Central Bank Policies and Financial Markets: Lessons from the Euro Crisis

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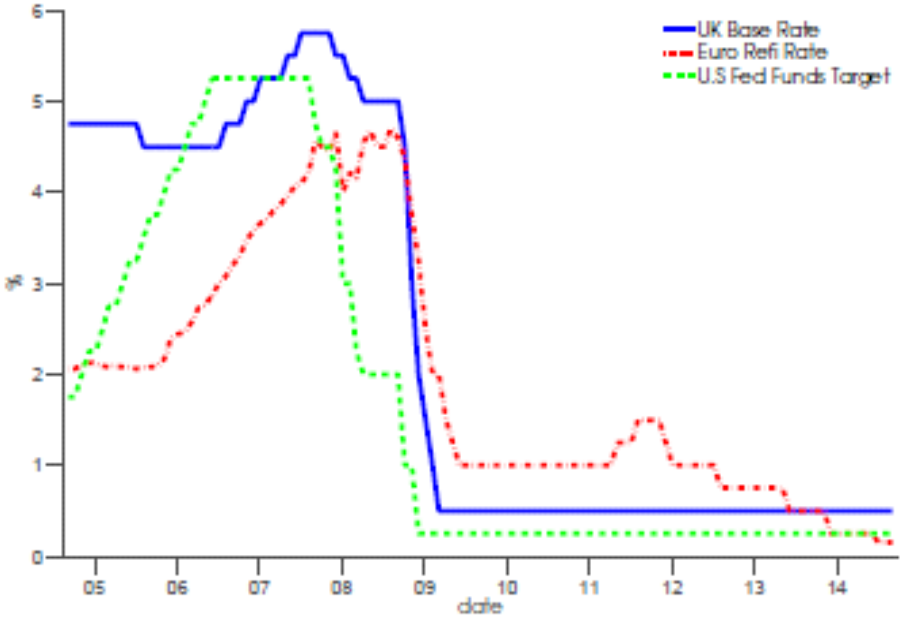
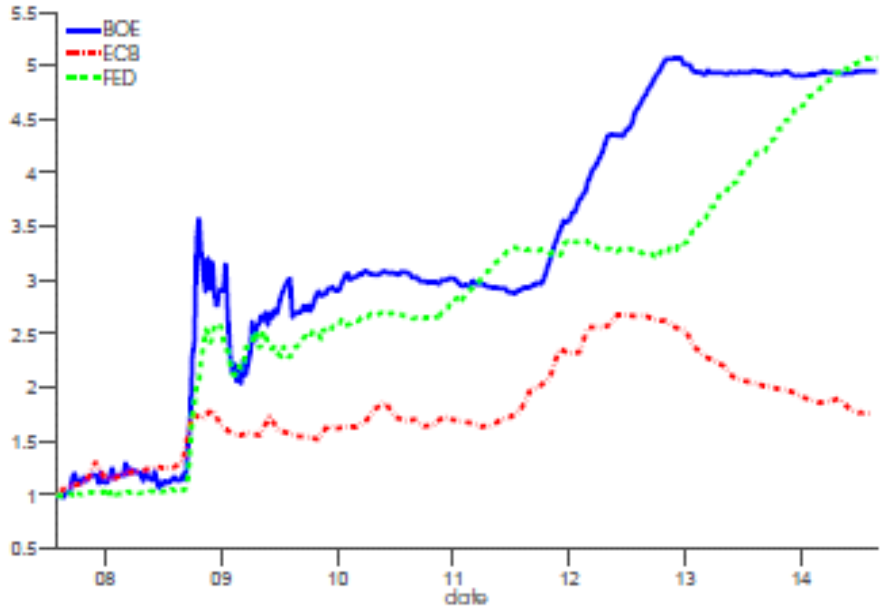
Motivation

After the onset of GFC, major central banks provided liquidity and monetary stimulus, although with different emphasis and timing.

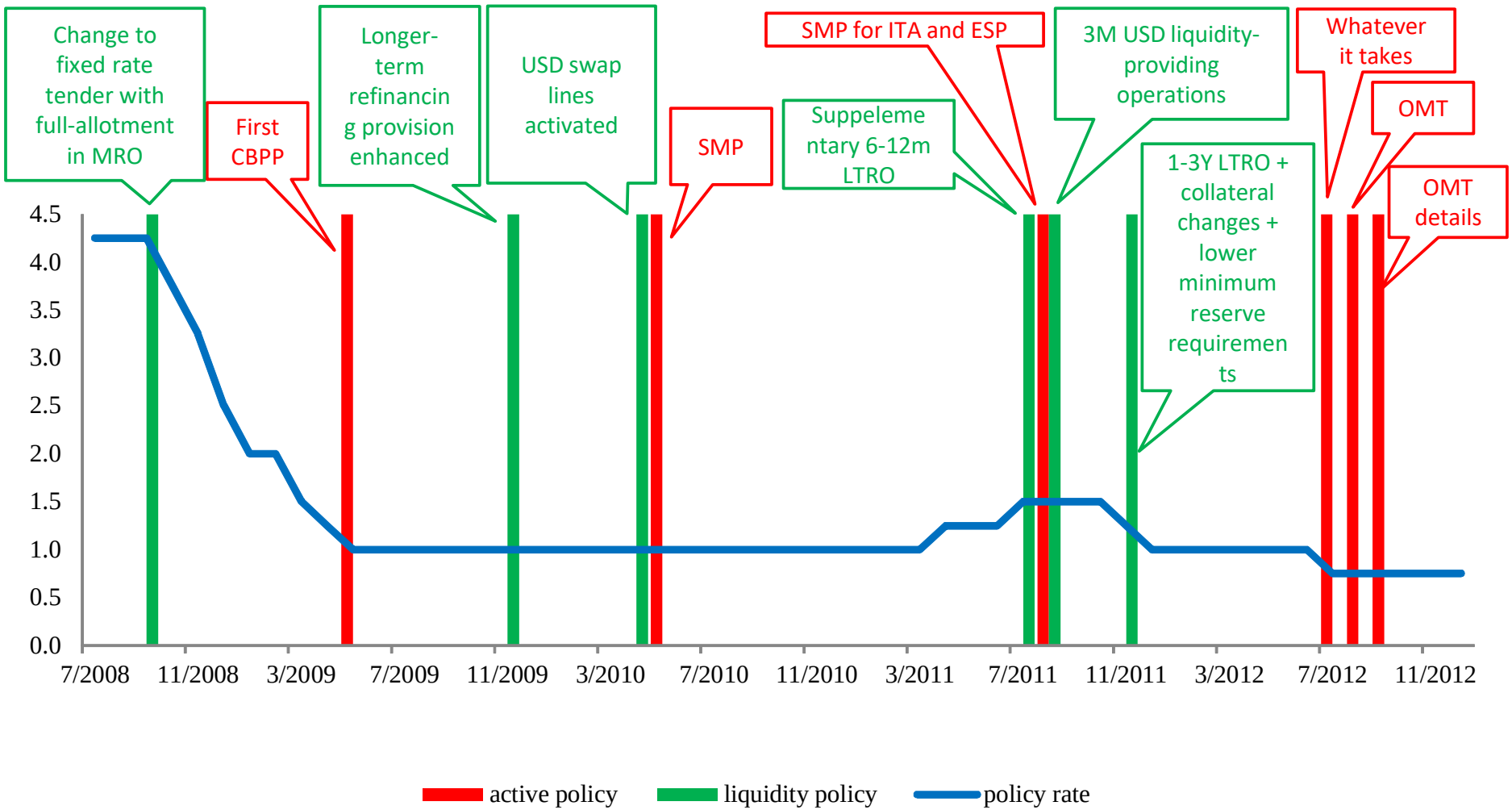
The policy rates (left) and the growth rate of the CBs balance sheet's asset side (right):





Source: Buraschi and Whelan (2015).

The ECB used a combination of policies during the Eurocrisis



- Can we compare them?

Empirical approach

- Use external information to **identify policy interventions**: Orthogonalized changes in the policy indicators on the policy announcement days.
- Study **bond spreads** in augmented quantile VAR framework (QVARX, White et al, 2015).
  - Nonlinear dependence in the conditional distribution; dynamic spillovers between the assets; causal impact of multiple policy interventions.
  - Obtain measures of central prediction (conditional median) and uncertainty (interquantile range). Track the asymmetries in the uncertainty responses.
- Study multiple country & sector **equity returns** using QVARX (and FAVAR for additional checks).

Key findings

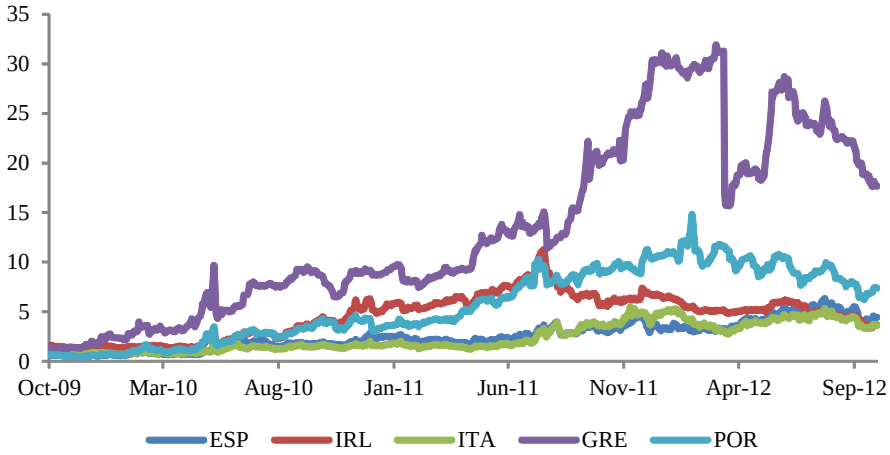
- **Dollar liquidity** provisions lowered bond spreads and raised equity prices significantly.
- **Euro liquidity** measures had only marginal effect on the asset prices.
- The pre-OMT government **bond interventions and policy rate changes** lowered the median bond spreads; yet the risk of large spread increases remained high; no positive effect on equity prices.
- The **OMT** improved the sovereign bond market sentiment and led to a significant rise in the euro-wide equity prices, especially for the banks.

Relation with the literature

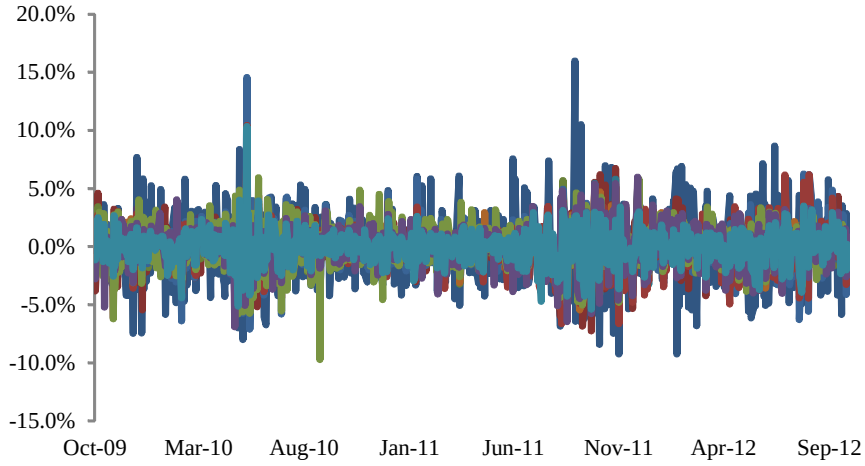
- We consider multiple policy instruments.
- Where we overlap with others, on euro liquidity and OMT, our results are similar to that in the literature.
- We uncover an important difference between dollar and euro liquidity policies.
- We highlight the difference in financial market's reaction to the OMT relative to earlier bond purchase and interest rate interventions.
- These distinctions help reveal the importance of unambiguous stimulative monetary policy for driving market expectations.

Data

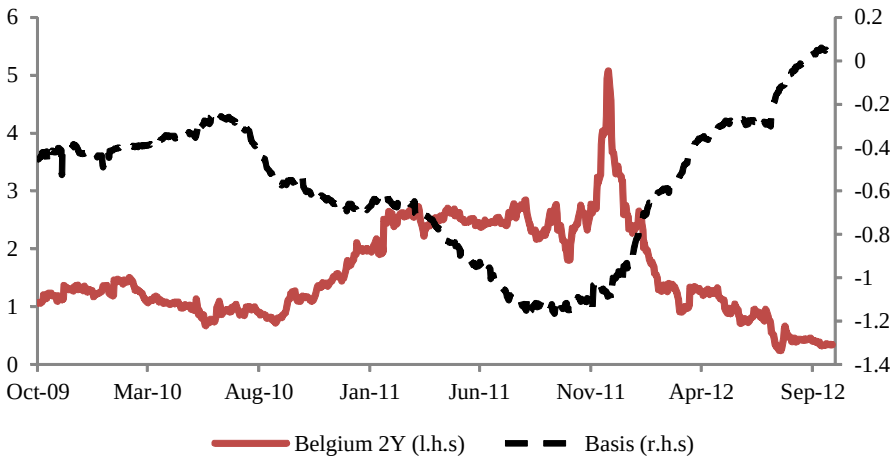
Bond spread levels (percentages)



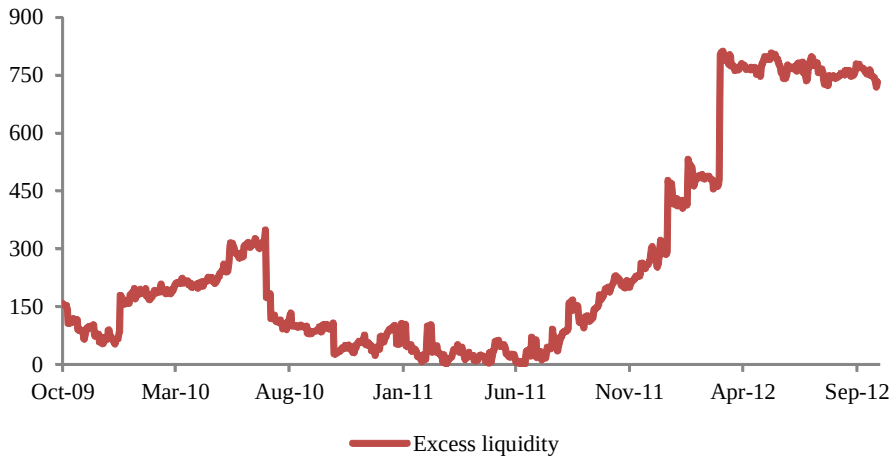
MSCI country returns (percentages)



2Y BEL bond yield and 3M €/$ swap basis

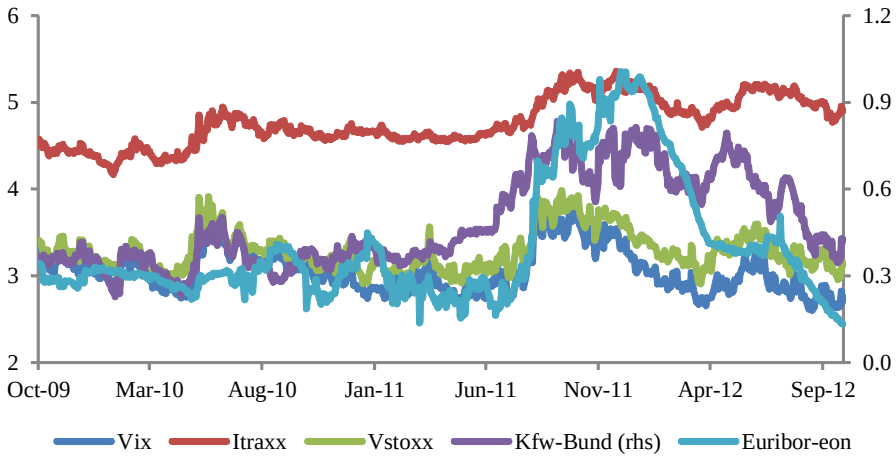


Bank excess liquidity (bn EUR)

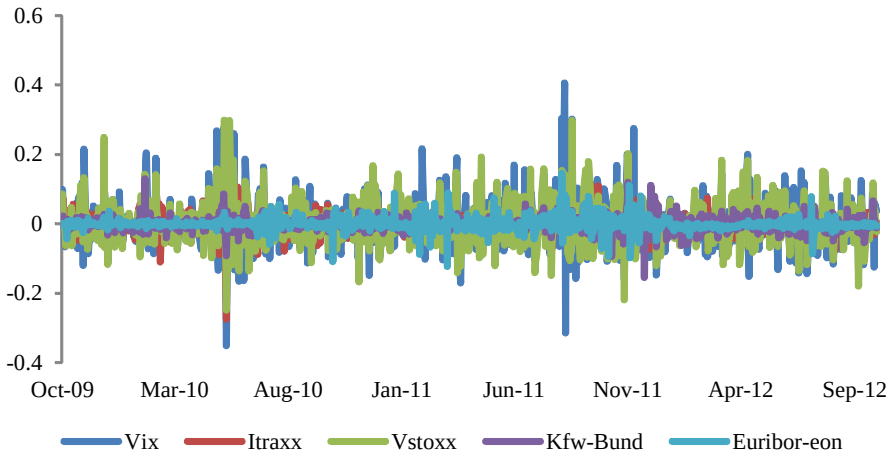


Confounding factors

Confounding factors: (log) levels



Confounding factors: changes



- VIX & VSTOXX: implied volatility in the US and Euro equity markets.
- KfW-Bund yield spread: a proxy for bond market liquidity (Schwarz, 2018).
- Itraxx Europe: 125 most liquid CDS contracts for Euro companies.
- Euribor-Eonia 3M spread: a proxy for money market tightness.
- Hand collected news on key economic and political news for Euro Area and periphery countries; and sovereign rating changes.

Identifying policy interventions

We identify a policy intervention as the daily change in the policy indicator that is orthogonal to contemporaneous news releases and public information about the state of the economy on the days of policy announcements.

$$\begin{aligned}\Delta PI_t &= \alpha + \sum_{i=1}^{p} \phi_i \Delta PI_{t-i} + \sum_{i=1}^{q} \beta_i \Delta y_{t-i} + \theta N_t + \sum_{i=1}^{r} \rho_i x_{t-i} \\ &\quad + \sum_{j=1}^{9} \delta_j SPF_{t,j} + \sum_{j=1}^{9} \gamma_j \Delta SPF_{t,j} + u_t \end{aligned} \tag{1}$$

$\triangle PI_t$: policy indicators; $\triangle y_{t-1}$: vector of the periphery bond spread changes; N_t: vector of the contemporaneous news releases (other two policy interventions, EU-level policy actions, country-level rating changes and local news); x_{t-1}: vector of confounding factors; SPF_t: vector of the latest available current year, next year and 4Q ahead forecast of inflation, unemployement and output.

- $M_t = \widehat{u}_t 1\{t = A_t\}$.

Measure of euro liquidity intervention

Date of release	Date in estimations	Policy action	Policy measure	Coefficient
		Euro liquidity		
03/12/2009	03/12/2009	The ECB's Governing Council signals gradual phasing out of liqudity operations	2.381	
04/03/2010	04/03/2010	ECB announces return to variable rate tender procedures in the regular 3-month longer-term refinancing operations (LTROs), starting with the operation to be allotted on 28 April 2010.	0.049	
25/03/2010	25/03/2010	ECB announces that it will continue to accept bonds with BBB- rating as collateral in its monetary operations	-1.412	
09/05/2010	10/05/2010	ECB announces a supplementary six-month LTRO at a rate which will be fixed at the average minimum bid rate of MRO during the period	-7.721	
10/06/2010	10/06/2010	ECB announces return to fixed rate tender procedure in 3-month LTROs	-4.020	
28/07/2010	28/07/2010	ECB announces stricter rules on bank collateral by revising haircuts on some classes of assets. It also provides details on the haircut schedule effective from January 2011	6.387	
04/08/2011	04/08/2011	ECB announces a liquidity-providing supplementary LTRO with a maturity between 6-12 months	-0.595	-0.99***
06/10/2011	06/10/2011	ECB announces second covered bond purchase programme and the details of new 6-12 months LTRO	-10.126	(0.37)
08/12/2011	08/12/2011	ECB announces 12-36 months LTRO + collateral changes + lower minimum reserve requirements	-26.094	
09/02/2012	09/02/2012	ECB announces specific national eligibility criteria and risk control measures for the temporary acceptance of additional credit claims as collateral in Eurosystem credit operations for 7 central banks (4 periphery).	-3.717	
22/06/2012	22/06/2012	ECB announces expanding pool of assets that can be used as collateral in monetary operations	-28.656	
03/07/2012	03/07/2012	ECB announces cap at the current levels of the amount of government-guaranteed debt that banks can offer as collateral in monetary operations	18.390	

Empirical analysis: QVARX

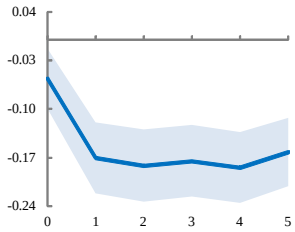
$$Q_t^\theta = \alpha + AQ_{t-1}^\theta + B\Delta y_{t-1} + CM_t + Dx_{t-1} + GN_t \tag{2}$$

- $\triangle y_{t-1}$: the $K-$dimensional vector of the spread changes.
- M_t: the $3-$dimensional vector of policy interventions.
- x_{t-1}: the $p-$dimensional vector of confounding factors.
- N_t: the $3-$dimensional vector of the contemporaneous news releases (EU-level policy actions, country-level rating changes and local news).
- $Q_{t,i}^\theta$: the $\theta-$th quantile of the conditional distribution $P\left(\Delta y_{t,i} < y \mid \Delta y_{t-1}, M_t, x_{t-1}, N_t\right)$.
- Use LTE estimator (Chernozhukov and Hong, 2003) based on block adaptive RW MH algorithm. [details]

Dollar liquidity interventions: 10Y bond spreads (%)

Conditional median response

Greece



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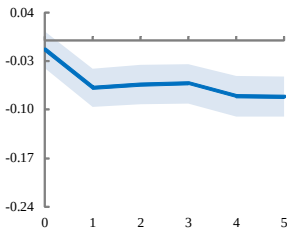

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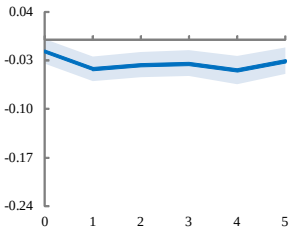
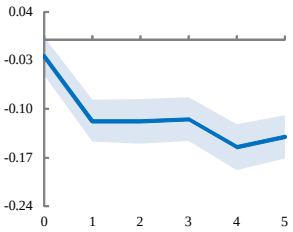
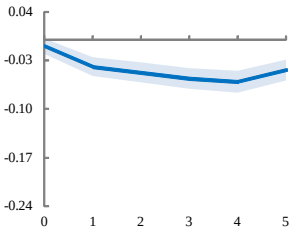


Portugal

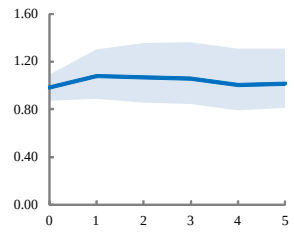


Spain



Left uncertainty response

Greece



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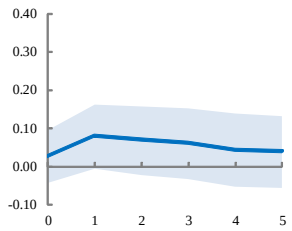

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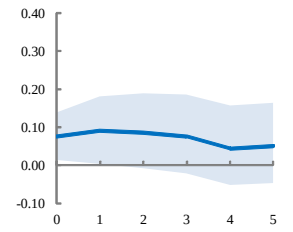

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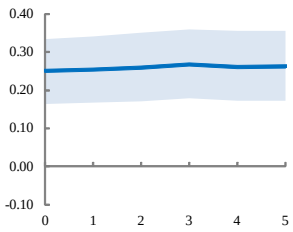

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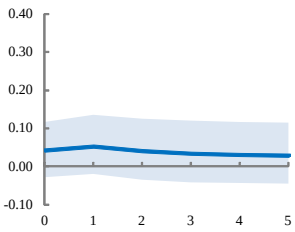
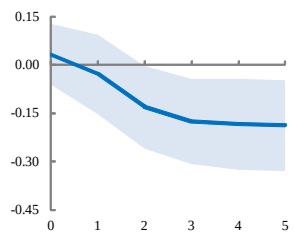


Right uncertainty reponse

Greece



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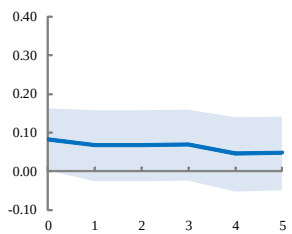

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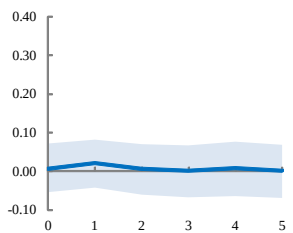

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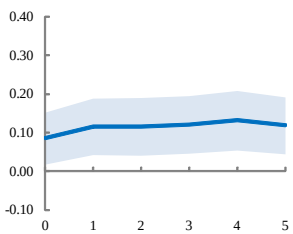

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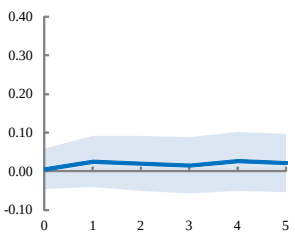
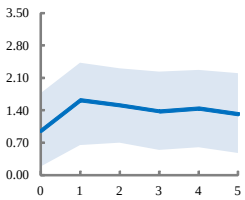


Dollar liquidity interventions: equity returns (%)

Conditional median response

Greece



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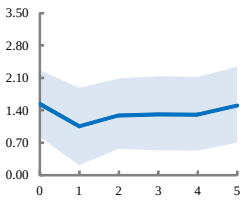

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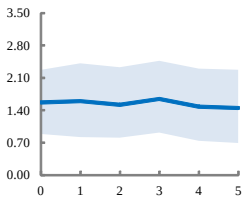

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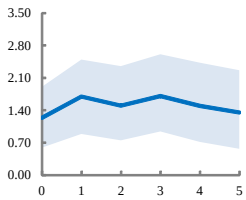

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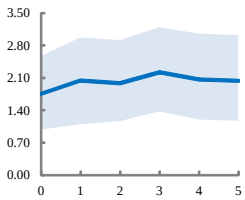
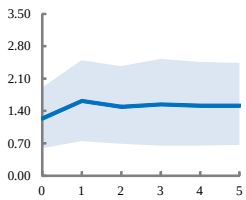
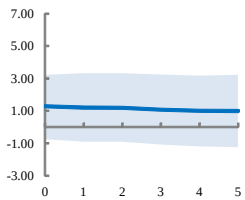


Banks



Left uncertainty response

Greece



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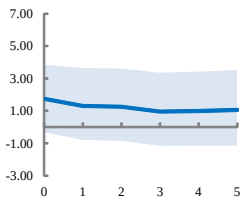

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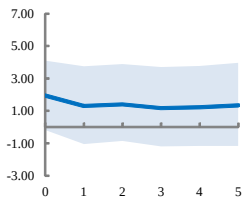

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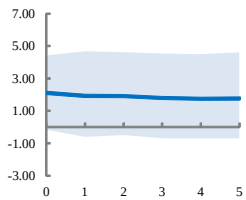

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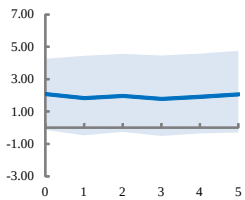

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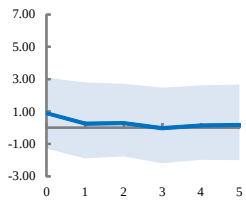
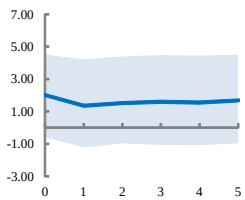


Right uncertainty reponse

Greece



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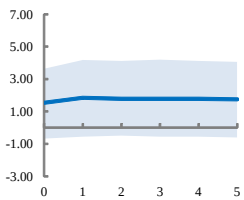

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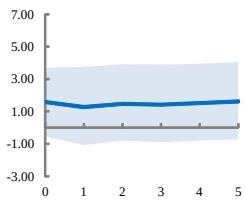

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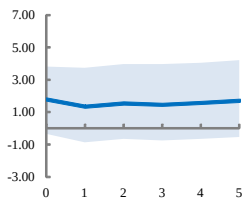

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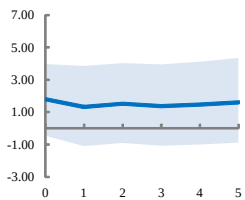

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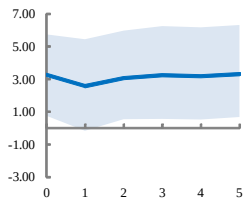
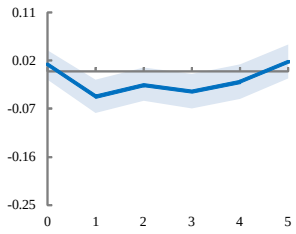


Euro liquidity interventions: 10Y bond spreads (%)

Conditional median response

Greece



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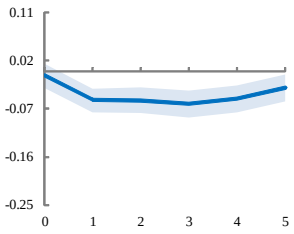

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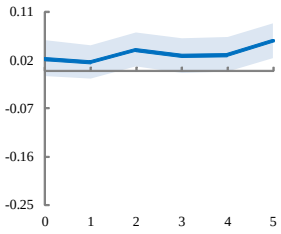

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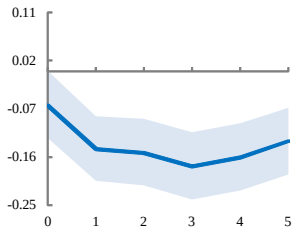
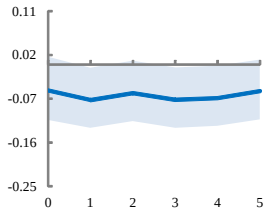
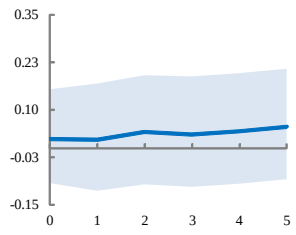


Spain

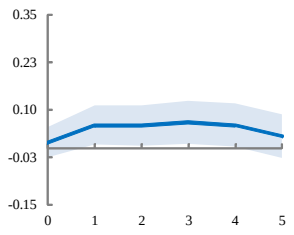


Left uncertainty response

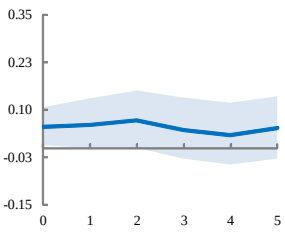
Greece



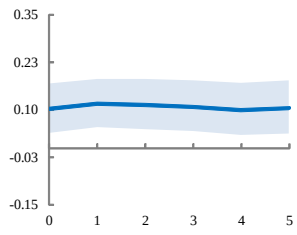
Ireland



Italy



Portugal



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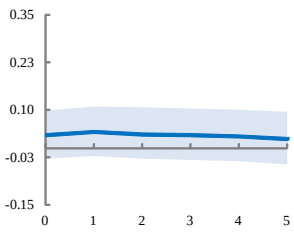
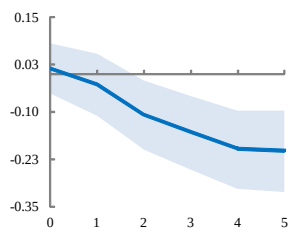


Right uncertainty reponse

Greece



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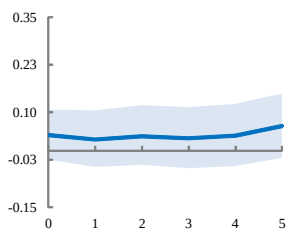

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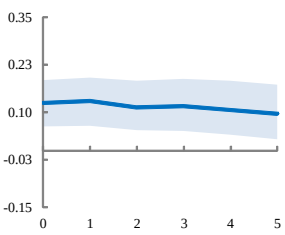

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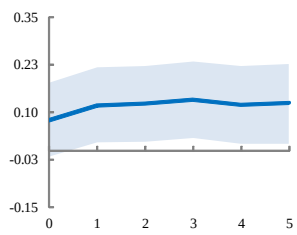

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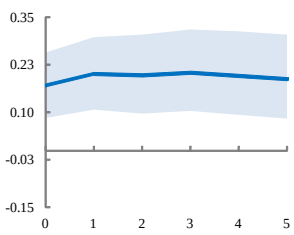
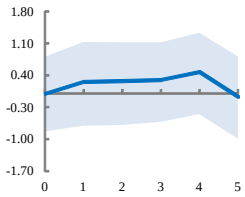


Euro liquidity interventions: equity returns (%)

Conditional median response

Greece



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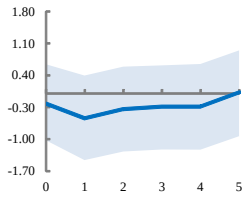

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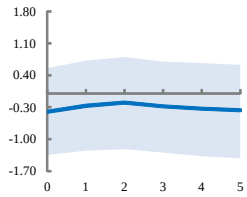

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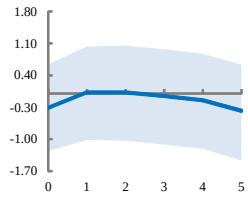

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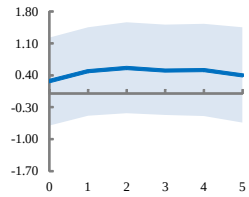
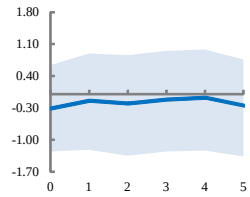
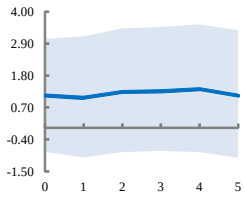


Banks



Left uncertainty response

Greece



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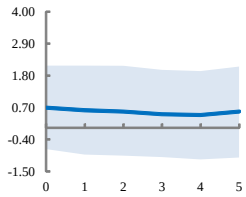

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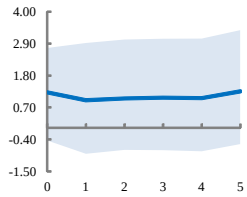

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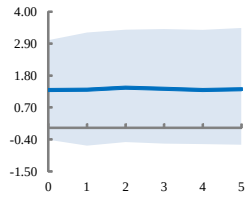

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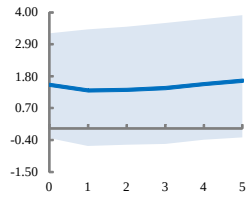

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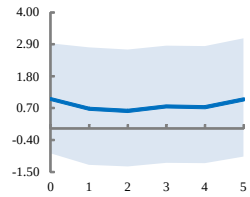
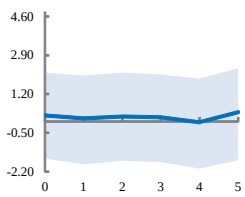


Right uncertainty reponse

Greece



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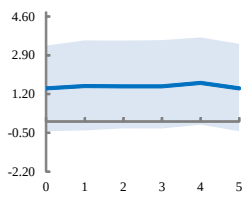

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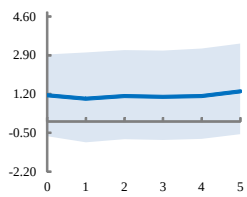

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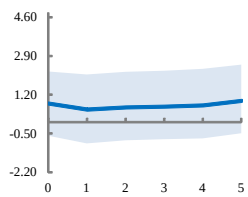

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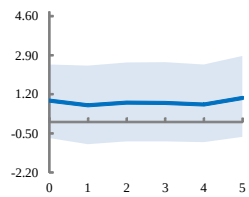

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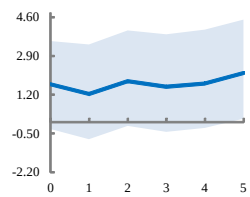
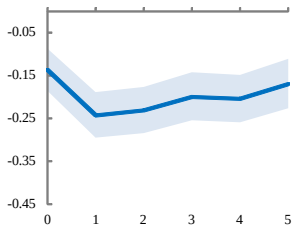


Monetary stimulus interventions: 10Y bond spreads (%)

Conditional median response

Greece



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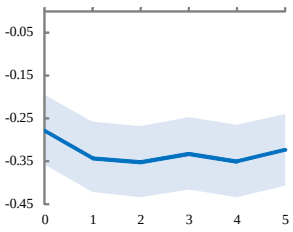

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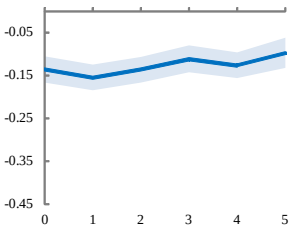

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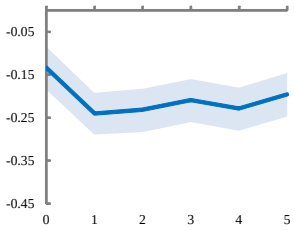
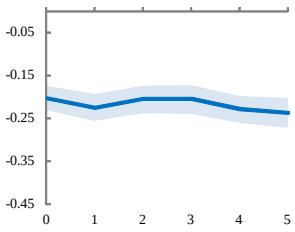
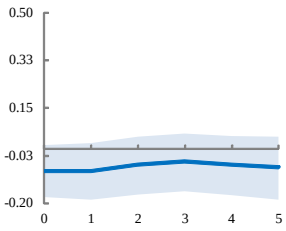


Spain

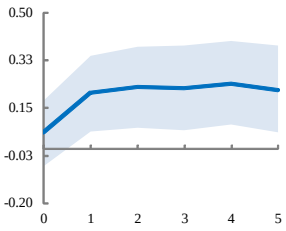


Left uncertainty response

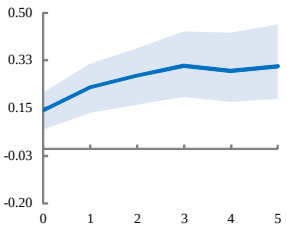
Greece



Ireland



Italy



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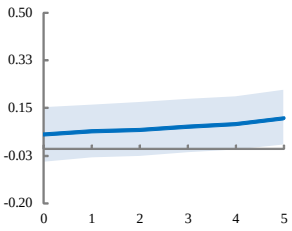
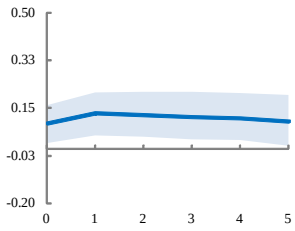
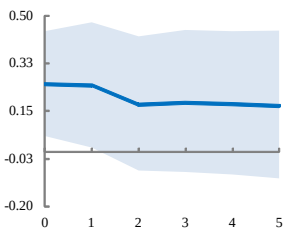


Spain



Right uncertainty reponse

Greece



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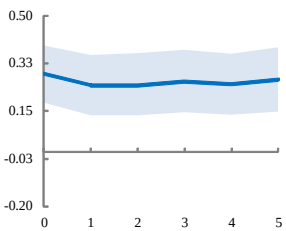

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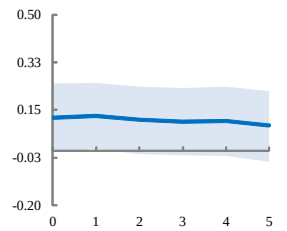
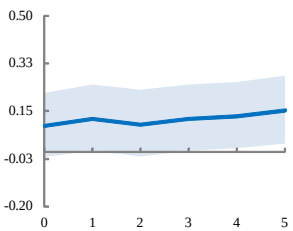
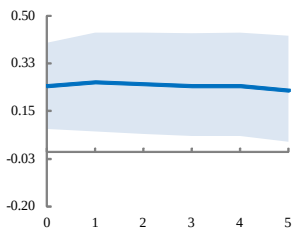


Portugal



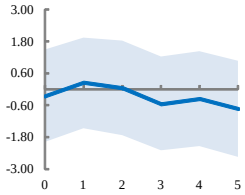
Spain



Monetary stimulus interventions: equity returns (%)

Conditional median response

Greece



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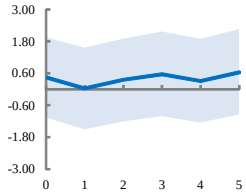

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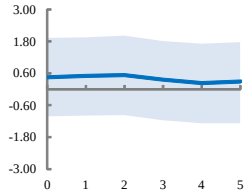
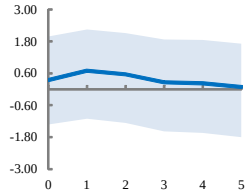
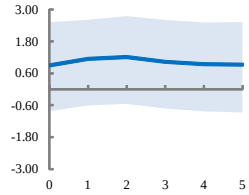


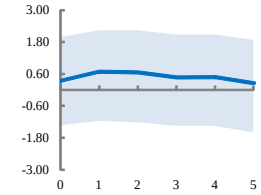
Portugal



Spain

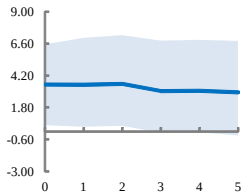


Banks



Left uncertainty response

Greece



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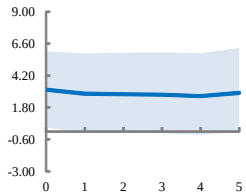
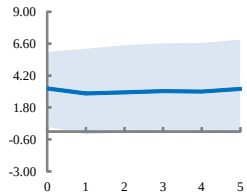
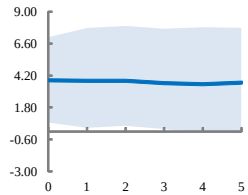


Italy



Portugal



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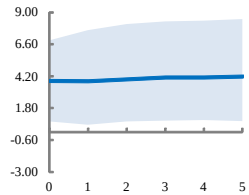

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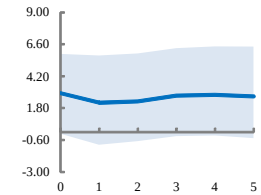
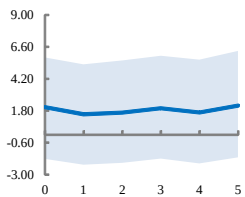


Right uncertainty reponse

Greece



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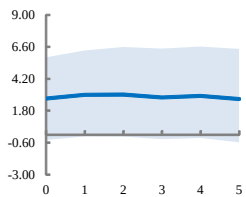
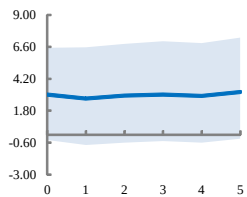
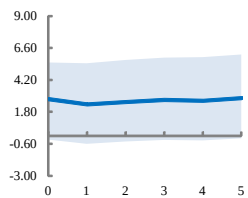


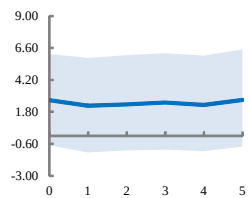
Italy



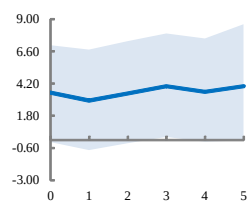
Portugal



Spain



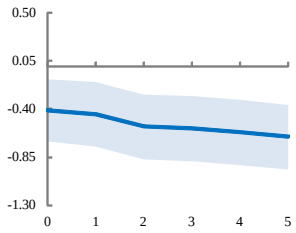
Banks



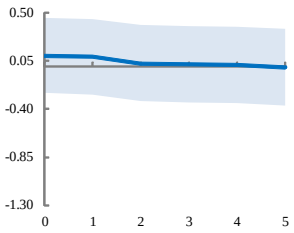
OMT intervention: 10Y bond spreads (%)

Conditional median response

Greece



Ireland



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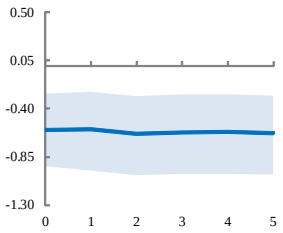

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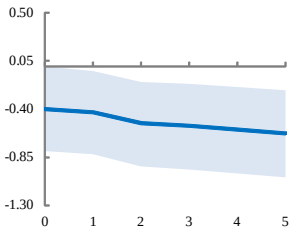

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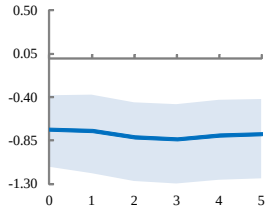
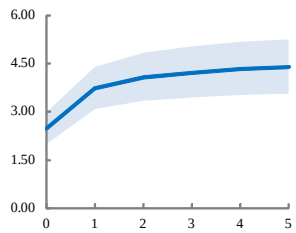


Left uncertainty response

Greece



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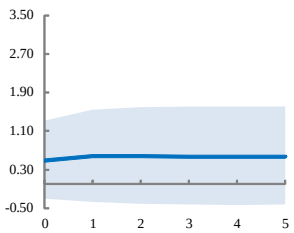
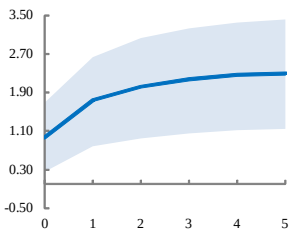


Italy



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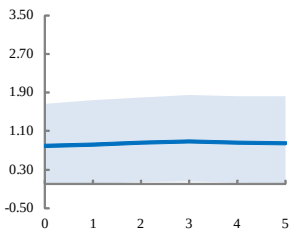

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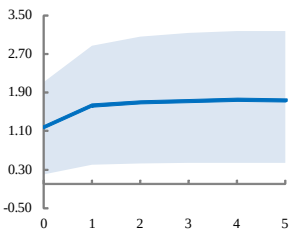
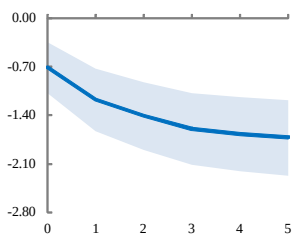


Right uncertainty reponse

Greece



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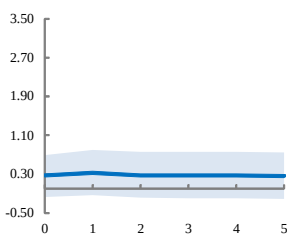

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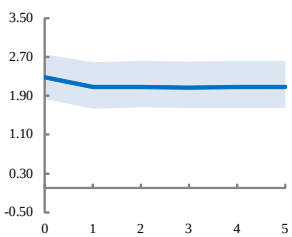

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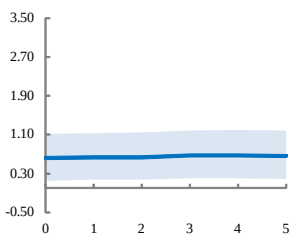

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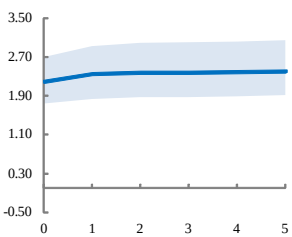
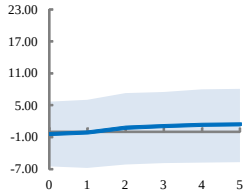


OMT intervention: equity returns (%)

Conditional median response

Greece



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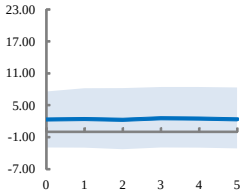
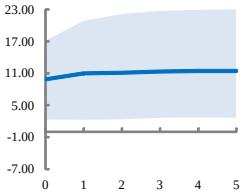
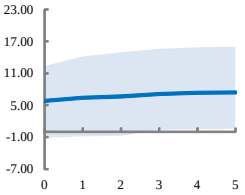


Italy



Portugal



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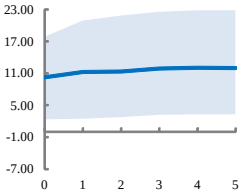
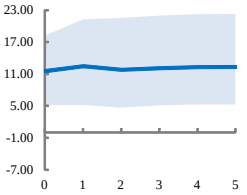
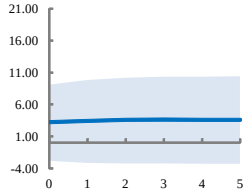


Banks



Left uncertainty response

Greece



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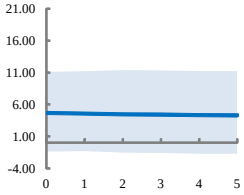
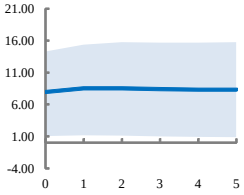
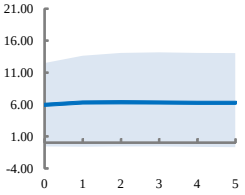


Italy



Portugal



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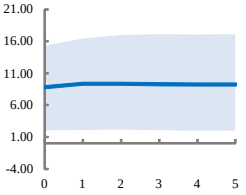

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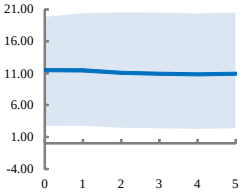
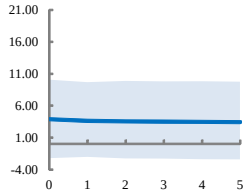


Right uncertainty reponse

Greece



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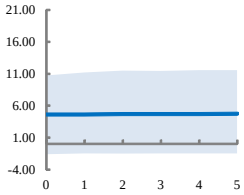
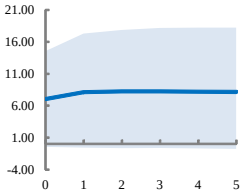


Italy



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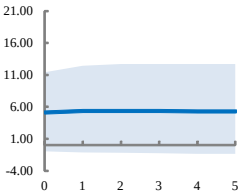

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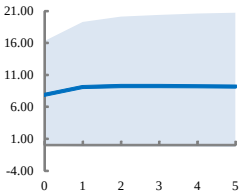
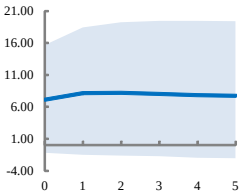


Banks



Specification checks

- Different dependent variable: 2Y bond spreads, 10Y bond yields.
- Choice of controls: Alternative controls.
- Plausability of the news releases (estimating responses).
- Specification tests: Escanciano and Velasco (2010) test.
- The choice of quantiles for uncertainty measurement: Alternative choices.
- Alternative estimation methods (FAVAR).
- Persistency of responses (thirty days).
- Random perturbation tests.

30 day cummulative responses: equities FAVAR

	Dollar Liquidity	Euro Liquidity	Active intervention	OMT
Country				
Greece	**1.18**	-0.12	0.18	2.76
Ireland	**1.45**	-0.30	-0.48	**4.09**
Italy	**1.60**	-0.13	0.08	**5.42**
Portugal	**1.04**	-0.03	0.17	**4.15**
Spain	**1.54**	0.04	0.47	**6.72**
Austria	**1.50**	-0.23	-0.17	3.88
Belgium	**1.19**	-0.19	-0.35	**4.14**
Finland	**1.33**	-0.40	-0.54	1.92
France	**1.47**	-0.25	-0.32	**4.52**
Germany	**1.40**	-0.31	-0.51	**3.86**
Netherlands	**1.27**	-0.24	-0.38	**3.76**
Industry				
Banks	**2.06**	-0.03	0.61	**7.45**
Insurances	**1.69**	-0.17	-0.02	**5.50**
Automobiles	**1.72**	-0.56	**-1.00**	3.03
Communic Equipment	**1.30**	-0.57	-0.74	-0.71
Construction	**1.56**	-0.26	-0.24	**4.39**
Multi Utilities	**1.43**	-0.08	0.06	**5.36**
Telecomm. Services	**1.13**	0.01	0.22	**4.90**

Recap

- We developed an empirical framework to identify financial markets' causal responses to central bank policy interventions.
- We uncovered significant differences in responses to the ECB's liquidity (dollar and euro) and monetary stimulus measures.
- The results generally imply that central bank's interventions are effective if they provide clear signals of the central bank's commitment to stabilize the economy; and address the source rather than the symptom of financial stress.

QVARX Impulse response analysis

$$Q_{t+1}^{SH} - Q_{t+1}^{NO} = A\left(Q_t^{SH} - Q_t^{NO}\right) + B\left(\Delta y_t^{SH} - \Delta y_t^{NO}\right) + D\left(x_t^{SH} - x_t^{NO}\right)$$

- The quantile impulse responses are dependent on the history.
- The responses depend on its own path $\left\{Q_t^{SH} - Q_t^{NO}\right\}$ and the paths of other variables $\left\{\Delta y_t^{SH} - \Delta y_t^{NO}\right\}$ and $\left\{x_t^{SH} - x_t^{NO}\right\}$ following the shock.
- The responses are independent of other shocks and news releases $\{M_{t,2}, N_t\}$ that occur simultaneously with $M_{t,1}$ or during the forecast horizon as long as they are independent of $M_{t,1}$.
- **Solution:** Plug in 500 simulated paths of $\left\{\Delta y_t^{SH}, x_t^{SH}\right\}$ and $\left\{\Delta y_t^{NO}, x_t^{NO}\right\}$.

$$UNC_{t+h}^{SH} - UNC_{t+h}^{NO} = \left(Q_{t+h}^{UP,SH} - Q_{t+h}^{UP,NO}\right) - \left(Q_{t+h}^{LOW,SH} - Q_{t+h}^{LOW,NO}\right)$$

QIR: simulation

1. Draw 500 paths (with repetition) of $\{\Delta y_t^{SH} ... \Delta y_{t+H-1}^{SH}, x_t^{SH} ... x_{t+H-1}^{SH}\}$ from the observed data on the randomly selected days of policy announcements using a one-sided window of four days (the day of the announcement A_t and the subsequent four days).
2. Draw 500 paths for non-shock response from the remaining days in the sample (outside the $h-$sided window around A_t).
3. Using generated paths, estimated parameters and the remaining data $\{M_{t,2}, N_t\}$, obtain 500 realizations of Q_{t+1}^{SH} and Q_{t+1}^{NO}.
4. QIR at time $t+1$ are an average of $Q_{t+1}^{SH} - Q_{t+1}^{NO}$ from step over the 500 paths.
5. Repeat the steps 1-4 for the selected days and take the average of the responses.
6. Repeat previous steps for other horizons: $h = 2, 3, , , , , H$.

- Alternatively, replace the steps 1-2 by sampling realizations from the one-step ahead conditional distributions $\widehat{F}\left(\Delta y_{t+h} \middle|\ \Delta y_{t+h-1}\right)$ and $\widehat{F}\left(x_{t+h} \middle|\ x_{t+h-1}\right)$.

MCMC details

Step 1: Draw a candidate vector of parameter values in block b, β_b^*, as:

$$\beta_b^* = \beta_b + \xi_b$$

Step 2: Accept or reject the proposal based on the acceptance probability:

$$\min\left(1, \frac{\exp\left\{L_T\left(\beta_b^*, \beta_{-b}\right) - L_T\left(\beta_b, \beta_{-b}\right)\right\}}{\lambda_b}\right)$$

- $L_T(\beta) = T^{-1}\sum_{t=1}^{T}\left\{\sum_{i=1}^{N}\rho_{\theta,i}\left(\Delta y_{it} - q_{it}^{\theta}(\cdot,\beta)\right)\right\}$; λ_b is the scale parameter set in the range around 0.1 (Kormiltsina and Nekipelov, 2016).
- m^{th} proposal $\xi_{m,b}$ is drawn from the mixture of normal distributions:

$$\xi_{m,b} \sim \left\{\begin{array}{ll} N\left(0, v_{m,b}^2\widehat{\Sigma}_{m,b}\right) & w.p.\ 1-\delta \\ N\left(0, \phi_b^2 I_b\right) & w.p. \quad \delta \end{array}\right\}$$

[back]

Equity analysis: FAVAR

$$y_t = [\Lambda \ \Gamma] \left[F_t'; x_t'\right]' + e_t \tag{3}$$

$$\left[F_t'; x_t'\right]' = A(L) \left[F_t'; x_t'\right]' + BM_t + CN_t + u_t \tag{4}$$

- y_t is the $N-$dimensional vector of ordered equity returns (aggregate euro area stock index, industry indices, country indices).
- F_t is the $k-$dimensional vector of unobserved common factors.
- x_t is the $r-$dimensional vector of observed factors.
- Bai and Ng (2002)'s criterion suggests three factors which explain $\sim 70\%$ of total variation (of which the first factor explains $\sim 64\%$).

News data summary

	Total number	Higher sovereign risk	Lower sovereign risk
EU policy announcements	28	1	27
Rating changes Spain	19	19	0
Local news Spain	27	21	6
Rating changes Ireland	17	14	3
Local news Ireland	24	14	10
Rating changes Italy	10	10	0
Local news Italy	14	7	7
Rating changes Greece	28	25	3
Local news Greece	33	19	14
Rating changes Portugal	17	17	0
Local news Portugal	19	9	10

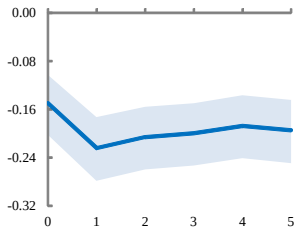
Random perturbation tests:

Spread	Estimate	Euro Liquidity	FX liquidity	Active
Greece	Median	0.017	0.020	0.022
	CI	[-0.031 0.098]	[-0.046 0.098]	[-0.072 0.094]
Ireland	Median	0.003	0.002	0.010
	CI	[-0.033 0.032]	[-0.035 0.039]	[-0.039 0.043]
Italy	Median	0.004	0.002	0.010
	CI	[-0.021 0.029]	[-0.023 0.038]	[-0.035 0.474]
Spain	Median	0.004	0.007	0.003
	CI	[-0.024 0.027]	[-0.035 0.035]	[-0.041 0.042]
Portugal	Median	0.002	0.005	0.016
	CI	[-0.031 0.037]	[-0.041 0.058	[-0.043 0.063]

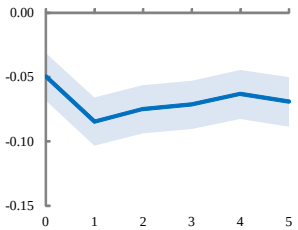
Control news responses: 10Y bond spreads (%) median

EU policy announcements

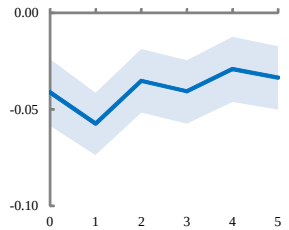
Greece



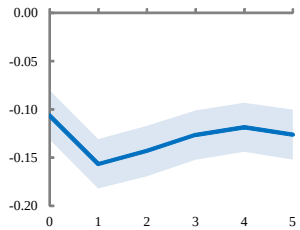
Ireland



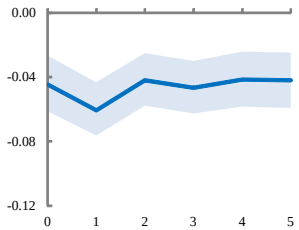
Italy



Portugal

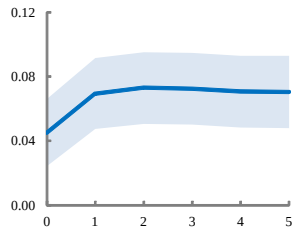


Spain

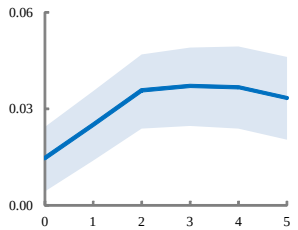


Rating downgrades

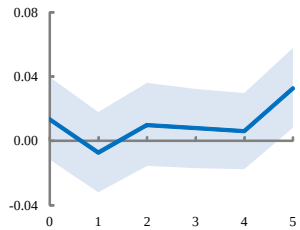
Greece



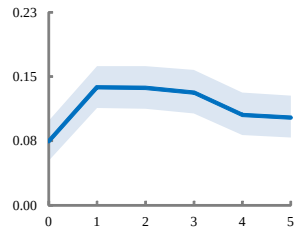
Ireland



Italy



Portugal



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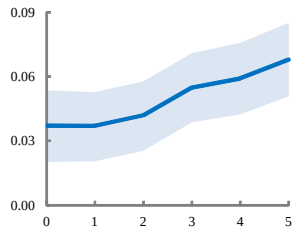
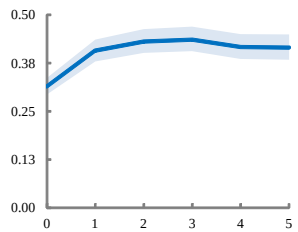


Negative local news

Greece



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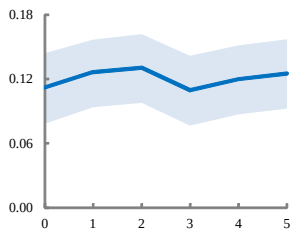

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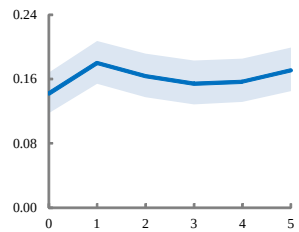
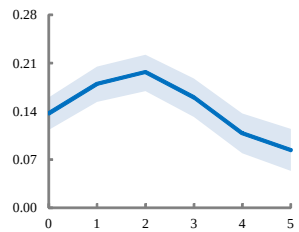
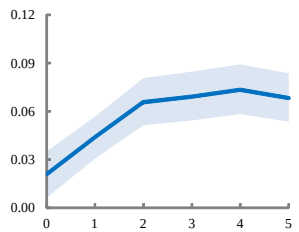


Portugal



Spain



30 day cummulative responses: 10Y bond spread

	Dollar liquidity			Euro liquidity		
Response	Conditional median	Left uncertainty	Right uncertainty	Conditional median	Left uncertainty	Right uncertainty
Greece	-9.74 [-14.45 -4.98]	112.18 [90.58 144.67]	-0.38 [-13.18 11.96]]	2.16 [-0.77 5.14]	4.11 [-9.39 19.16]	1.77 [-7.50 10.58]
Ireland	-3.35 [-6.02 -0.77]	6.88 [-1.58 15.18]	8.93 [-0.51 17.97]	-2.16 [-4.47 -0.07]	3.99 [-1.13 8.96]	4.32 [-3.09 12.06]
Italy	-1.30 [-3.05 0.41]	14.29 [4.10 27.78]	0.73 [-5.94 7.15]	3.55 [0.55 6.77]	8.81 [1.69 17.28]	12.09 [6.33 19.15]
Portugal	-4.41 [-7.15 -1.71]	25.81 [17.25 34.68]	10.25 [3.21 17.22]	-8.17 [-14.06 -1.99]	10.64 [4.69 17.19]	9.72 [0.02 19.64]
Spain	-2.26 [-3.41 -1.12]	4.58 [-2.71 13.50]	0.10 [-6.94 6.80]	-4.98 [-10.73 1.67]	3.88 [-2.48 10.71]	19.09 [9.70 30.09]
	Active policy			OMT		
Response	Conditional median	Left uncertianty	Right uncertainty	Conditional median	Left uncertianty	Right uncertainty
Greece	-20.79 [-26.01 -15.54]	-8.76 [-19.99 1.89]	30.03 [3.99 56.45]	-39.46 [-70.35 -9.62]	472.23 [388.79 564.34]	-140.67 [-195.67 -88.56]
Ireland	-33.14 [-41.33 -24.83]	21.17 [6.01 36.75]	22.27 [10.64 34.11]	14.74 [-21.20 50.49]	53.63 [-45.65 157.43]	36.53 [-11.32 84.24]
Italy	-15.24 [-18.32 -12.29]	28.02 [16.84 42.92]	13.06 [-0.33 25.57]	-58.22 [-98.27 -23.62]	250.96 [133.28 382.03]	210.54 [166.03 263.61]
Portugal	-19.79 [-24.91 -14.88]	4.37 [-5.13 14.53]	7.84 [-4.31 20.77]	-41.77 [-82.21 -2.82]	78.02 [-4.95 173.98]	66.02 [18.83 116.87]
Spain	-19.36 [-22.56 -16.41]	13.30 [5.14 22.58]	25.96 [7.04 46.26]	-73.81 [-120.20 -36.98]	179.10 [46.59 325.01]	237.00 [186.21 300.08]