European Stock Markets and the ECB's Monetary Policy Surprises*

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Abstract

This paper contributes to the literature measuring the response of stock markets to monetary policy actions. We analyze the reaction of European stock market returns to unexpected interest rate decisions by the ECB. Endogeneity between interest rate changes and stock returns is taken into account using the identification through heteroskedasticity approach. Relying on different methods to extract monetary policy shocks, we find a negative and significant relation between unexpected ECB decisions and European stock markets performance. Moreover, monetary policy decisions of the ECB are well anticipated by the market implying that the central bank successfully communicates its monetary policy.

JEL Classification: E44, E47, E52

Keywords: Monetary Policy Shocks, European Stock Markets, Identification through Heteroskedasticity, Principal Components Analysis

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This paper contributes to the literature measuring the response of stock markets to monetary policy actions. We analyze the reaction of European stock market returns to unexpected interest rate decisions by the ECB. Endogeneity between interest rate changes and stock returns is taken into account using the identification through heteroskedasticity approach. Relying on different methods to extract monetary policy shocks, we find a negative and significant relation between unexpected ECB decisions and European stock markets performance. Moreover, monetary policy decisions of the ECB are well anticipated by the market implying that the central bank successfully communicates its monetary policy.

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1 Introduction

There is substantial interest in measuring the impact of monetary policy decisions on financial markets. When evaluating the transmission process of interest rate decisions, central bankers monitor asset prices as they may influence the real economy through the wealth and capital cost channels. Furthermore, portfolio decisions by financial market participants are affected by the consequences of monetary policy shocks on asset prices. This paper analyzes European stock markets' response to unexpected monetary policy decisions by the European Central Bank (ECB). Estimating the response of major national stock markets in the European Monetary Union (EMU) deepens our knowledge about the nature of the transmission mechanism of monetary policy in the euro zone. It provides information about the extent of stock markets' reaction and whether monetary impulses spread uniformly across major EMU member stock markets. Moreover, by developing a measure of monetary policy shocks, we are able to evaluate the predictability of the ECB's interest rate policy. We extract unexpected monetary policy decisions by using EURIBOR future and EONIA swap data as well as survey data covering the opinions of financial market experts. The approach developed by Rigobon and Sack (2004), and Rigobon (2003), is adopted because this technique controls for the endogeneity of the variables in question.

Previous research has mainly focused on Federal Reserve's interest rate setting behavior and its effects on US financial asset prices.[1] Surprisingly, there is little research that estimates how euro area financial markets react to unexpected monetary policy decisions of the ECB. Sellin (2001) provides an extensive survey of the literature showing that much of the empirical research is focused on the US experience. Andersson (2007) analyzes stock market volatility reactions after the ECB's and the Fed's interest rate decisions and finds a strong upsurge after those announcements.

Brand et al. (2006), and Perez-Quiros and Sicilia (2002) focus on changes in the Euro area yield curve. The first authors find a significant impact of ECB monetary policy decisions on the medium and long-term interest rates in the Euro area. The second paper concentrates on unexpected monetary policy decisions by the ECB. Applying a simple OLS approach with an event study character they find limited impact of shocks on the yield curve. Vähämaa (2005) studies bond market expectations around ECB decisions and finds asymmetries in the expectations implying that market participants attach higher probabilities for sharp yield increases than for sharp decreases around policy tightenings (and vice versa). Napolitano (2006) uses Markov-switching models to distinguish between bull and bear markets' reaction to monetary policy. He finds small negative and asymmetric effects on euro area stock markets. Angeloni and Ehrmann's (2003) study is partly related to measuring the impact of ECB monetary policy surprises on the stock markets in

[1] See, for example, Chen (2007), Crowder (2006), Davig and Gerlach (2006), Bernanke and Kuttner (2005), Gürkaynak et al. (2005), Rigobon and Sack (2004), and Thorbecke (1997).

Europe. The authors find that a monetary tightening has a significant and negative impact on most European stock retuns examined. However, the sample period is much shorter than ours and their work differs in how they handle the endogeneity of the variables in question and the method used to extract monetary policy shocks. Our paper contributes to this literature by focusing specifically on European stock markets and applying an econometric approach which controls for the endogenous relationship between interest rates and stock prices, relying on the heteroskedasticity of the high frequency time series under investigation to identify the parameters of interest.

The remainder of this paper is structured as follows: Section 2 gives a short introduction to the methodology used. Section 3 describes the dataset and presents the empirical results. Section 4 summarizes our findings and concludes.

2 Methodology

When empirically analyzing the link between monetary policy and financial markets the problem of endogeneity emerges as revealed by a model that describes the interaction between monetary policy and stock prices

$$\Delta i_t = \beta \Delta s_t + \gamma z_t + \epsilon_t \tag{1}$$

$$\Delta s_t = \alpha \Delta i_t + z_t + \eta_t \tag{2}$$

Equation (1) is a simplified version of a monetary policy reaction function where the change in the short-term interest rate (Δi_t) responds to stock returns (Δs_t), a vector of other variables z_t (assumed to be exogenous), and a monetary policy shock (ϵ_t). Stock returns, as shown in Equation (2), are explained by the change in the interest rate, other variables denoted by z_t, and a residual term (η_t). α is the parameter of interest in our investigation. We expect a negative value for this short-run elasticity based on the present value model of stocks. Briefly, the theory is as follows. The fundamental value of a stock is equal to the present value of future cash flows. An increase in the central bank interest rate tends to raise borrowing costs and increases the discount factor, which, in turn, leads ceteris paribus to a reduction of the present value. Consequently, stock prices are supposed to decline after unexpected interest rate raises (Gertler and Gilchrist (1994)).

Different strategies are available to deal with the endogeneity issue. Most frequently, an event-study methodology (Bernanke and Kuttner (2005), Bomfim (2003), Thorbecke (1997), Cook and Hahn (1989)), or an impulse-response analysis based on VAR models (Crowder (2006), Peersman (2002), Evans and Marshall (1998), Christiano et al. (1999)), is applied. The event-study methodology is criticized because it assumes that the monetary policy shock is fully captured by some ad hoc window size around the chosen event. Strictly speaking, if this assumption does not hold the method is proven to be biased (Rigobon and Sack (2004)). The use of VARs is challenged by Rudebusch (1998) because these exhibit fragile coefficient estimates, contradictory monetary shocks and innovations that can be uncorrelated with financial market surprises. However, this view is not unanimously shared, see Sims (1998).

In this paper, we apply the identification through heteroskedasticity approach of Rigobon and Sack (2004), and Rigobon (2003), to estimate the impact of monetary policy shocks on stock returns. The technique posits that an increase in the variance of the monetary policy shock in Equation (1) reduces the bias in the OLS estimate of the asset price reaction Equation (2) generated by the simultaneity problem and the exclusion of other exogenous variables. In the traditional event-study approach it is assumed that the variance of the policy shocks σ_ϵ is strictly greater than the variability of the vector of exogenous variables σ_z and the variance of the asset price shock σ_η. A much weaker set of assumptions is required when relying on the identification through heteroskedasticity technique. Following Rigobon and Sack's approach, the *level* of the bias resulting from endogeneity and the exclusion of other exogenous variables (e.g., macroeconomic announcements) is not required to be zero. In contrast, the parameter α is estimated from the *change* of this bias as the variance of the monetary policy shock changes. Applying this method, it is the change in the covariance of stock prices and interest rates which allows the investigator to identify the parameter of interest when the variance of the policy shock changes.

Adapted to our paper, the basic assumption required is that the variance of monetary policy shocks is higher on days when the ECB Governing Council meets than on other days. At the same time the variances of other shocks are supposed to remain constant over the observed period. Such an assumption is uncontroversial, as financial markets clearly focus their attention on what the ECB intends to do around the time the Governing Council meets and releases its interest rate decision.

Since we assume the variance of monetary policy shocks to be higher on certain days than on others we need to define two subsamples. Define F as the subsample containing the policy dates, i.e., the days on which the central bank makes its interest rate announcement. Subsample F^* then consists of the non-policy dates which we define as the day immediately preceding the policy date. In order to identify α, we solve the reduced form of Equations (1) and (2) and estimate the covariance, as in Equation (3), for both subsamples respectively

$$\Omega_s = \frac{1}{(1-\alpha\beta)^2} \begin{bmatrix} \sigma_\epsilon^s + \beta^2\sigma_\eta^s + (\beta+\gamma)^2\sigma_z^s & \alpha\sigma_\epsilon^s + \beta\sigma_\eta^s + (\beta+\gamma)(1+\alpha\gamma)\sigma_z^s \\ . & \alpha^2\sigma_\epsilon^s + \sigma_\eta^s + (1+\alpha\gamma)^2\sigma_z^s \end{bmatrix} \tag{3}$$

with $s = \{F, F^*\}$. Assuming α, β and γ are stable across the two samples, we are able to identify α by subtracting one covariance matrix from the other

$$\Delta\Omega = \Omega^F - \Omega^{F^*} = \frac{\sigma_\epsilon^F - \sigma_\epsilon^{F^*}}{(1-\alpha\beta)^2} \begin{bmatrix} 1 & \alpha \\ \alpha & \alpha^2 \end{bmatrix}. \tag{4}$$

The estimator $\hat{\alpha}$ can now be obtained via

$$\hat{\alpha} = \frac{\Delta\hat{\Omega}_{1,2}}{\Delta\hat{\Omega}_{1,1}} \tag{5}$$

where $\Delta\hat{\Omega}_{i,j}$ represents the (i,j) element of the change in the $\hat{\Omega}$ matrix. Following Rigobon and Sack (2004) we use an instrumental variable approach to implement Equation (5).[2]

Let T be the number of ECB Governing Council meetings. The change in interest rate and equally the change in asset prices are included in $2T \times 1$ vectors covering at first policy dates followed by non-policy dates

$$\Delta i = \left[\Delta i_{t(1)}, \Delta i_{t(2)}, ..., \Delta i_{t(2T)}\right] \tag{6}$$

$$\Delta s = \left[\Delta s_{t(1)}, \Delta s_{t(2)}, ..., \Delta s_{t(2T)}\right] \tag{7}$$

with the date indices, $t(k), k = 1, 2, ..., 2T$, placed in chronological order and $t(k) \in F \cup F^*$. For the vector of instruments consider

$$w_i = \left[\Delta i^*_{t(1)}, \Delta i^*_{t(2)}, ..., \Delta i^*_{t(2T)}\right]' \tag{8}$$

with

$$\Delta i^*_{t(k)} = \begin{cases} \frac{\Delta i_{t(k)}}{(T-1)}, & t(k) \in F \\ \frac{-\Delta i_{t(k)}}{(T-1)}, & t(k) \in F^* \end{cases}. \tag{9}$$

The variable w_i is a valid instrument: it is correlated with the regressor Δi_t because the subsample F outweighs F^* due to the heteroskedasticity of ϵ_t. At the same time the instrumental variable is not correlated with z_t and η_t. Those shocks are homoskedastic, thus the two subsamples cancel each other out. Using this instrument the parameter of interest can now be estimated by

$$\hat{\alpha} = (w_i'\Delta i)^{-1}(w_i'\Delta s). \tag{10}$$

Following Rigobon and Sack (2004), it can be formally shown that the instrumental variables

[2] An alternative to the instrumental variables approach is GMM. Due to the very similar findings of both techniques in Rigobon and Sack (2004), we only rely on the instrumental variable approach.

estimator is equivalent to the estimator in Equation (5). Rigobon and Sack (2004) illustrate their approach for small samples but rely on asymptotic standard errors. However, it is well known that the bootstrap p-value is more accurate than the p-value derived from asymptotic theory, especially in small samples (Davison et al. (2003), MacKinnon (2002) and Efron (1985)). We therefore implement a bootstrap technique to estimate p-values in small samples by resampling the observations. For each subsample (F, F^*) as many observation pairs are drawn with replacement as the number of shocks that were extracted by the different shock definitions. Resampling 1000 times, we obtain an hypothetical empirical distribution for the t-statistic.

3 Data and Empirical Results

We resort to daily data for a sample that runs from January 1, 1999 to February 28, 2007, i.e. since the period the ECB became responsible for monetary policy in the euro area. To describe the impact of monetary policy shocks on European stock markets we focus on the four largest national stock markets, namely the German DAX 30, the French CAC 40, the Spanish $IBEX$ 35 and the Italian MIB 30. Furthermore, as a proxy for the aggregate European stock market, we choose the *Euro Stoxx* 50. We anticipate that while ECB monetary policy surprises potentially impact European stock market it is unlikely that repercussions will be felt in US markets (Ehrmann and Fratzscher (2003)). All data are obained from Thomson Financial Datastream.

The EURIBOR is the benchmark money market rate for the euro area. We select, the one month EURIBOR as the interest rate proxy, while interest rates with shorter maturities are neglected due to their high volatility. EURIBORs with maturities longer than one month may not be sensitive enough to monetary policy changes (Kleimeier and Sander (2006)).

Table 1 reports some descriptive statistics on daily changes in the policy rate and the respective stock indices. For the non-policy dates (F^*) there is no discernible relationship as described by the small covariances on these days. The opposite holds for the ECB Council meeting days (F). On those days a considerable negative comovement becomes evident. As elaborated in section 2, this shift in the covariance is used to estimate α.

[Insert Table 1 about here]

While the ECB's Governing Council meets twice per month, press releases announcing its monetary policy decisions are only published after the first monthly meeting.[3] The Council's decisions

[3]However, this procedure has only been in place since November 8th, 2001. Before that time, the ECB generally decided every fortnight about their monetary policy. A press release was published after every meeting. Hence, from January 1, 1999 to November 8, 2001 the ECB Governing Council met for 69 monetary policy decisions. From November 8, 2001 until the end of our sample period on February 28, 2007 the ECB only decided monthly, which led

are made public at 1.45 p.m. C.E.T. Shortly thereafter, during the press conference, additional information is released to the market. We assume the news of an unexpected interest rate setting of the ECB to be priced in shortly after the information has hit the stock market, or at least until trading ceases the same day. Thus, we use the daily closing prices of the above mentioned European stock price indicies. Closing time is between 5.30 p.m. and 6 p.m. C.E.T. Assuming continuously compounding, we use log returns. The EURIBOR is published at 11 a.m. C.E.T. every weekday. Due to the timing of the policy announcement, the quotes of the day following the Governing Council meeting are used, accepting a period of a few hours of non-overlapping trading between the EURIBOR and stock returns.

Since the objective of the paper is to analyze the impact of unexpected interest rate decisions on stock returns, we have to proxy monetary policy shocks around Governing Council meeting days. We rely on changes in expectations of market participants. These expectations are typically derived from futures and swaps heavily traded on financial markets as well as surveys of market economists (Rigobon and Sack (2004), Gürkaynak et al. (2002), Kuttner (2001)). Thus, in this paper we use surveys from Reuters and Bloomberg and choose EONIA swaps as well as EURIBOR futures with different maturities to extract unexpected interest rate decisions (Bernoth and von Hagen (2004), Perez-Quiros and Sicilia (2002)). The EONIA swaps are made available from Reuters. The EURIBOR futures are provided by Thomson Financial Datastream. The swaps and future quotes used are daily closing prices.

In order to extract the shocks from EONIA swaps and EURIBOR futures, a principal components analysis is used (Stock and Watson (2002)). This method captures the common variation pattern from a set of time series in the form of one or more linear combinations. Technically, this is acomplished by estimating the eigenvectors and their eigenvalues from the variance-covariance matrix of the time series. Whereas the eigenvectors form linear combinations of the variables, the eigenvalues indicate the proportion of total variance explained by each combination. These combinations (also known as principal components) are then ranked according to their contribution to the total variance of the original data. As we are interested in the combination which captures best the common variation of the EURIBOR and EONIA time series only the first principal component is chosen (see Table 2). Prior to extracting the principal components, all time series are standardized to prevent the most volatile from dominating the analysis.

[Insert Table 2 about here]

Following Perez-Quiros and Sicilia (2002), a principal components analysis with three different

to 59 interest rate decisions. Consequently, 128 press meetings with monetary policy decisions took place in the full sample.

data sets is used to account for shocks in the short-run, the long-run, and the overall-expectation of policy steps by the ECB. PC_{Short} is the principal component generated by the EONIA swap of one week and the EONIA swap of one month; PC_{Long} covers the EONIA swap of two and three month as well as the EURIBOR future of three month. Capturing the mixed expectations for short and long horizons, PC_{All} consists of all five time series. A monetary shock is identified when the rate exceeds the mean of the time series by at least twice its standard deviation on a day when the ECB Governing Council meets. To cross-check the shocks derived by the three principal components analyses, we identify a shock when it is indicated by PC_{All} and at least by one of PC_{Short} or PC_{Long}.

As a robustness check we also rely on surveys from two sources. Reuters and Bloomberg ask financial market experts every month what decision they expect the ECB to take at their next meeting.[4] An interest rate decision is recorded as a shock if less than half the respondents expected the move in advance. For the third shock definition, a decision is identified as a shock when at least two of the measures considered indicate an unexpected interest rate movement. See Table 3 for an overview of all identified shocks. During the period under consideration monetary policy shocks are infrequent events. Table 3 shows a concentration of shocks at the beginning of the sample period, in particular during the years 2000 and 2001 and a few in 2002 and 2003. Interestingly, only one shock is identified since Jean-Claude Trichet became the ECB's President on November 1, 2003. All the others are identified with the presidency of Wim Duisenberg.

[Insert Table 3 about here]

Table 4 presents the estimated parameters $\hat{\alpha}$, the bootstrapped p-values and the p-values from asymptotic theory for the three shock definitions. In general, stock markets react negatively (positively), and significantly, immediately after an unanticipated raise (cut) of the interest rate directly influenced by the ECB's Governing Council. The coefficients in Table 4 can be interpreted as the change in daily stock returns following an unexpected 100 basis point change in the policy rate. The estimate $\hat{\alpha}_{PC}$ for the *Euro Stoxx* 50 is -8.40, implying that an unexpected 25-basis point increase of the main lending rate results in a 2.1 percent decline in the *Euro Stoxx* 50 on the same day. The coefficients for the national stock indices produce similar responses, although the size of the response is slightly lower. In particular, a 1.42 percent to 2.30 percent fall of the respective indices follows an unexpected 25-basis point interest rate hike. With the exception of Italy, our findings are supportive of a homogeneous reaction of major EMU stock markets to ECB's monetary policy shocks. Moreover, the estimated short-run elasticities are comparable to the ones reported

[4]Reuters survey data are available from January 1999 to February 2007 and Bloomberg survey results are available from October 2000 to February 2007.

in Rigobon and Sack (2004) for US stock market indices, although the impact of ECB decisions on European stock markets is generally significant.

[Insert Table 4 about here]

As previously discussed, three different policy shock definitions are considered. In general, when relying on the surveys to proxy monetary policy shocks, the results are comparable to ones obtained using a principal components analysis. Not surprisingly, the same conclusion is obtained when the combination of survey data and the principal components approach is used. All coefficients exhibit the correct sign and, with the exception of the Italian MIB 30, the estimated coefficients are statistically significant, especially when relying on the bootstrapped p-values.

4 Conclusions

This paper estimates the short-run impact of unexpected interest rate decisions of the ECB on returns in major European stock markets. Whereas the evidence concerning the significance of the response of US stock returns to the Fed's policies (Rigobon and Sack (2004)) is somewhat inconclusive, our findings for Europe indicate a negative and significant response of European stock returns to monetary policy shocks induced by the ECB. Across all shock definitions, European stock markets fall between 1.42 percent and 2.30 percent on the day when an unanticipated interest rate hike of 25-basis points takes place. The findings reveal that unexpected monetary policy impulses by the ECB spread uniformly across major EMU stock markets.

The empirical findings confirm that, at least in the short-run, monetary policy is not neutral. Following an unexpected expansionary monetary policy, real effects evolve since increasing future cash flows, or the decreasing discount factor, are reflected in stock prices. Since stock returns tend to impact the real economy (Poterba (2000)), it is essential for central bankers to assess the consequences of their decision on financial markets. Our results contribute to the understanding of this relationship.

Our results are also informative about the predictability of the ECB's policy, and the number of monetary shocks generated since the fledgling central bank became responsible for monetary policy in the euro area. Our shock definitions suggest that, since 1999, only about 10 percent of all interest rate decisions were unexpected ones. This supports the findings of Perez-Quiros and Sicilia (2002), as well as Ehrmann and Fratzscher (2007), who conclude that, in most cases, the ECB successfully communicated its monetary policy, especially since Trichet became President of the ECB.[5]

[5]The BIS (2007) credits the ECB's communication efforts for the success of the Governing Council at being reasonably predictable about its policy decisions.

Future research might ask what are the sources of stock returns' reactions to monetary policy shocks. Tight money might increase the riskiness of stocks in general due to rising credit costs. Alternatively, negative returns could also represent a kind of overreaction of stocks to monetary policy shocks, which quickly disappears. As suggested in Bernanke and Kuttner (2005), an analysis of a broader class of assets might also be useful to obtain more detailed insights about the relationship between monetary policy shocks and stock market returns.

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Table 1: Covariance between Stock Returns and the Policy Rate

	Covar. with one month EURIBOR	
Stock Index	F^* dates	F dates
Euro Stoxx 50	0.52	-1.89
DAX 30	0.33	-1.77
CAC 40	0.56	-1.53
IBEX 35	0.17	-1.30
MIB 30	0.58	-0.76

Notes: The table uses daily percentage changes for stock prices (in percentage points) and daily changes of the one month EURIBOR (in basis points).

Table 2: Results for Principal Components Analysis, 1 January 1999 - 28 February 2007

		PC_{All}	PC_{Short}	PC_{Long}
Variance Prop.		0.496	0.664	0.614
Eigenvectors	EONIA swap 1 week	-0.307	0.707	
	EONIA swap 1 month	-0.506	0.707	
	EONIA swap 2 month	-0.534		-0.627
	EONIA swap 3 month	-0.502		-0.636
	EURIBOR future 3 month	-0.326		-0.445

Notes: Only the first principal component of each PC is stated above. *Variance Prop.* denotes the proportion of the variance of the time series explained by each first principal component. E.g., the first principal component of PC_{All} explains nearly 50 percent of the total variation of all five time series.

Table 3: Shocks Extracted by Different Definitions

Date of Press Meeting	Shock Definition		
	PC	SURVEY	COM
08.04.1999	x		x
07.10.1999	x		x
03.02.2000		x	x
27.04.2000	x	x	x
08.06.2000	x		x
20.07.2000	x		x
05.10.2000	x	x	x
04.01.2001	x		x
29.03.2001		x	
11.04.2001		x	x
10.05.2001	x	x	x
30.08.2001		x	x
17.09.2001	x	x	x
11.10.2001	x	x	x
10.10.2002	x		x
07.11.2002	x		x
06.03.2003	x	x	x
08.05.2003		x	
06.04.2006	x		x
No. of shocks	14	11	17

Notes: Only press meetings indicating an unexpected interest rate decision are displayed. The total number of press meetings in the sample period is 128. An x denotes that a monetary policy shock was identified by the shock definition. PC indicates shocks derived through the principal components analysis. $SURVEY$ states the shocks found from the survey results. COM denotes extracted shocks as combination of the survey and the principal components definition.

Table 4: Stock Returns after Monetary Policy Shocks, 1 January 1999 - 28 February 2007

Shock Definition	PC	SURVEY	COM
Point Estimator	$\hat{\alpha}_{PC}$	$\hat{\alpha}_{SUR}$	$\hat{\alpha}_{COM}$
Euro Stoxx 50	-8.40	-9.17	-7.66
	$(0.024)^{**}$	$(0.011)^{**}$	$(0.018)^{**}$
	$[0.018]^{**}$	$[0.066]^{*}$	$[0.029]^{**}$
DAX 30	-7.78	-7.51	-6.99
	$(0.019)^{**}$	$(0.030)^{**}$	$(0.019)^{**}$
	$[0.045]^{**}$	$[0.148]$	$[0.062]^{*}$
CAC 40	-6.98	-7.07	-6.34
	$(0.026)^{**}$	$(0.030)^{**}$	$(0.035)^{**}$
	$[0.053]^{*}$	$[0.146]$	$[0.076]^{*}$
IBEX 35	-6.26	-6.36	-5.69
	$(0.013)^{**}$	$(0.003)^{***}$	$(0.006)^{**}$
	$[0.033]^{**}$	$[0.134]$	$[0.065]^{*}$
MIB 30	-4.32	-3.49	-4.14
	(0.117)	(0.151)	(0.118)
	$[0.201]$	$[0.427]$	$[0.101]$

Notes: PC indicates shocks derived through the principal components analysis. $SURVEY$ states the shocks found from the survey results. COM denotes extracted shocks as combination of the survey and the principal components definition. Bootstrapped p-values are in paratheses and p-values from asymptotic theory are in brackets. The one month EURIBOR is applied as a proxy for the policy rate. *, **, *** denotes statistical significance at the 10 percent, 5 percent, and 1 percent level, respectively.