	-2.92	AN_QE2
12/10/2010	FOMC says additional accomodation may be appropriate	*Fresh Fed boost more likely*	title	-	-0.03	
15/10/2010	Bernanke says Fed stands ready for action	*Bernanke hints at further stimulus*	title	-	-0.85	AN_QE2
3/11/2010	QE2 announced	*Fed to pump in extra $600bn*	title	-	-2.01	AN_QE2
21/9/2011	Maturity Extension Programm announced	*Fed 'twist' seeks to boost US economy*	title	-	4.46	
20/6/2012	Maturity Extension Programm extended	*Fed opts to extend its Operation Twist' plan*	title	-	-1.14	
22/8/2012	FOMC says additional monetary accomodation is likely	*SA mining unrest spreads*	No	title	0.09	AN_QE3
13/9/2012	QE3 announced	*Bernanke takes plunge with QE3*	title	-	-1.75	AN_QE3
12/12/2012	QE3 expanded	*Fed links interest rates to US unemployment figures*	main text	-	0.38	

Notes to Appendix B

See Notes to Appendix A. The focus is set on the fifteen "expansionary" announcements listed in Table 1A in Fawley and Neely (2013).

APPENDIX C: Description of the data

Country/Region	Variable	Country/Region	Variable
EU countries (DE, AT, BE, FR, NL, SP, IT, PT, GR)	Industrial production excl. construction	World	Commodity oil price
	Industrial production: Manufacturing		S&P 500 Composite
	Industrial production: Energy		VIX-CBOE volatility index
	Industrial production: Intermediate goods		ECB Commodity price index
	Industrial production: Non-durable goods		
	Industrial production: Durable goods		
	Industrial production: Capital goods		
	Unemployment over 25 years old		
	Unemployment rate		
	Producer Price Index: All items		
	Producer Price Index: Manufacturing	Aggregate euro-area variables	EUROSTOXX 50
	Producer Price Index: Energy		Yen to EU exchange rate
	Producer Price Index: Intermediate goods		EU to UK exchange rate
	Producer Price Index: Non-durable goods		EU to USD exchange rate
	Producer Price Index: Durable goods		Real effective exchange rate
	Producer Price Index: Capital goods		EU individual consumption exp.
	Consumer Price Index: All items		Hourly labor cost
	Consumer Price Index: Food		Unit labor cost
	Consumer Price Index: Energy		VSTOXX
	Short-term interest rate nominal		
	Long-term interest rate (gvt.bonds) nominal		
	Capacity utilization rate		
	Price deflator		
	Final consumption expenditure		
	M1		
	M2		
	M3		
	GDP, real		
	GDP deflator		
	Private final consumption		
	Unit labor cost		
	Main stock price index		
	Economic sentiment indicator		
	Trade balance		
	Harmonised index of consumer prices		

Notes to Appendix C

The Table presents data directly taken from EIKON and Bloomberg. Transformations are as in Bernanke et al. (2005), Stock and Watson (2002), and Boivin et al. (2009). The second column presents the country specific variables for the nine countries of our sample (35 time series for each country), while the fourth column presents the common variables (13 time series).

APPENDIX D: Description of the FAVAR model

We briefly present the FAVAR model, estimated by the two-step principal component approach (for more details see BBE and BGM). In the first step, a set of factors that capture the dynamics of financial markets derive from our large dataset through the principal component analysis (PCA), under the assumption that key interest rates, a vector of observed factors and a set of latent factors have an effect on financial markets. In the second step, a standard VAR model is estimated, including the latent factors and the key interest rates and IRFs can be computed for all the variables in the system.

Within the FAVAR framework, let $N \times 1$ a vector of macroeconomic time series X_t and assume that the evolution of the financial markets is affected by a $K \times 1$ vector of unobserved factors, F_t, and an observed factor, the policy instrument, R_t, such that:

$$C_t = \begin{bmatrix} F_t \\ R_t \end{bmatrix} \tag{8}$$

The estimation of the observation equation using principal components appears as follows:

$$X_t = \Lambda^f F_t + \Lambda^r R_t + e_t \tag{9}$$

where Λ^f, the $N \times K$ matrix of factor loadings, Λ^r the $N \times 1$ vector of factor loadings, and e_t the $N \times 1$ vector of error terms with mean zero, assumed to be serially and mutually weakly correlated. Then, we estimate the following standard VAR with the C_t:

$$C_t = \Phi(L) C_{t-1} + u_t \tag{10}$$

where $\Phi(L)$ is the matrix of lag polynomials of finite order. After estimating the VAR model, we can study the IRFs and FEVDs deriving from the model. More specifically, we can investigate the effect of a policy shock by multiplying the IRFs derived from the VAR in Eq. (10) with the factor loadings from the observation equation. FEVDs are calculated using the augmented formula for the FAVAR model from BBE.

Table 1
Descriptive Statistics

Panel A: Descriptive Statistics					
Variable	**Obs**	**Mean**	**Std. Dev.**	**Min**	**Max**
MROr	594	-0.0454	0.1737	-0.75	0.25
Stock_Ret	594	-0.0090	0.0736	-0.3260	0.1982
IP	594	-0.0017	0.0230	-0.0884	0.0857
Unemploym	594	0.0842	0.2156	-0.6101	1.0902
Tradebal	594	0.5208	1.6521	-5.7691	3.9414
HICP	594	0.0065	0.4220	-1.6011	2.3014
ESI	594	-0.3936	2.5906	-10.8	7.2
Panel B: Lag-order selection statistics for Panel VAR estimated using GMM					
		Lag	**CD**		
		1	0.6758		
		2	0.7743		
		3	0.8268		
		4	0.9027		
Panel C: Roots of the Companion Matrix					
		Eigenvalue			
		Real	**Imaginary**	**Modulus**	
		0.5436	0	0.5436	
		-0.4037	0	0.4037	
		0.3566	0.0628	0.3621	
		0.3566	-0.0628	0.3621	
		-0.1097	0	0.1097	
		0.0924	0	0.0924	
		-0.0455	0	0.0455	

Notes to Table 1

Panel A presents descriptive statistics for the following variables: The Main Refinancing Operations rate (denoted as MROr), the Stock market returns (denoted as Stock_Ret), the Industrial Production index (denoted as IP), the Unemployment rate (denoted as Unemploym), the Trade balance (denoted as Tradebal), the Harmonised Index of Consumer Prices (denoted as HICP) and the Economic Sentiment Indicator (denoted as ESI). All of the time series are transformed to ensure stationarity; Main Refinancing Operations rate, Unemployment rate, Harmonised Index of Consumer Prices and Economic Sentiment Indicator are used in first differences, Stock market returns and Industrial Production in log differences while trade balance in growth rate. All data are monthly and obtained from EIKON and Bloomberg. The sample covers the period between May 2007 and October 2012. Panel B presents test results for the optimal lag structure. CD is the overall coefficient of determination. Panel C: the stability of the PVAR requires the moduli of the eigenvalues of the dynamic matrix to lie within the unit circle, which is the case in the estimated model (Lütkepohl, 2005).

Table 2
Conventional ECB Policy: Variance Decomposition Analysis

	Impulse variables						
Response variable	**IP**	**HICP**	**MROr**	**Stock_Ret**	**Unemploym**	**Tradebal**	**ESI**
Panel A: 2007 – 2012							
Eurozone countries							
ESI	5.33	0.75	5.46	17.26	1.48	0.87	68.81
Core countries							
ESI	3.96	2.32	9.80	21.94	1.18	1.37	59.45
Peripheral countries							
ESI	8.13	1.16	2.30	10.29	1.46	0.83	75.79
Panel B: 2007 – 2010							
Eurozone countries							
ESI	3.47	3.65	5.51	28.55	1.65	1.39	55.74
Core countries							
ESI	1.94	7.01	9.00	25.67	1.63	3.22	51.50
Peripheral countries							
ESI	7.80	0.74	7.14	14.79	11.08	44.76	13.67
Panel C: 2010 – 2012							
Eurozone countries							
ESI	2.82	6.13	3.89	7.78	17.41	19.95	41.99
Core countries							
ESI	11.23	1.30	16.74	11.2	3.34	6.20	50.00
Peripheral countries							
ESI	0.38	8.11	1.92	41.5	15.37	9.91	22.79

Notes to Table 2
The Table presents results for Variance Decomposition Analysis, i.e. the contribution of each variable to the variance in sentiment. Panel A presents results for the full sample, Panel B for the period between 2007 and 2010, while Panel C for the period between 2010 and 2012. The results were computed from a panel VAR with 3 lags, apart from Peripheral countries group for the 2007-2010 period and Core countries and Peripheral countries group for the 2010-2012 period, in which due to fewer observations than parameters, the lags are two. Note that we perform variance decomposition analysis for all variables, however, we report here only the results for sentiment (the rest of the results are available upon request). Variables: Main Refinancing Operations rate (denoted as MROr), stock market returns (denoted as Stock_Ret), Industrial Production index (denoted as IP), unemployment rate (denoted as Unemploym), Trade balance (denoted as Tradebal), Harmonised Index of Consumer Prices (denoted as HICP), Economic Sentiment Indicator (denoted as ESI). All time series are transformed to ensure stationarity; Main Refinancing Operations rate, Unemployment rate, Harmonised Index of Consumer Prices and Economic Sentiment Indicator are used in first differences, Stock market returns and Industrial Production in log differences while trade balance in growth rate. All data are monthly and obtained from EIKON and Bloomberg.

Table 3
Fed's Monetary Policy stance: Variance Decomposition Analysis

	Impulse variables						
Response variable	**FFr**	**IP**	**HICP**	**MROr**	**Stock_Ret**	**Tradebal**	**ESI**
Panel A: 2007 – 2012							
Eurozone countries							
ESI	2.75	5.64	0.39	17.26	5.98	1.02	66.65
Core countries							
ESI	4.11	4.15	1.36	8.46	21.44	1.26	59.18
Peripheral countries							
ESI	2.71	8.11	0.73	3.68	13.21	0.34	71.17
Panel B: 2007 – 2010							
Eurozone countries							
ESI	5.07	3.85	3.61	5.67	25.01	2.02	54.74
Core countries							
ESI	7.01	2.72	5.91	7.47	25.53	3.58	48.57
Peripheral countries							
ESI	4.9	4.86	1.52	8.13	8.03	61.16	11.37
Panel C: 2010 – 2012							
Eurozone countries							
ESI	5.24	4.78	0.93	7.4	3.78	35.56	42.28
Core countries							
ESI	4.26	10.52	2.15	16.29	10.77	6.82	49.16
Peripheral countries							
ESI	0.52	3.21	1.93	3.06	2.64	37.44	51.17

Notes to Table 3
The Table presents results for Variance Decomposition Analysis, i.e. the contribution of each variable to the variance in sentiment. FFr is the Shadow Federal Funds rate estimated by Wu and Xia (2016). Panel A presents results for the full sample, Panel B for the period between 2007 and 2010, while Panel C for the period between 2010 and 2012. Note that we perform variance decomposition analysis for all variables, however, we report here only the results for sentiment (the rest of the results are available upon request). See also *Notes to Table 2*.

Table 4
Variance Decomposition Analysis: Sentiment Spill-Overs from US to EU

	Impulse variables						
Response variable	**IP**	**HICP**	**MROr**	**MCSI**	**Stock_Ret**	**Tradebal**	**ESI**
Panel A: 2007 – 2012							
Eurozone countries							
ESI	5.97	0.5	6.42	4.51	17.23	0.7	64.63
Core countries							
ESI	4.42	2.09	9.9	4.69	20.67	1.01	57.19
Peripheral countries							
ESI	10.34	0.76	3.45	3.92	13.39	0.36	67.75
Panel B: 2007 – 2010							
Eurozone countries							
ESI	4.36	3.24	7.1	5.78	28.86	1.12	49.51
Core countries							
ESI	4.19	6.92	12.23	7.97	22.14	2.95	43.59
Peripheral countries							
ESI	6.45	0.87	8.57	1.01	9.96	62.34	10.77
Panel C: 2010 – 2012							
Eurozone countries							
ESI	5.11	0.89	8.15	2.43	4.71	28.26	50.42
Core countries							
ESI	10.17	0.9	16	3.54	11.33	5.06	52.98
Peripheral countries							
ESI	4.3	1.6	4.92	1.66	2.53	27.37	57.6

Notes to Table 4
Table 4 reports Variance Decomposition Analysis results with a focus on possible sentiment spill-overs from the US to EU. That is, we report the contribution of US sentiment to the sentiment variance of Eurozone, Core, and Peripheral countries, for three sample periods. The Table is organized in a similar manner to Table 3. The models include all variables, however, we report here only the results for the sentiment indexes. The recursive ordering occurs after the assumption that US investor sentiment may affect the stock markets in Europe, but is allowed to respond to IP, HICP and MROr within a given month. *See also Notes to Table 2.*

Table 5
Spill-Over Matrices

	Panel A: Core countries / Financial Crisis (US)							
Response/Impulse	*IP*	*HICP*	*MROr*	*Stock_Ret*	*Unemploym*	*Tradebal*	*ESI*	**Sum OUT**
IP	**65.88**	7.55	8.61	12.5	1.27	1.81	10.27	42.01
HICP	3.13	**63.43**	21.4	16.95	6	5.61	4.99	58.08
MROr	4.25	16.61	**50.67**	35.72	4.89	4.18	11.86	77.51
Stock_Ret	3.51	3.79	8.6	**77.39**	1.51	2.73	9.32	29.46
Unemploym	6.89	8.93	14.41	9.56	**68.41**	2.94	2.58	45.31
Tradebal	2.47	2.84	1	1.77	0.77	**91.63**	0.94	9.79
ESI	1.94	6.78	13.69	27.73	1.87	4.1	**57.58**	56.13
Sum IN	22.19	46.5	67.71	104.23	16.31	21.37	39.96	**318**
Net	19.82	11.58	9.8	-74.77	29	-11.58	16.17	0

	Panel C: Core countries / Sovereign Debt Crisis (EU)							
Response/Impulse	*IP*	*HICP*	*MROr*	*Stock_Ret*	*Unemploym*	*Tradebal*	*ESI*	**Sum OUT**
IP	**71.5**	7.7	1.82	3.95	2.12	18.62	4.66	38.87
HICP	3.48	**54.98**	4.46	1.66	8.18	36.95	1.45	56.18
MROr	4.78	6.54	**74.94**	6.71	5.13	4.5	0.96	28.62
Stock_Ret	2.05	4.58	19.25	**64.47**	3.08	10.09	8.65	47.7
Unemploym	1.79	1.04	4.19	2.14	**86.53**	9.68	3.92	22.76
Tradebal	1.57	1.57	2.71	0.71	7.02	**92.5**	3.06	16.64
ESI	11.23	1.24	16.55	8.69	5.34	9.08	**63.37**	52.13
Sum IN	24.9	22.67	48.98	23.86	30.87	88.92	22.7	**263**
Net	13.97	33.51	-20.36	23.84	-8.11	-72.28	29.43	0

	Panel B: Peripheral countries / Financial Crisis (US)							
Response/Impulse	*IP*	*HICP*	*MROr*	*Stock_Ret*	*Unemploym*	*Tradebal*	*ESI*	**Sum OUT**
IP	**35.58**	1.51	8.64	13.15	14.13	49.45	5.44	92.32
HICP	9.93	**36.88**	21.38	24.07	21.45	23.51	7.54	107.89
MROr	10.79	7.94	**28.32**	25.58	19.54	49.43	6.95	120.23
Stock_Ret	7.34	2.45	4.43	**37.21**	9.91	55.13	10.63	89.89
Unemploym	7.58	9.06	15.8	18.51	**67.22**	14.62	3.55	69.12
Tradebal	1.9	2.18	2.11	3.09	4.57	**89.14**	2.82	16.67
ESI	7.79	0.83	7.57	20.94	14.82	60.34	**21.31**	112.29
Sum IN	45.33	23.97	59.93	105.34	84.42	252.48	36.93	**608**
Net	46.99	83.92	60.3	-15.45	-15.3	-235.81	75.36	0

	Panel D: Peripheral countries / Sovereign Debt Crisis (EU)							
Response/Impulse	*IP*	*HICP*	*MROr*	*Stock_Ret*	*Unemploym*	*Tradebal*	*ESI*	**Sum OUT**
IP	**82.08**	2.85	2.02	5.1	8.44	5.33	5.94	29.68
HICP	5.19	**38.8**	2.76	36.53	22.3	32.61	22.57	121.96
MROr	1	8.67	**23.9**	47.56	34.63	46.34	16.91	155.12
Stock_Ret	1.76	10.11	1.98	**54.86**	38.94	42.68	18.44	113.91
Unemploym	3.72	8.15	4	29.31	**64.23**	31.41	14.81	91.4
Tradebal	0.08	11.3	1.93	57.93	40.84	**68.79**	29.18	141.27
ESI	0.38	7.87	2.12	47.51	28.16	52.34	**47.25**	138.38
Sum IN	12.13	48.95	14.81	223.94	173.31	210.71	107.85	**792**
Net	17.55	73.01	140.31	-110.03	-81.91	-69.44	30.53	0

Notes to Table 5

Variables in the first column are the impulse origin, while in the top row are the respondents to the shock. Values in the matrix represent the average cumulated spillover effect. The cumulative impact is bound between 0 and 1. A value of 0.5 means that the response variable will be impacted in the same direction with an intensity of 50% the initial unexpected shock in the impulse variable. In the last column we have the aggregated impact sent (Sum OUT) by each row variable and on the bottom row the aggregated spillover received (Sum IN) by each column variable. The bottom-right cell (in bold) shows total spillover in the system (by dividing this value to the total number of non-diagonal cells, i.e. 7x6, we obtain the contagion index of the Core and Peripheral group for the two different periods. The "Net" row represents the net spillover of each variable (Net Spillover=Sum OUT-Sum IN).

Table 6
Panel-VAR and FEVDs with Latent Variable from Qual VAR

Panel A (1 lag)							
Country group ESI	Impulse variables						
	IP	HICP	ystar	Stock_Ret	Unemploym	Tradebal	ESI
Eurozone	5.20	0.60	6.67	21.23	0.47	0.02	65.78
Core countries	3.63	0.96	12.8	25.27	0.45	0.08	56.83
Peripheral countries	6.23	0.60	2.41	16.84	2.01	0.36	71.51
Panel B (2 lags)							
Country group ESI	Impulse variables						
	IP	HICP	ystar	Stock_Ret	Unemploym	Tradebal	ESI
Eurozone	5.21	0.37	8.34	19.5	0.26	0.16	66.12
Core countries	3.90	1.09	12.6	21.43	2.28	0.26	58.43
Peripheral countries	6.53	0.10	4.7	15.78	1.45	0.54	69.98
Panel C (3 lags)							
Country group ESI	Impulse variables						
	IP	HICP	ystar	Stock_Ret	Unemploym	Tradebal	ESI
Eurozone	2.55	0.68	8.78	19.94	1.00	0.78	66.18
Core countries	2.36	2.05	10.60	22.7	2.40	1.29	58.63
Peripheral countries	6.28	0.97	7.94	12.22	1.49	0.88	70.18
Panel D - The US case							
US MCSI	Impulse variables						
	IP	CPI	ystar	Stock_Ret	Unemploym	Tradebal	MCSI
US	14.46	7.79	6.80	7.32	1.68	2.83	59.84

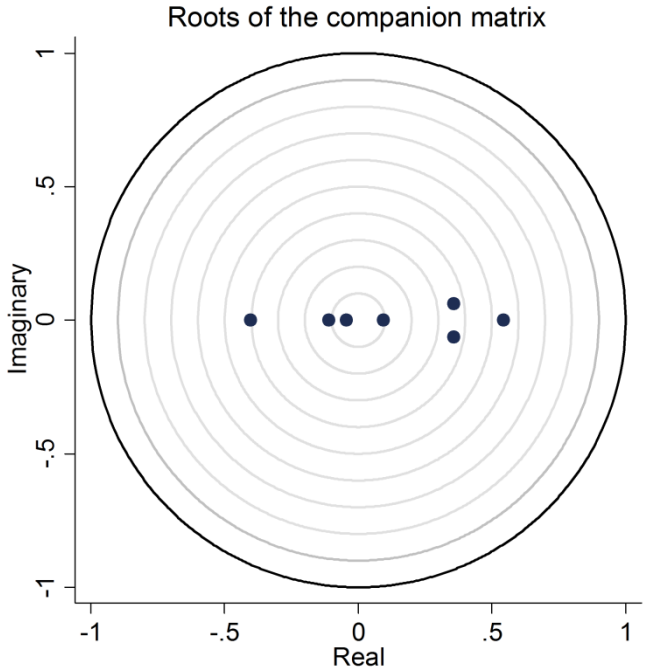
Notes to Table 7
The Table presents results for Variance Decomposition Analysis, i.e. the contribution of ECB's latent propensity to unconventional measures (ystar) to the variance in each column variable (IP, HICP, ystar, Stock_Ret, Unemploym, Tradebal and ESI) for each country group, namely the Eurozone countries including all countries, the Core countries (Germany, Austria, Belgium, France and the Netherlands) and the Peripheral countries (Spain, Italy, Portugal and Greece). The results are computed from a panel VAR with 1 lag (Panel A), 2 lags (Panel B) and 3 lags (Panel C). Note that we perform variance decomposition analysis for all variables shocks and impulse responses, however, we report here only the results for the decomposition of ESI and MCSI (the rest of the results are available upon request).

Table 7
Contribution of the policy shock to variance of the common component

	FEVD 10-month horizon	FEVD 20-month horizon	R^2
ESI GER	8.03	8.32	0.67
ESI AUS	4.05	4.31	0.50
ESI BE	4.44	4.71	0.57
ESI FR	4.87	5.08	0.55
ESI NL	4.27	4.41	0.64
ESI SP	3.10	2.00	0.24
ESI IT	1.40	1.52	0.35
ESI PT	2.40	2.57	0.28
ESI GR	3.30	3.40	0.30

Notes to Table 7
The column titled FEVD 10-month and FEVD 20-month horizon, reports the fraction of the variance of the forecast error, at the 10-month and 20-month horizon, explained by the policy shock. R^2 refers to the fraction of the variance of the variable explained by the common factors, (F_t and R_t).

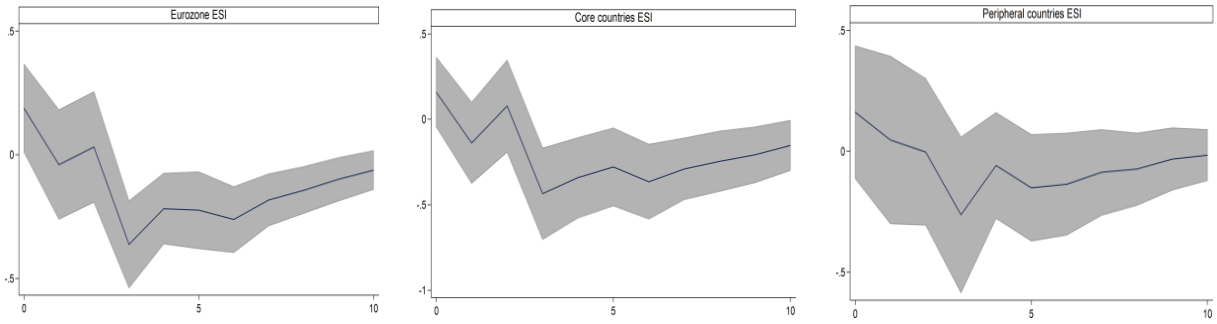
Figure 1
Roots of Companion Matrix



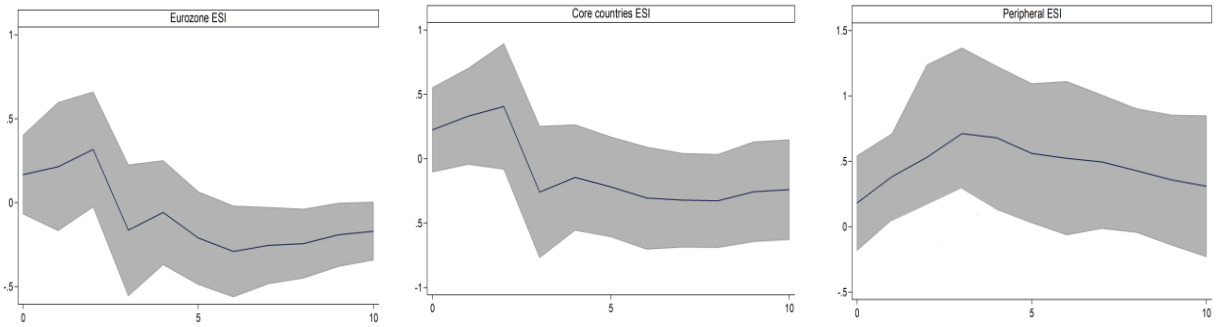
Notes to Figure 1
The stability of the panel VAR requires the moduli of the eigenvalues of the dynamic matrix to lie within the unit circle. Panel VAR satisfies stability condition as all eigenvalues lie inside the unit circle.

Figure 2
IRFs: the effect of ECB's conventional monetary policy on EU expectations

The effect of a shock to ECB's conventional monetary policy stance on ESI during 2007- 2012



The effect of a shock to ECB's conventional monetary policy stance on ESI during 2007- 2010



The effect of a shock to ECB's conventional monetary policy stance on ESI during 2010- 2012

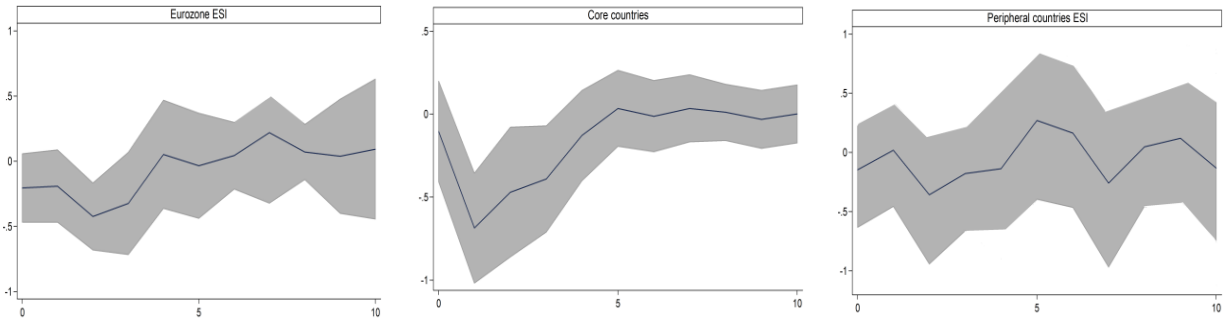
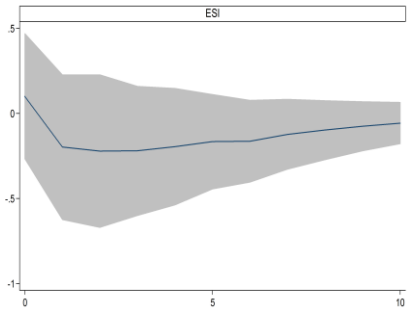
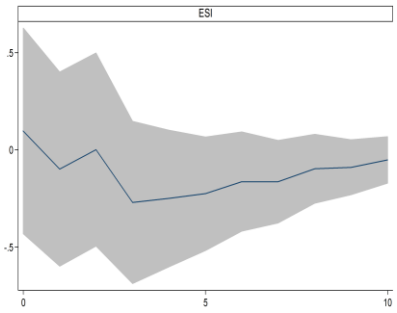


Figure 3
Country specific IRFs: the effect of ECB's conventional monetary policy on EU expectations

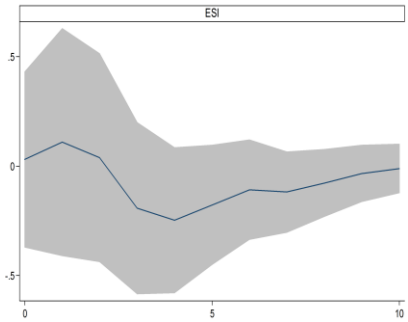
Germany



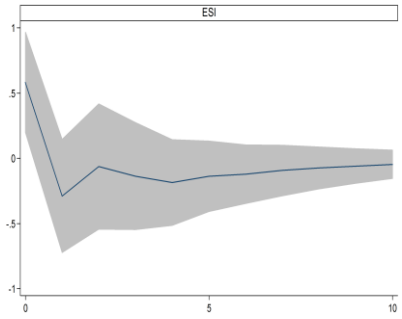
Belgium



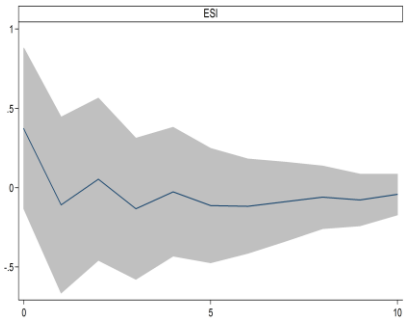
Austria



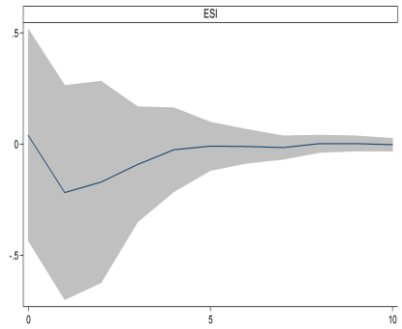
France



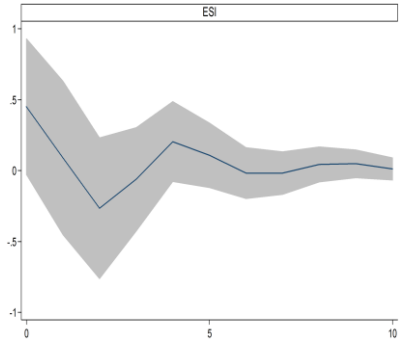
Netherlands



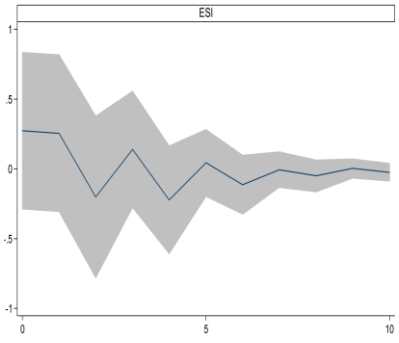
Spain



Italy



Portugal



Greece

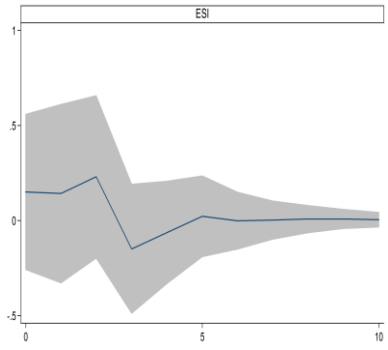
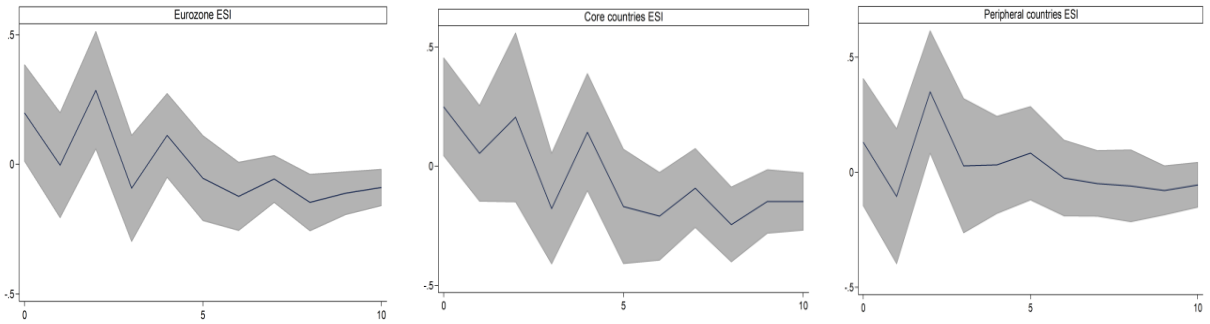
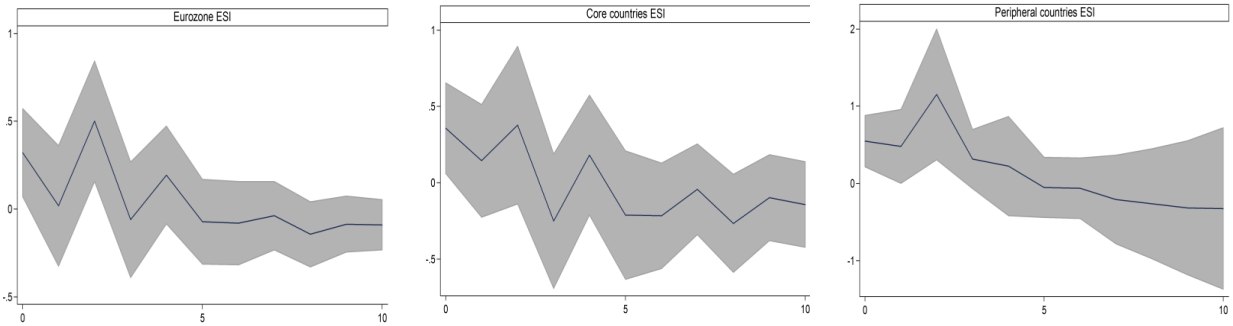


Figure 4
IRFs: the effect of Fed's monetary policy stance on EU expectations

The effect of a shock to Fed's monetary policy stance on ESI during 2007- 2012



The effect of a shock to Fed's monetary policy stance on ESI during 2007- 2010



The effect of a shock to Fed's monetary policy stance on ESI during 2010- 2012

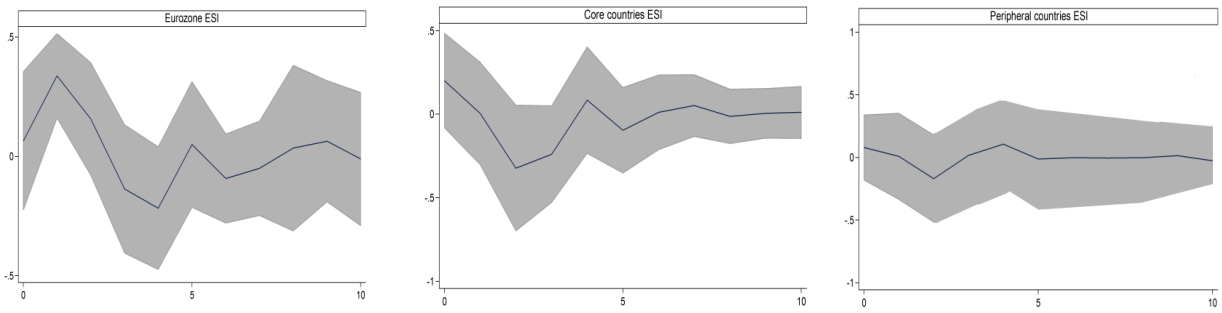
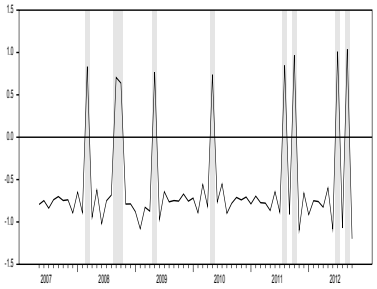
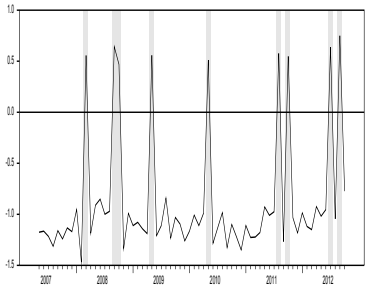


Figure 5
ECB announcements (shaded) and latent propensity for ECB unconventional monetary measures (dash line) for Eurozone countries

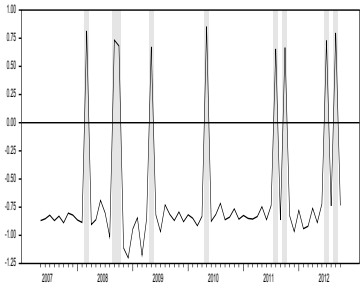
Germany



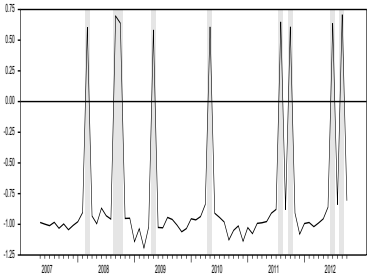
Belgium



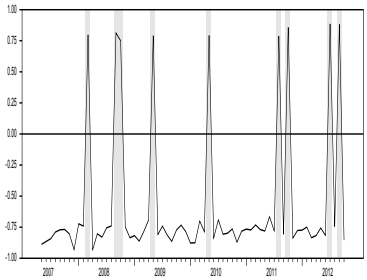
Austria



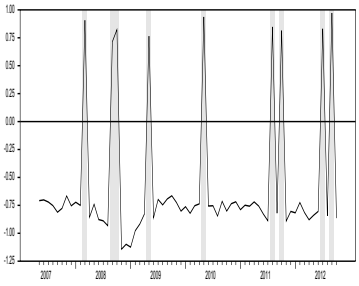
France



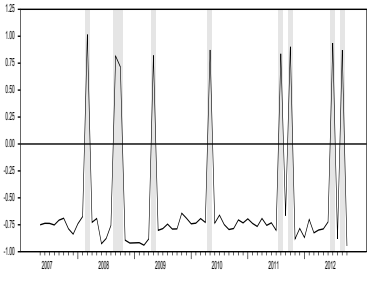
Netherlands



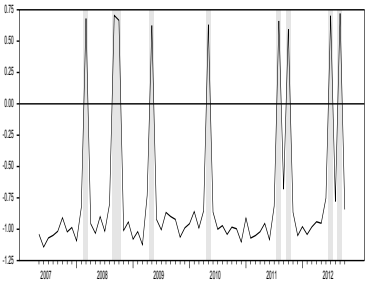
Spain



Italy



Portugal



Greece

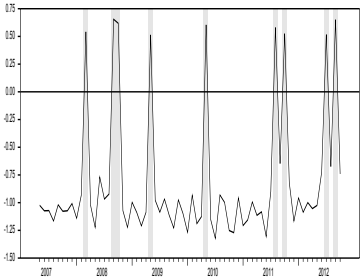
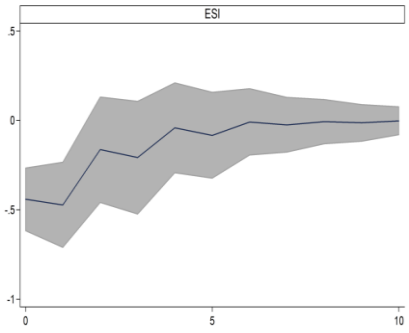


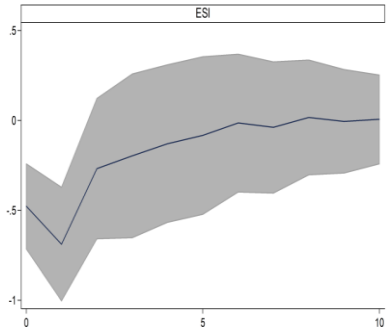
Figure 6
The effect of a shock of ECB's unconventional policy stance on ESI

Panel A

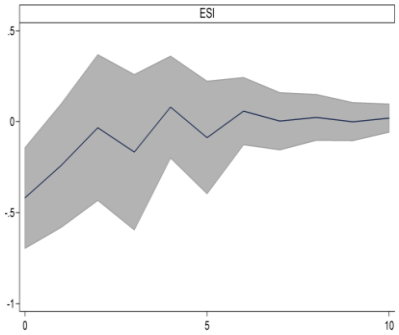
Eurozone countries



Core countries

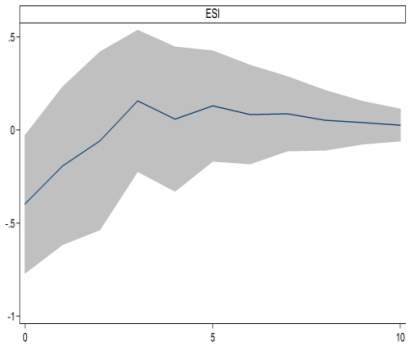


Peripheral countries

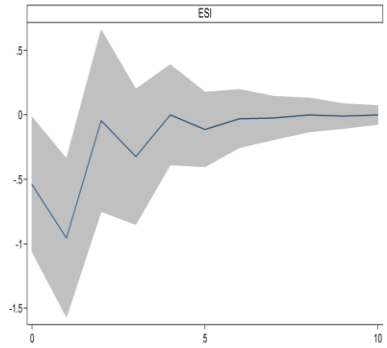


Panel B

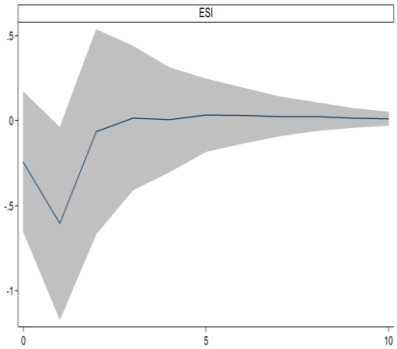
Germany



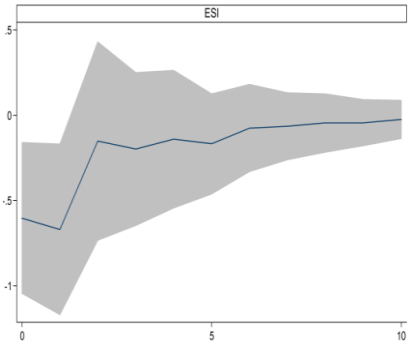
Belgium



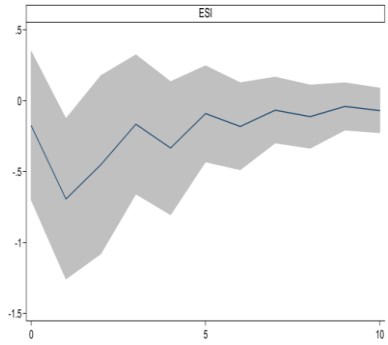
Austria



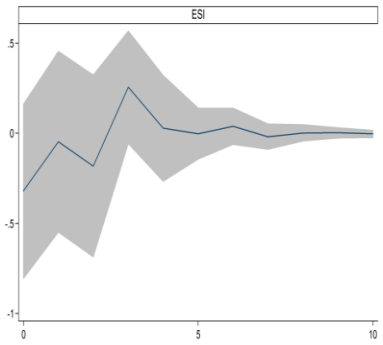
France



Netherlands



Spain



Italy

Portugal

Greece

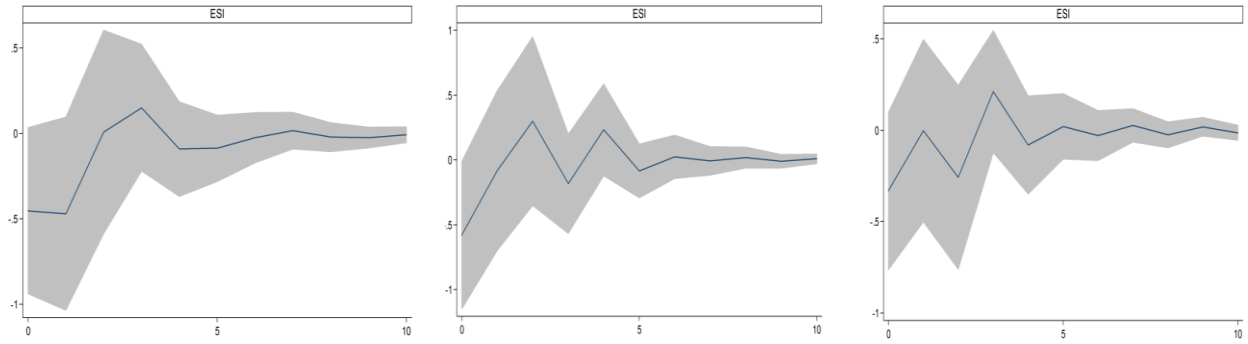
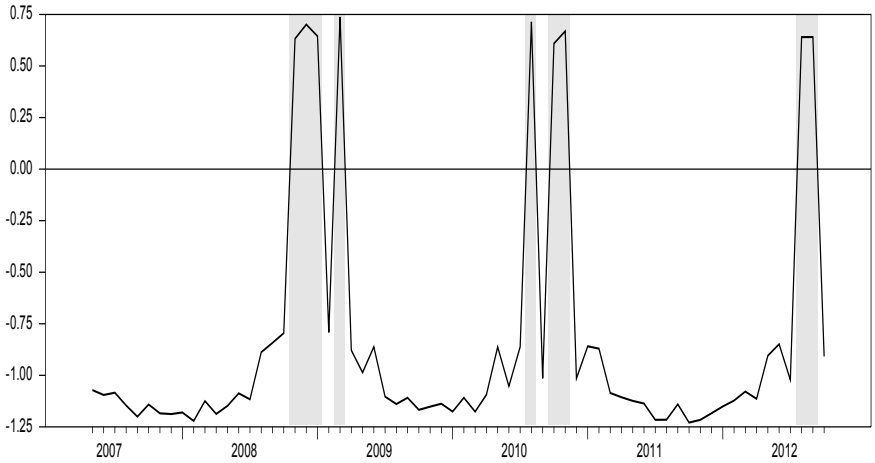


Figure 7
Fed's announcements (shaded) and latent propensity for QE (dash line)



The response of US economic expectations (MCSI) to a shock of Fed's latent propensity to unconventional policy

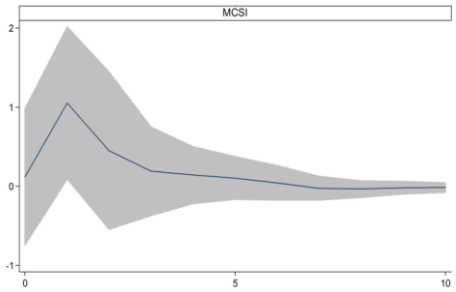
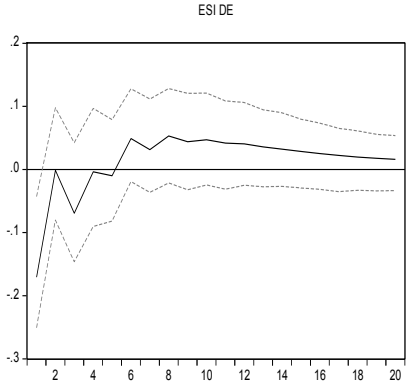
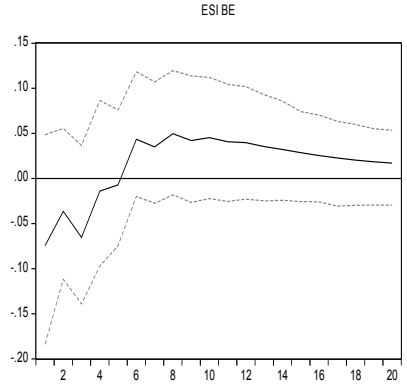


Figure 8
The effect of a shock to the latent propensity to ECB's unconventional monetary policy stance on ESI- FAVAR model

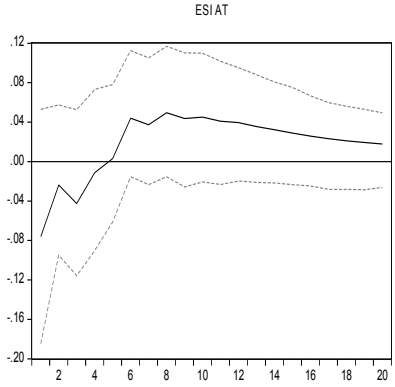
Germany



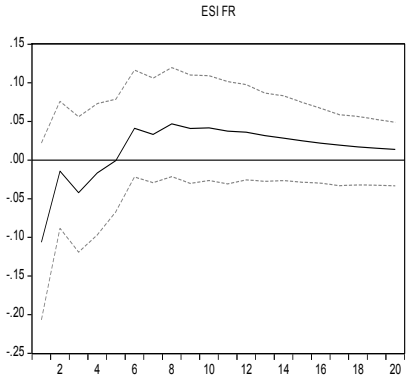
Belgium



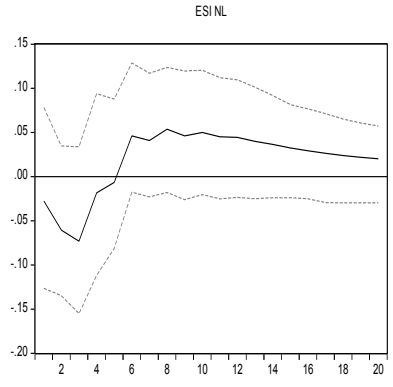
Austria



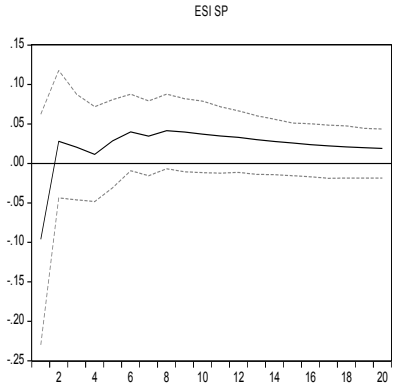
France



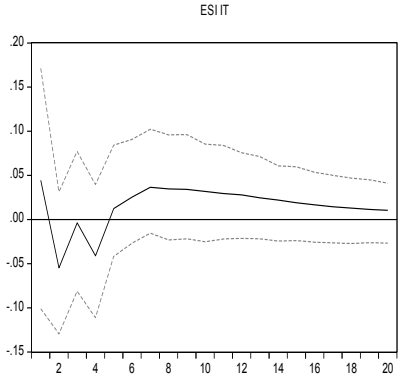
Netherlands



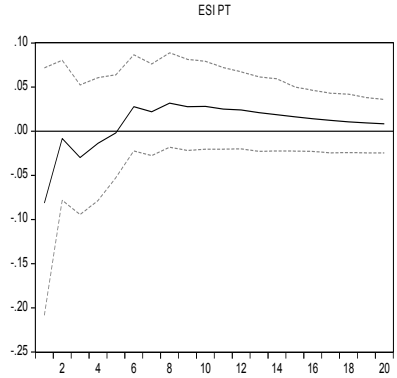
Spain



Italy



Portugal



Greece