Unconventional monetary policies: **Quantitative Easing** and **Forward Guidance**

Supervisors:
Professor Moisă Altăr
Lecturer Bogdan Cozmâncă

Presented by:
Cristina-Diana Florescu

DOFIN

„***The essence of Quantitative Easing (QE) is to reduce the costs of private borrowing through large-scale purchases of privately issue debts, instead of public debts***” (Ben Bernanke, 2009).

1. Unconventional monetary policies (US)

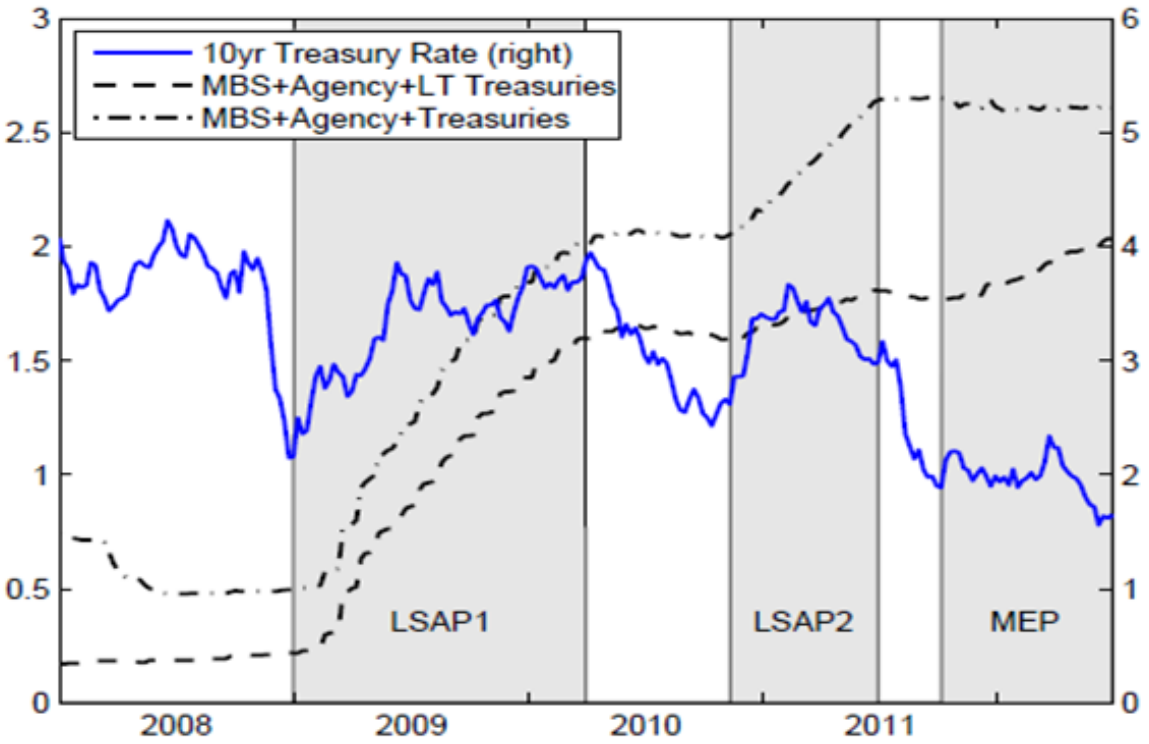
In December 2008, **the Federal Reserve reduced its target for the federal funds rate to nearly zero**. Between **late 2008 and October 2014** it made **a series of large-scale asset purchases (LSAPs)**. Moreover, it used for the first time „*forward guidance*", providing indications to the public **about the stance of monetary policy expected to prevail in the future**.

There is a major interdependence between the 2 intervention measures that, **with the current exercise, creates the premises of a faster adjusment of market expectations regarding the possible response of the Federeal Reserve in the event of a future crisis** (Eric M. Engen, Thomas T. Laubach and David Reifschneider, 2015).

1. Unconventional monetary policies (US)

In conducting LSAPs, the Federal Reserve purchased longer-term securities issued by the U.S. government and longer-term securities issued or guaranteed by government-sponsored agencies such as Fannie Mae or Freddie Mac (GSE-Government Sponsored Entity).

The overall effect of the Fed's LSAPs and it's forward guidance **was to put downward pressure on yields of a wide range of longer-term securities, support mortgage markets, and promote a stronger economic recovery**.



The evolution of Federal Reserve securities holdings, compared with the evolution of the yield on 10-year Treasuries. The grey regions identify three programs under which the Fed has increased its holdings of longer-term securities. Units: (left scale) trillions of dollars; (right scale) percent per annum. *Source: Woodford, 2012*

2. THE MODEL
BVAR because…

The objective of the paper is to measure the impact of large scale asset purchases on the real GDP, the inflation and the 10 year yields.

The main difference between Bayesian vector autoregression (BVAR) and standard VAR models lies in the fact that the **model parameters are treated as random variables and prior probabilities are assigned to them**.

Given the limited length of standard macroeconomic datasets, Bayesian methods have become an increasingly popular way of dealing with the problem of **over-parameterization**: the analyzed period is March 2009 - October 2014, **the whole period that the Fed purchased assets.**

Bayesian Estimation

In the Bayesian approach, it is assumed that the non sample or prior information is available in the form of a density. Denoting the parameters of interest with β let's assume that the prior information is summarized in the **prior probability density function $g(\beta)$**.

The sample information is sumarized in $f(\mathbf{y} \mid \boldsymbol{\beta})$.

Bayes' theorem states: $g(\boldsymbol{\beta} \mid \mathbf{y}) = \dfrac{f(\mathbf{y} \mid \boldsymbol{\beta})\, g(\boldsymbol{\beta})}{f(\mathbf{y})}$

-where $f(y)$ is just a normalizing constant.

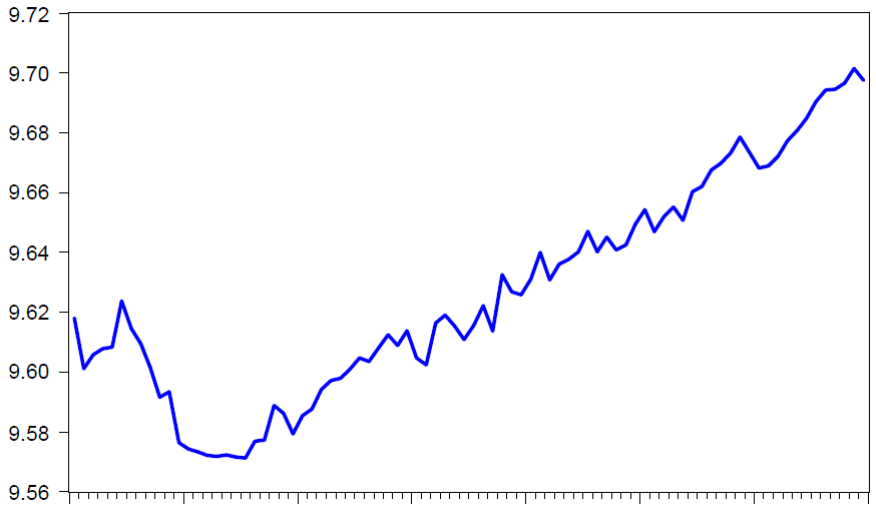
$g(\boldsymbol{\beta} \mid \mathbf{y}) \propto f(\mathbf{y} \mid \boldsymbol{\beta})\, g(\boldsymbol{\beta}) = \ell(\boldsymbol{\beta} \mid \mathbf{y})\, g(\boldsymbol{\beta})$

-where $g(\boldsymbol{\beta} \mid \mathbf{y})$ is the **posterior probability density function**.

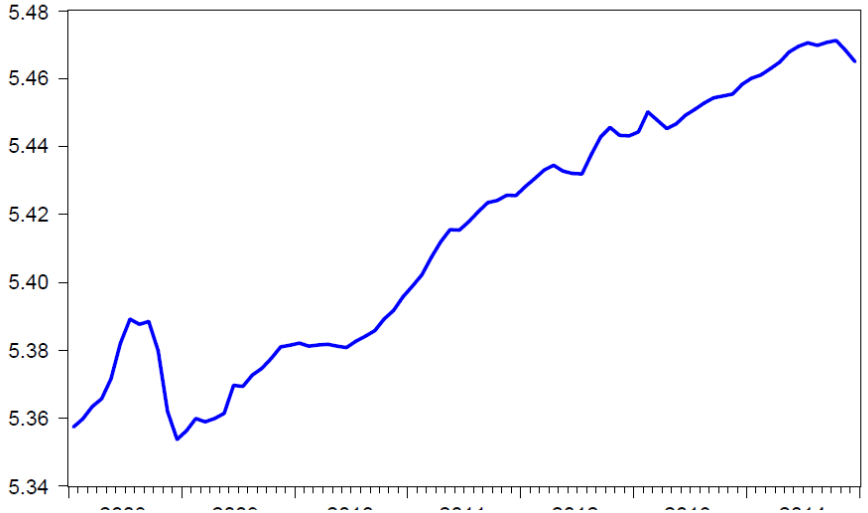
2.1 THE DATA

- **us_ln_rgdp**: Real Gross Domestic Product (logarithm), monthly, *source: www.macroadvisers.com/monthly-gdp/*;
- **us_ln_cpi**: Consumer Price Index (logarithm), monthly, *source: www.bls.gov/cpi/data.htm*
- **us_fed_ta_gdp**: total assets scaled by the nominal GDP, monthly, *source: Board of Governors of the Federal Reserve System*;
- **us_10y**: 10 year yields, monthly, *source: Reuters*;

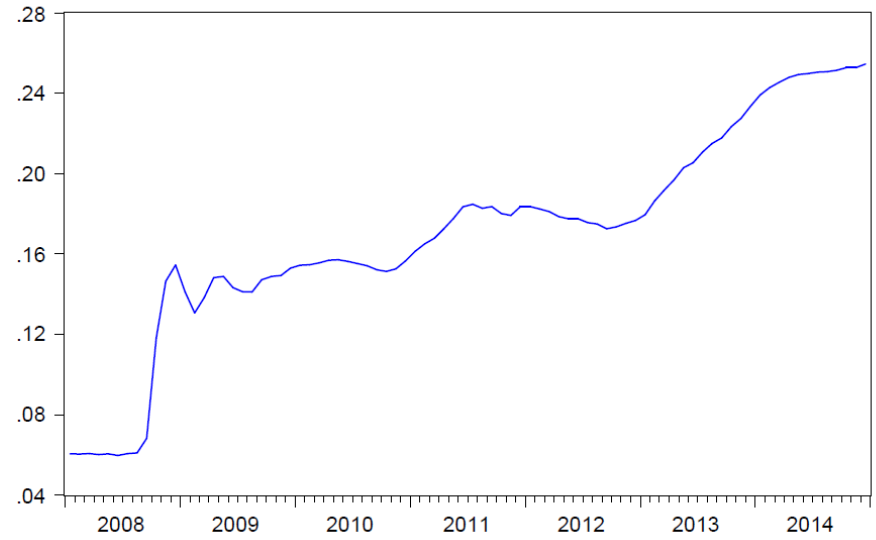
US_LN_RGDP



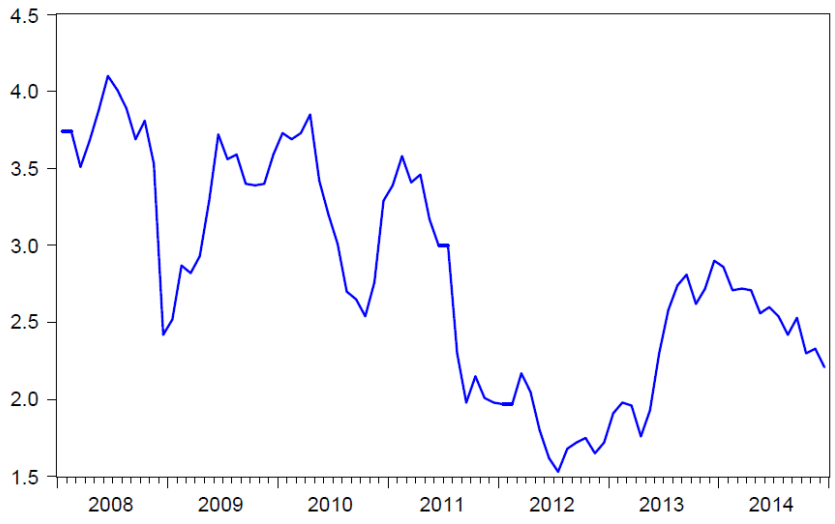
US_LN_CPI



US_FED_TA_GDP



US_10Y (%)



Bayesian Estimation

For a VAR (p) model we have:

$$y_t = \nu + A_1 y_{t-1} + \dots + A_p y_{t-p} + u_t \qquad y := [y_1, \dots y_T], \quad Z := [Z_0, \dots Z_{T-1}], \quad Z_t := \begin{bmatrix} 1 \\ y_t \\ \cdot \\ \cdot \\ \cdot \\ y_{t-p+1} \end{bmatrix}$$

$$\beta := [\nu, A_1, \dots, A_p].$$

We estimate a normal **prior distribution**: $\beta \sim \mathcal{N}(\beta^*, V_\beta)$

$$g(\beta) = \left(\frac{1}{2\pi}\right)^{Knp/2} |V_\beta|^{-1/2} \exp\left[-\frac{1}{2}(\beta-\beta^*)' V_\beta^{-1} (\beta-\beta^*)\right], \quad n=2$$

Combining with the sample information summarized in the Gaussian likelihood:

$$\ell(\beta \mid y) = \left(\frac{1}{2\pi}\right)^{KT/2} |I_T \otimes \Sigma_u|^{-1/2} \, x \exp\left[-\frac{1}{2}(y-(Z' \otimes I_K)\beta)' (I_T \otimes \Sigma_u^{-1})(y-(Z' \otimes I_K)\beta)\right]$$

Bayesian Estimation

Gives the posterior distribution function:

$g(\beta \mid y) \propto g(\beta)\, \ell(\beta \mid y)$

$$\propto \exp\{-\tfrac{1}{2}[(V_\beta^{-1/2}(\beta-\beta^*))'(V_\beta^{-1/2}(\beta-\beta^*))+\{(I_T \otimes \Sigma_u^{-1/2})\mathbf{y} - (Z' \otimes \Sigma_u^{-1/2})\boldsymbol{\beta}\}'$$

$$\times \{(I_T \otimes \Sigma_u^{-1/2})\mathbf{y} - (Z' \otimes \Sigma_u^{-1/2})\boldsymbol{\beta}\}]\}.$$

The white noise covariance matrix Σ_u is asumed to be known for the moment.

We denote:

$$w := \begin{bmatrix} V_\beta^{-1/2}\beta^* \\ (I_T \otimes \Sigma_u^{-1/2})y \end{bmatrix} \qquad W := \begin{bmatrix} V_\beta^{-1/2} \\ Z' \otimes \Sigma_u^{-1/2} \end{bmatrix}$$

Bayesian Estimation

The exponent can be rewritten:

$$-\frac{1}{2}(w-W\boldsymbol{\beta})'(w-W\boldsymbol{\beta}) = -\frac{1}{2}[(\boldsymbol{\beta}-\bar{\boldsymbol{\beta}})'W'W(\boldsymbol{\beta}-\bar{\boldsymbol{\beta}}) + (w-W\bar{\boldsymbol{\beta}})'(w-W\bar{\boldsymbol{\beta}})]$$

where $\bar{\boldsymbol{\beta}} := (W'W)^{-1}W'w = [\boldsymbol{V_\beta}^{-1}+(ZZ'\otimes\Sigma_u^{-1})]^{-1}[\boldsymbol{V_\beta}^{-1}\boldsymbol{\beta}^*+(Z\otimes\Sigma_u^{-1})\mathbf{y}]$
If $\beta^*=0$ and $V_\beta \neq 0$

The **mean of the posterior distribution** is:
$\bar{\boldsymbol{\beta}} = [\boldsymbol{V_\beta}^{-1}+(ZZ'\otimes\Sigma_u^{-1})]^{-1}(\boldsymbol{V_\beta}^{-1}\boldsymbol{\beta}^* + (Z\otimes\Sigma_u^{-1})\mathbf{y}]$

And the **covariance matrix** is:
$\bar{\Sigma}_{\boldsymbol{\beta}}=[\boldsymbol{V_\beta}^{-1}+(ZZ'\otimes\Sigma_u^{-1})]^{-1}$

2.2 Litterman prior

1. Set the **prior mean of the first lag of each variable equal to one in its own equation and set all other coeficients at zero**. In other words if the prior means were the true parameter values each variable were a random walk.
2. The **prior variances of the intercept terms are infinite** and the prior variance of $\beta_{ij,l}$ the *i,j*-th element of B_l is:

$$v_{ij,l} = \begin{cases} (\lambda/l)^2 & \text{if } i = j, \\ (\lambda\theta\sigma_i/l\sigma_j)^2 & \text{if } i \neq j, \end{cases}$$

- where λ is the prior standard deviation of $\beta_{ii,1}$, 0<θ<1 and σ_i^2 is the *i*-th diagonal element of Σ_u.

2.2 Litterman prior

For a VAR (2) system we have:

$$y_{1t} = \underset{(\infty)}{0} + \underset{(\lambda)}{1 \cdot y_{1,t-1}} + \underset{(\lambda\theta\sigma_1/\sigma_2)}{0 \cdot y_{2,t-1}} + \underset{(\lambda/2)}{0 \cdot y_{1,t-2}} + \underset{(\lambda\theta\sigma_1/2\sigma_2)}{0 \cdot y_{2,t-2}} + u_{1t},$$

$$y_{2t} = \underset{(\infty)}{0} + \underset{(\lambda\theta\sigma_2/\sigma_1)}{0 \cdot y_{1,t-1}} + \underset{(\lambda)}{1 \cdot y_{2,t-1}} + \underset{(\lambda\theta\sigma_2/2\sigma_1)}{0 \cdot y_{1,t-2}} + \underset{(\lambda/2)}{0 \cdot y_{2,t-2}} + u_{2t},$$

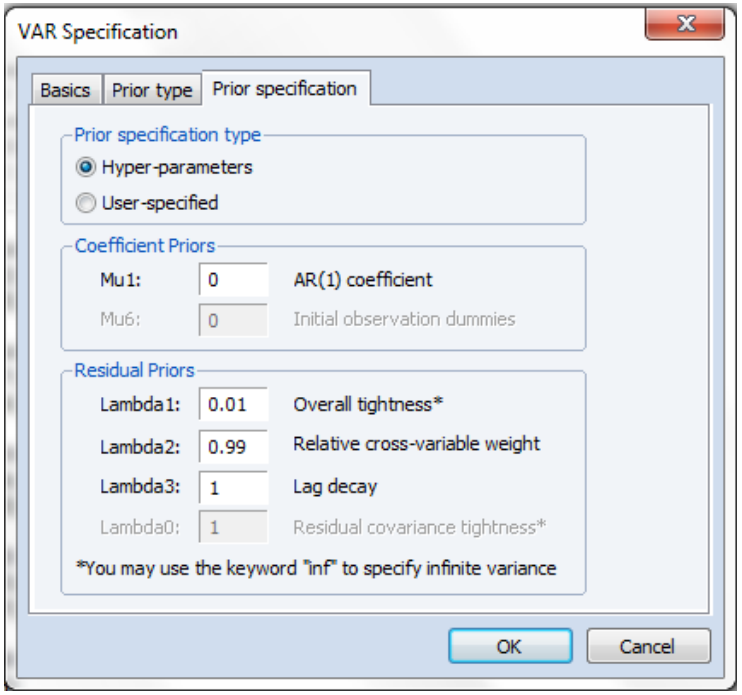
-where all the coefficients are set to their prior means and the numbers in parentheses are their prior standard deviations.

2.2 Litterman prior

$$V_{\beta}^{-1} = \begin{bmatrix} 0 & & & & & & & & \\ & 0 & & & & & & & \\ & & \frac{1}{\lambda^2} & & & & & & \\ & & & \frac{\sigma_1^2}{(\lambda\theta\sigma_2)^2} & & & & & \\ & & & & \frac{\sigma_2^2}{(\lambda\theta\sigma_1)^2} & & & & \\ & & & & & \frac{1}{\lambda^2} & & & \\ & & & & & & \frac{2^2}{\lambda^2} & & \\ & & & & & & & \frac{2^2\sigma_1^2}{(\lambda\theta\sigma_2)^2} & \\ & & & & & & & & \frac{2^2\sigma_2^2}{(\lambda\theta\sigma_1)^2} \\ & & & & & & & & & \frac{2^2}{\lambda^2} \end{bmatrix},$$

To compute $\bar{\beta}$ we need the inversion of $V_{\beta}^{-1} + (ZZ' \otimes \Sigma_u^{-1})$

A BVAR closes in an unrestricted VAR when λ_1 and λ_2 are infinite and to the mean of a prior random walk distribution when the coefficients go to zero.



μ=0 (the prior mean is set to zero for all coeficients);

λ_1=0,01 (λ_1- the parameter **controls the overall prior variance of all VAR coefficients,** a level of 0,01 reduces the prior and sets all coefficients to 0);

λ_2=0,99 (λ_2- **controls the tightness of the variances of the lagged inflation, assets/gdp and yields**. A value close to one means that all coefficients at lag 1 have about the same prior variance except for a scaling factor that takes care of the different variability of different variables)

λ_3=1 (λ_3 – lag lenght)

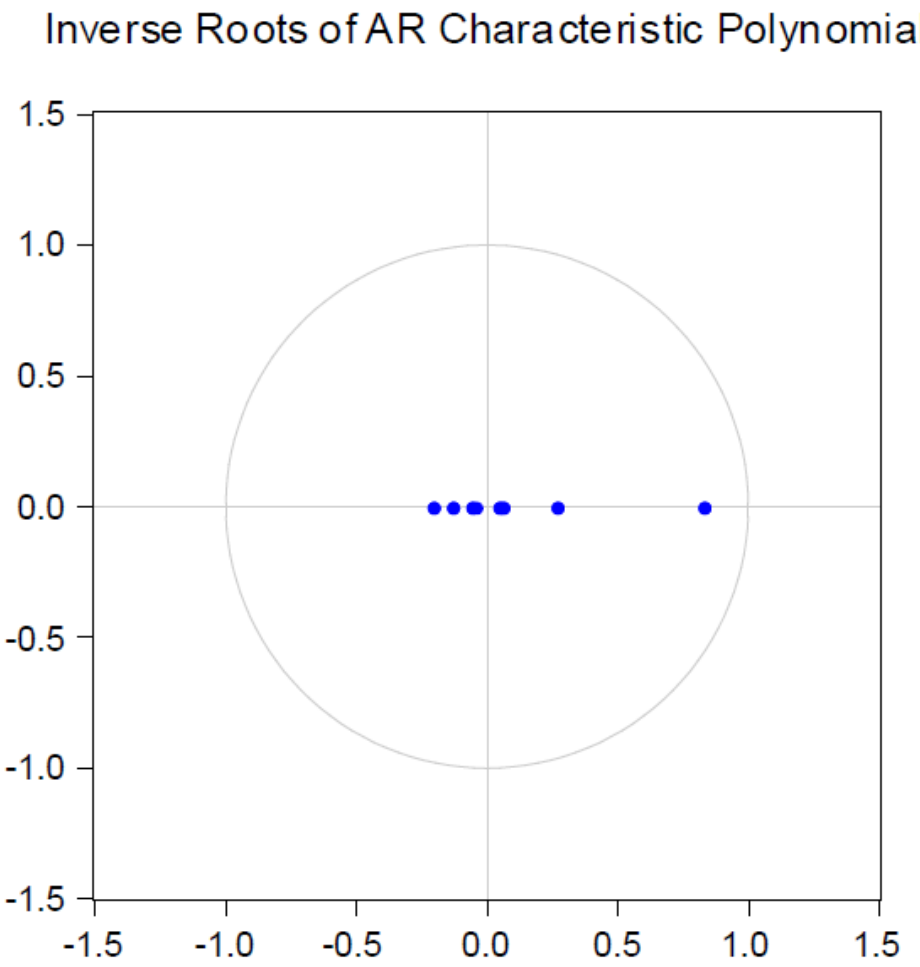
2.3 Lag Order Selection

VAR Lag Order Selection Criteria
Endogenous variables: US LN RGDP US LN CPI US FED TA GDP US 10Y
Exogenous variables: C
Date: 05/23/15 Time: 14:30
Sample: 2009M03 2014M10
Included observations: 68

Lag	LogL	LR	FPE	AIC	SC	HQ
0	536.0301	NA	1.88e-12	-15.64794	-15.51739	-15.59621
1	923.3982	717.7703	3.40e-17	-26.57054	-25.91774*	-26.31188
2	947.8172	42.37413	2.67e-17	-26.81815	-25.64312	-26.35257
3	972.5150	39.95227	2.09e-17	-27.07397	-25.37670	-26.40146*
4	993.9096	32.09192	1.83e-17	-27.23263	-25.01313	-26.35320
5	1014.397	28.32109*	1.67e-17*	-27.36462*	-24.62288	-26.27826
6	1029.910	19.61917	1.80e-17	-27.35029	-24.08631	-26.05700

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

2.4 Model Stability



The inverse roots of the characteristic polynomial are inside the unit circle, are real and less then 1, so the model is stable.

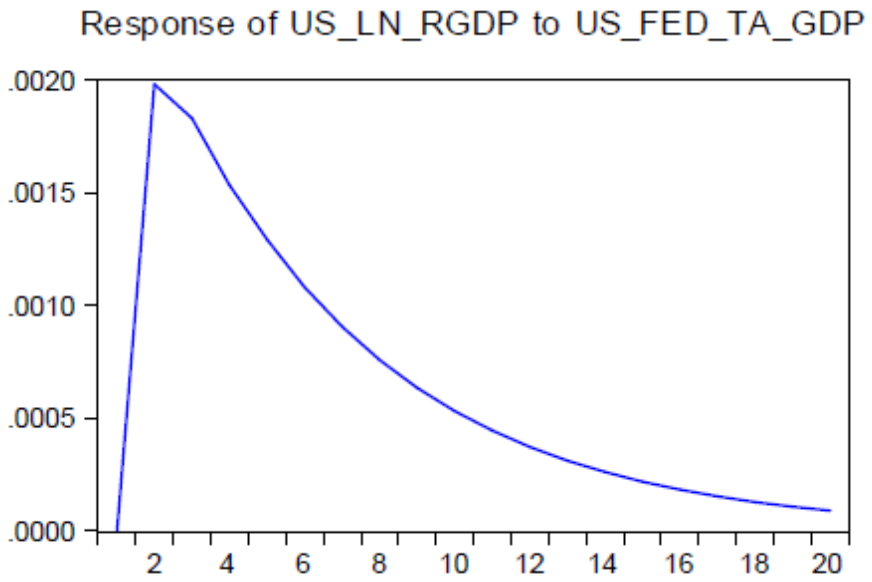
2.5 Variance Decomposition

Variance Decomposition of US_FED_TA_GDP:

Period	S.E.	US_LN_RGD	US_LN_CPI	US_FED_TA	US_10Y
1	0.011594	12.59221	0.979580	86.42821	0.000000
2	0.012512	17.24063	2.577145	80.17326	0.008971
3	0.013144	20.40485	4.273841	75.31256	0.008753
4	0.013549	22.31561	5.530671	72.14048	0.013244
5	0.013826	23.54437	6.383212	70.05481	0.017607
6	0.014017	24.35005	6.953245	68.67582	0.020883
7	0.014149	24.88975	7.337489	67.74959	0.023170
8	0.014240	25.25615	7.598902	67.12020	0.024744
9	0.014304	25.50731	7.778221	66.68864	0.025828
10	0.014349	25.68062	7.901985	66.39081	0.026577
11	0.014380	25.80076	7.987785	66.18435	0.027097
12	0.014402	25.88431	8.047454	66.04078	0.027458

On a short term basis, for example 3 months, an impulse or an innovation or a shock of Fed's assets scaled by the nominal GDP triggers a 20,4% variation of the real GDP and an own shock of 75%.

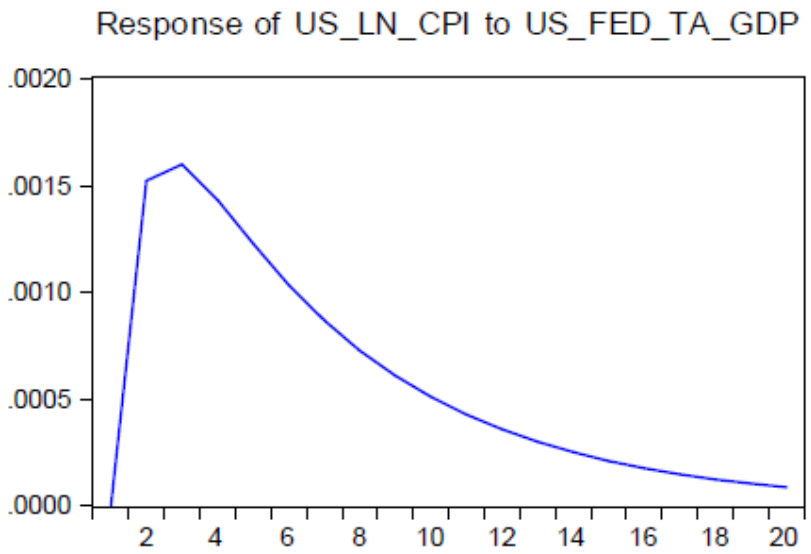
2.6 Cholesky Impulse response one standard deviation of errors



Decomposition of a positive symmetric matrix in a product of a lower triangular matrix and it's transpouse. In eViews it ensures that the error covariance matrix can be transformed in a diagonal matrix.

At a purchase of 1% of nominal GDP, real GDP increases by 0,002%.

2.6 Cholesky Impulse response one standard deviation of errors



At a purchase of 1% of nominal inflation rises by 0,0017%.

Comparison with other studies on the impact of LSAP 1. Differences appear because...

	Baumeister și Benati (2013)	Weale și Wieladek (2015)
Real GDP	**1,08**	**1,61**
CPI	**0,84**	**1,12**

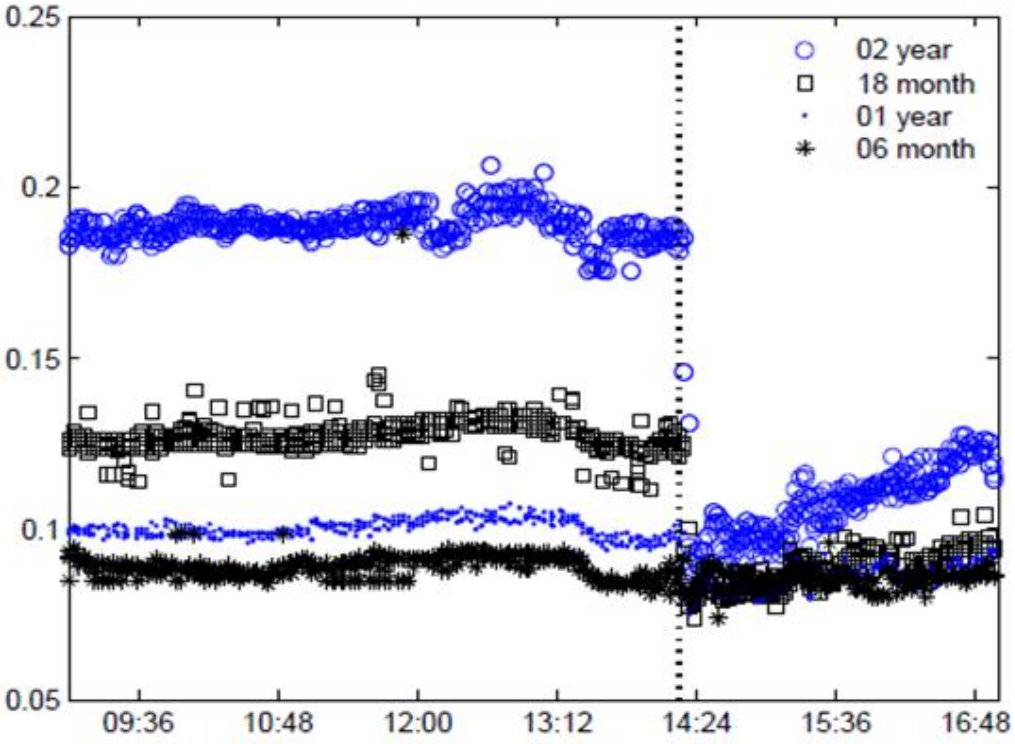
Unlike previous studies, the analyzed period is March 2009 and October 2014, the **whole period the Fed purchased assets**.

The model is left unrestricted beacuse unlike conventional monetary policies it is yet unclear both empirically and theroretical if the real GDP or the inflation sould or should not react to assets purchases (Weale and Wieladek, 2014).

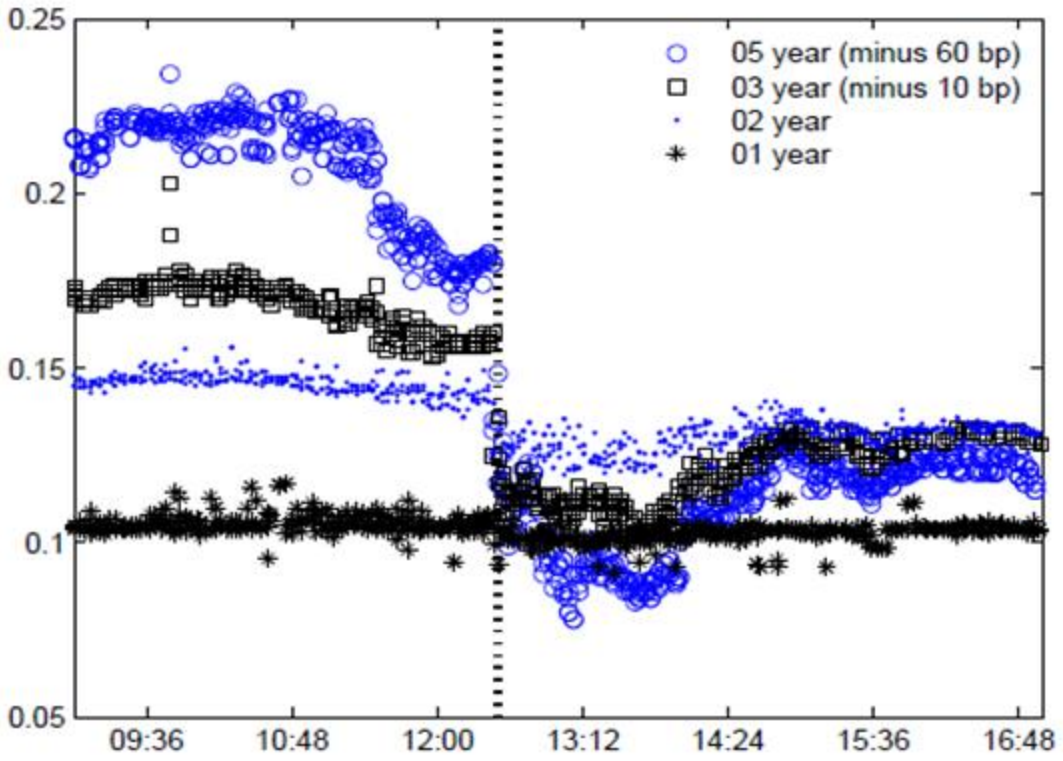
The short time series are an important reason for the lack of studies in this field.

3. FORWARD GUIDANCE (FED)

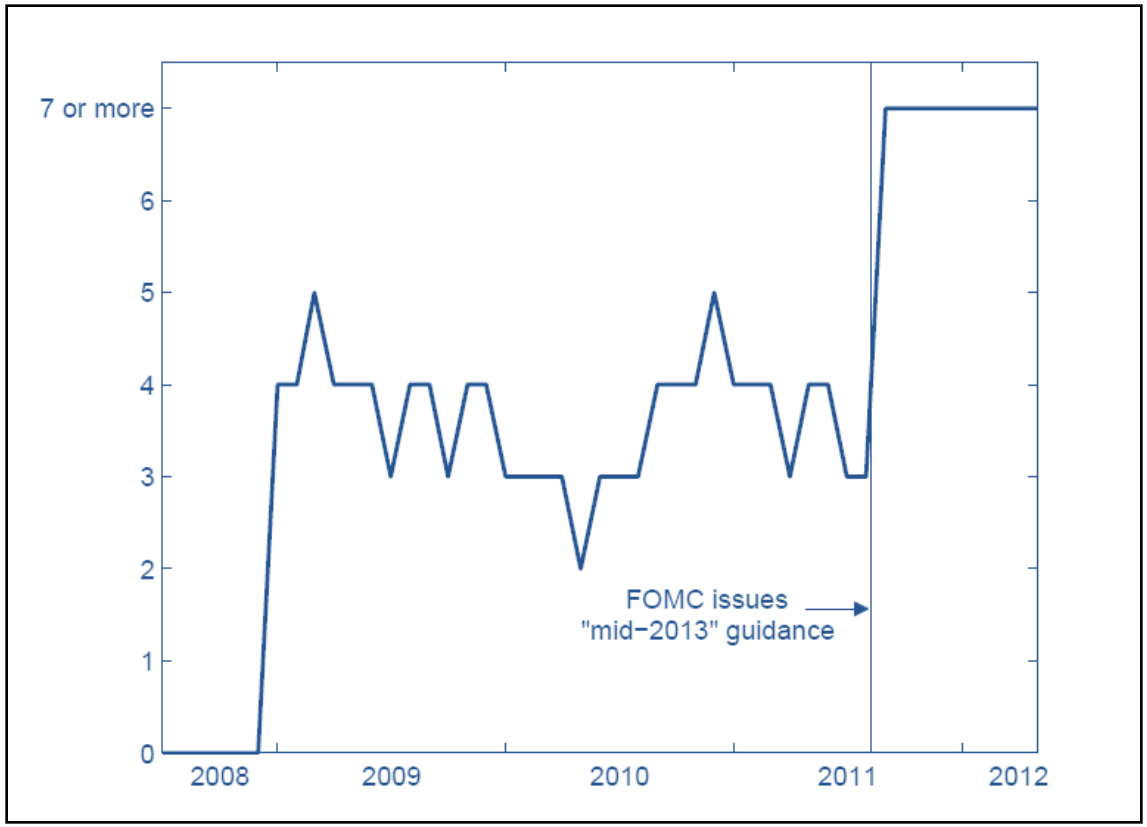
Through "*forward guidance*" the Federal Open Market Committee provides **an indication to households, businesses and investors about the stance of monetary policy expected to prevail in the future** (*federalreserve.gov*).



Intraday US dollar OIS rates on August 9, 2011. The dotted vertical line indicates the time of release of the FOMC statement indicating an expectation that the funds rate target would remain unchanged “at least through mid-2013.”
Source: Woodford, 2012



Intraday US dollar OIS rates on January 25, 2012. The dotted vertical line indicates the time of release of the FOMC statement indicating an expectation that the funds rate target would remain unchanged “at least through late 2014.” *Source: Woodford, 2012*



Median forecast of respondents in the Blue Chip Financial Forecasts survey of the number of quarters until the federal funds rate target will exceed 25 basis points. Vertical line indicates the release of the first FOMC statement indicating continuing accommodation until “mid-2013”.

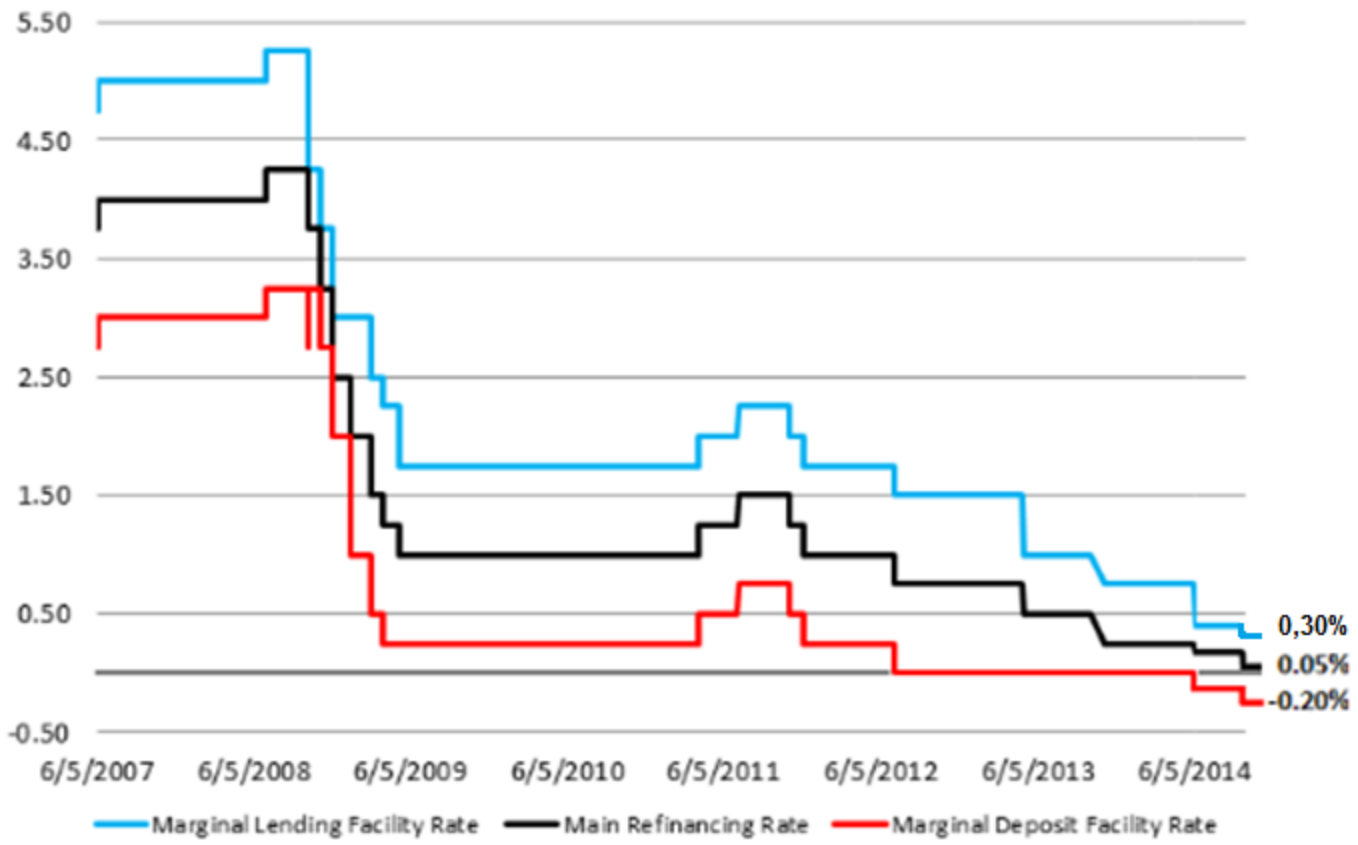
Source: Swanson and Wiliams, 2012

4. THE (NOT SO) UNCONVENTIONAL MONETARY POLICIES OF THE ECB

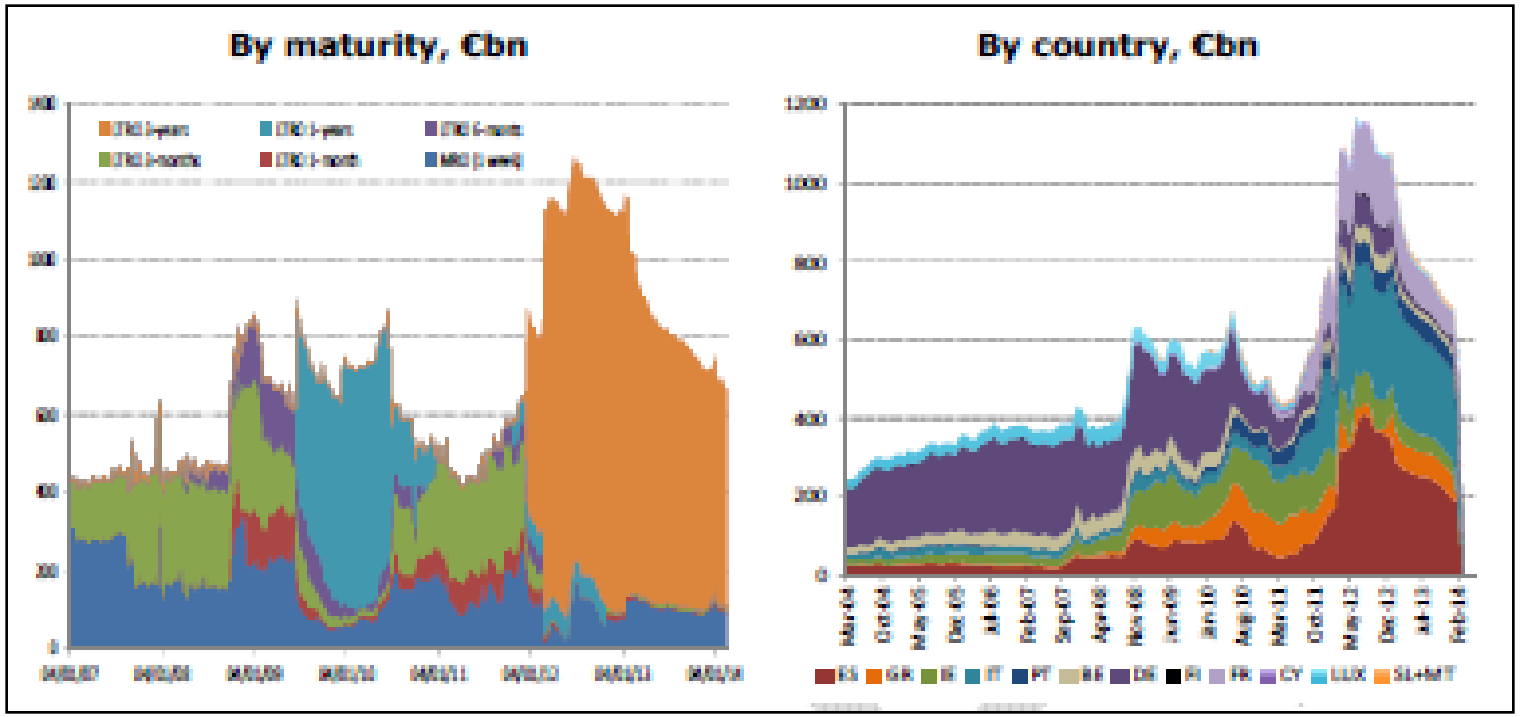
Together with the lowering of the policy rate from 4.25% to 1% between October 2008 and May 2009 (and later down to 0.05% from september 2014), the ECB introduced a number of measures to provide "*enhanced credit support*" to the economy.

Liquidity started to be allocated, through **main refinancing operations** (MRO) and **long-term refinancing operations** (LTRO), at a fixed rate and full-allotment basis, meaning de facto **that banks had unlimited access to central bank liquidity, on the basis of the provision of adequate collateral**.

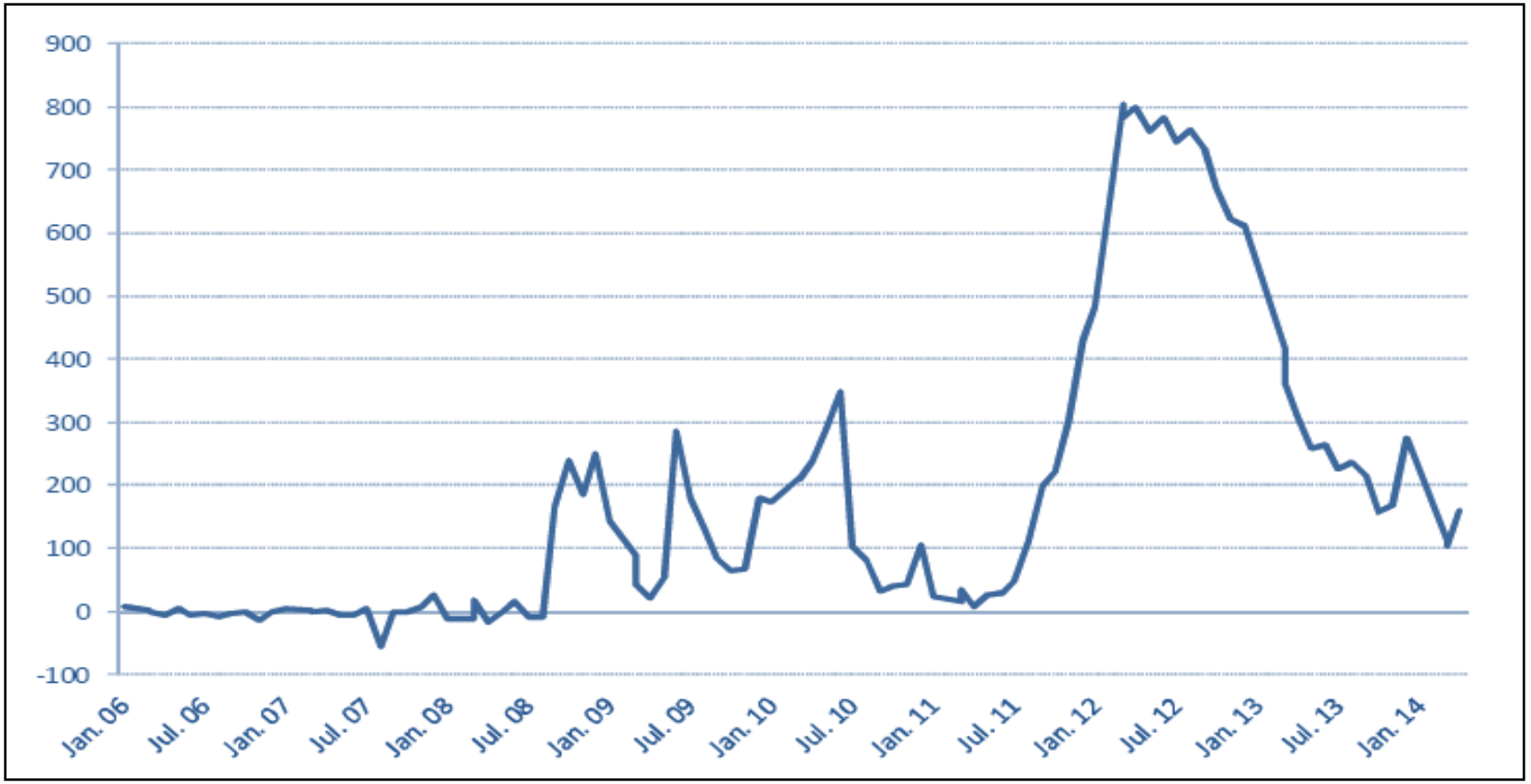
The maturity of LTROs, originally of 3 months, was lengthened, introducing two operations with a maturity of 3 years (in December 2011 and February 2012). The cumulative take-up exceeded €1 trillion. As a consequence, **the maturity of the ECB's balance sheet has lengthened**.



Past key ECB interest rates
Source: ECB



Eurosystem refinancing operations
Source: ECB



Excess liquidity – euro area, in euro bn
Source: ECB

4. THE (NOT SO) UNCONVENTIONAL MONETARY POLICIES OF THE ECB

Under the **Securities Market Programme**, initiated in May 2010, the ECB bought around €220 billion of Greek, Irish, Portuguese, Italian and Spanish government bonds (at present there are €175.5bn of SMP bonds left).

SMP was stopped in September 2012, when the ECB introduced the **Outright Monetary Transactions** (OMT), programme which has never been used. The programme allows the ECB to purchase essentially unlimited amounts of government bonds of member states that are subject to a European Stability Mechanism (ESM) programme. The ECB contends that this policy could be necessary to safeguard "*an appropriate monetary policy transmission and the singleness of the monetary policy*".

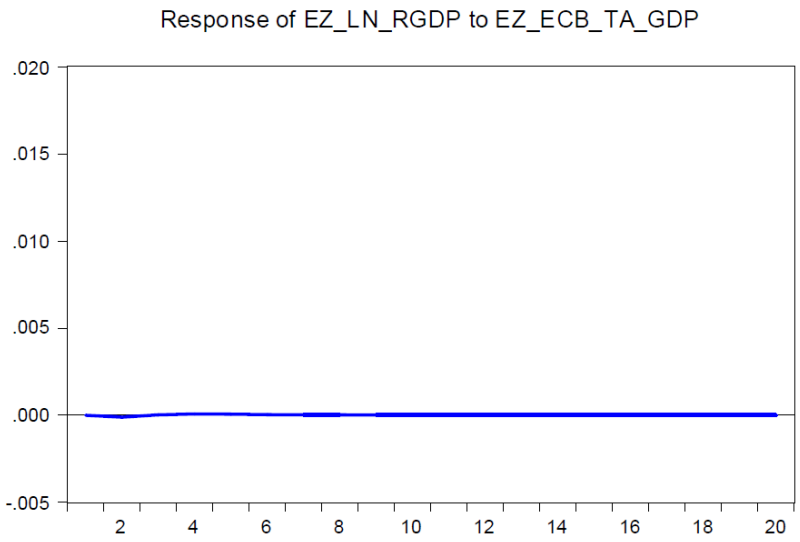
4.1 BACK TO THE MODEL

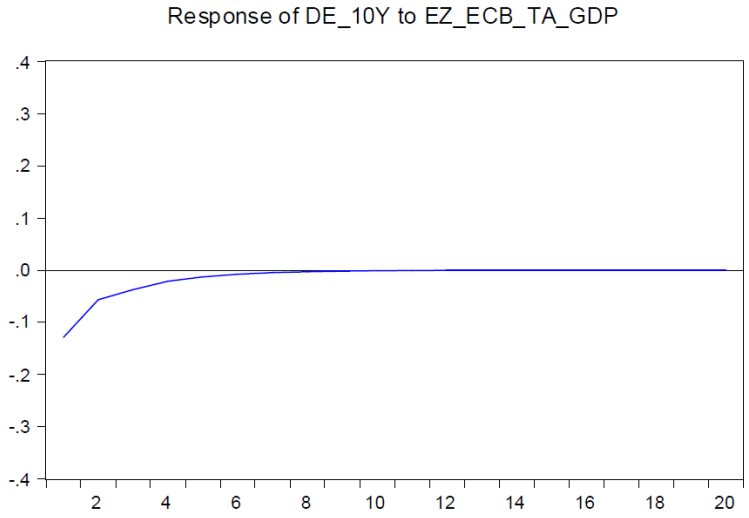
- **ez_ln_rgdp**: Real Gross Domestic Product (logarithm), monthly, *source: http://ec.europa.eu/eurostat*;

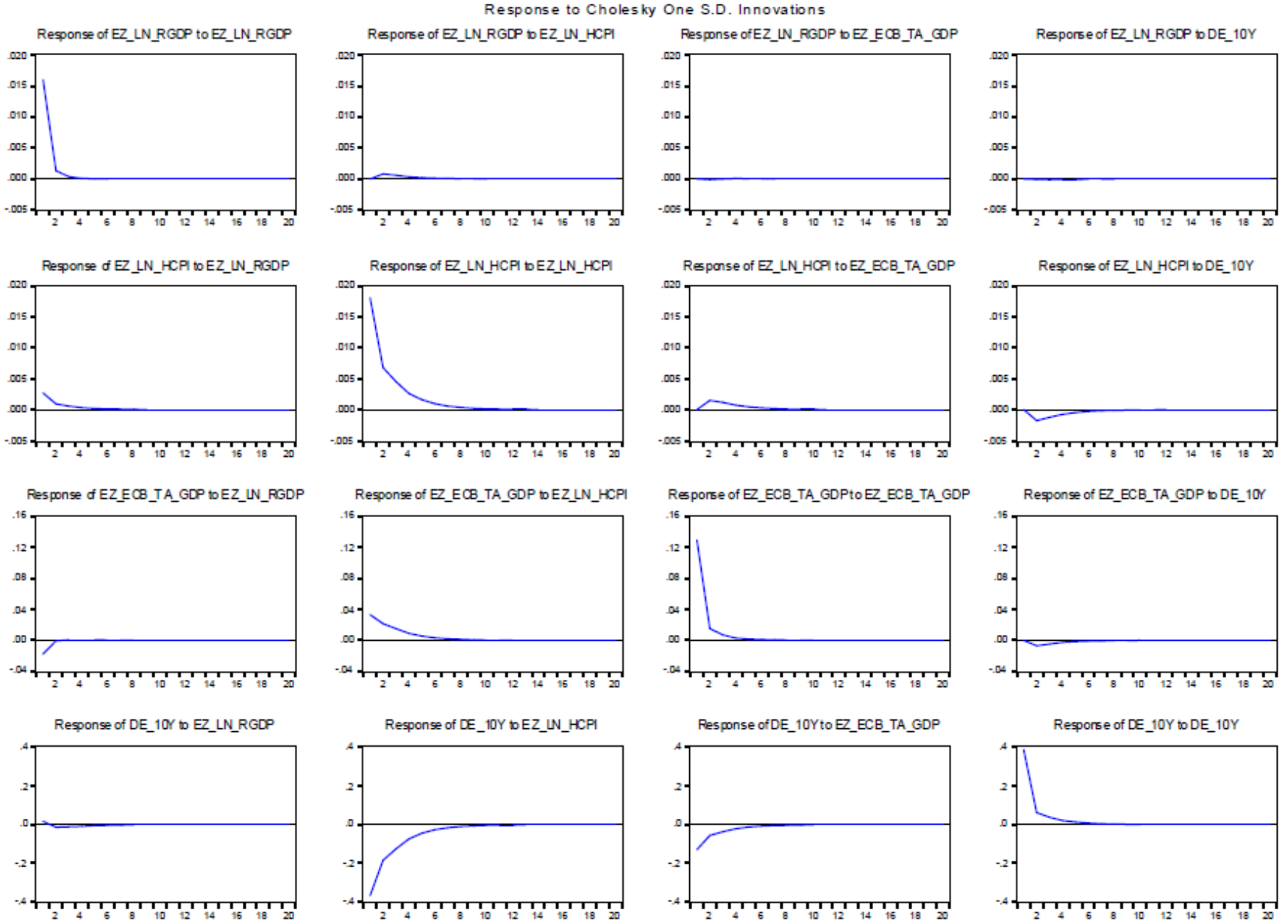
- **ez_ln_hcpi**: Harmonised Consumer Price Index - **HCPI**, (logarithm), monthly, *source: http://ec.europa.eu/eurostat;*

- **ez_ecb_ta_gdp**: total ECB assets scaled by the nominal GDP, monthly, *source: Board of Governors of the Federal Reserve System*;

- **de_10y**: 10 year bunds yields, monthly, *source: Reuters*;


Response of EZ_LN_RGDP to EZ_ECB_TA_GDP
.020
.015
.010
.005
.000
-.005
2
4
6
8
10
12
14
16
18
20


Response of DE_10Y to EZ_ECB_TA_GDP
.4
.3
.2
.1
.0
-.1
-.2
-.3
-.4
2
4
6
8
10
12
14
16
18
20

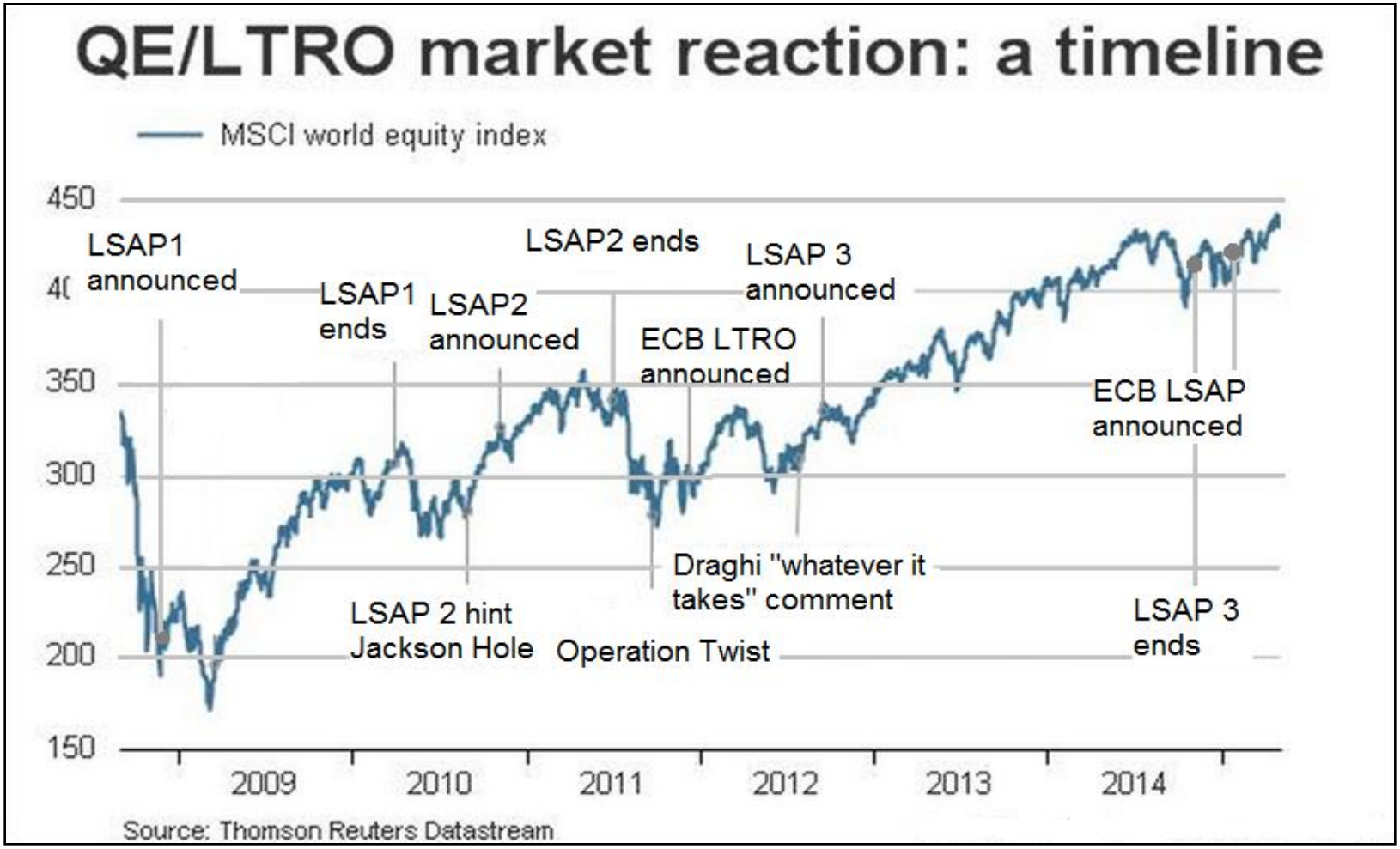

Response to Cholesky One S.D. Innovations
Response of EZ_LN_RGDP to EZ_LN_RGDP
Response of EZ_LN_RGDP to EZ_LN_HCPI
Response of EZ_LN_RGDP to EZ_ECB_TA_GDP
Response of EZ_LN_RGDP to DE_10Y
Response of EZ_LN_HCPI to EZ_LN_RGDP
Response of EZ_LN_HCPI to EZ_LN_HCPI
Response of EZ_LN_HCPI to EZ_ECB_TA_GDP
Response of EZ_LN_HCPI to DE_10Y
Response of EZ_ECB_TA_GDP to EZ_LN_RGDP
Response of EZ_ECB_TA_GDP to EZ_LN_HCPI
Response of EZ_ECB_TA_GDP to EZ_ECB_TA_GDP
Response of EZ_ECB_TA_GDP to DE_10Y
Response of DE_10Y to EZ_LN_RGDP
Response of DE_10Y to EZ_LN_HCPI
Response of DE_10Y to EZ_ECB_TA_GDP
Response of DE_10Y to DE_10Y

5. FORWARD GUIDANCE (ECB)

„*When people talk about the fragility of the euro and the increasing fragility of the euro, and perhaps the crisis of the euro, very often non-euro area member states or leaders,* ***underestimate the amount of political capital that is being invested in the euro****. And so we view this, and I do not think we are unbiased observers, we think the euro is irreversible [..].*

Within our mandate, the ECB is ready to do whatever it takes to preserve the euro. And believe me, it will be enough."

Speech by Mario Draghi, President of the European Central Bank at the Global Investment Conference in London 26 July 2012


QE/LTRO market reaction: a timeline
MSCI world equity index
450
350
300
250
200
150
LSAP1 announced
LSAP1 ends
LSAP2 announced
LSAP2 ends
ECB LTRO announced
LSAP 3 announced
ECB LSAP announced
LSAP 2 hint Jackson Hole
Operation Twist
Draghi "whatever it takes" comment
LSAP 3 ends
2009
2010
2011
2012
2013
2014
Source: Thomson Reuters Datastream

6. EUROPE'S QE QUANDARY

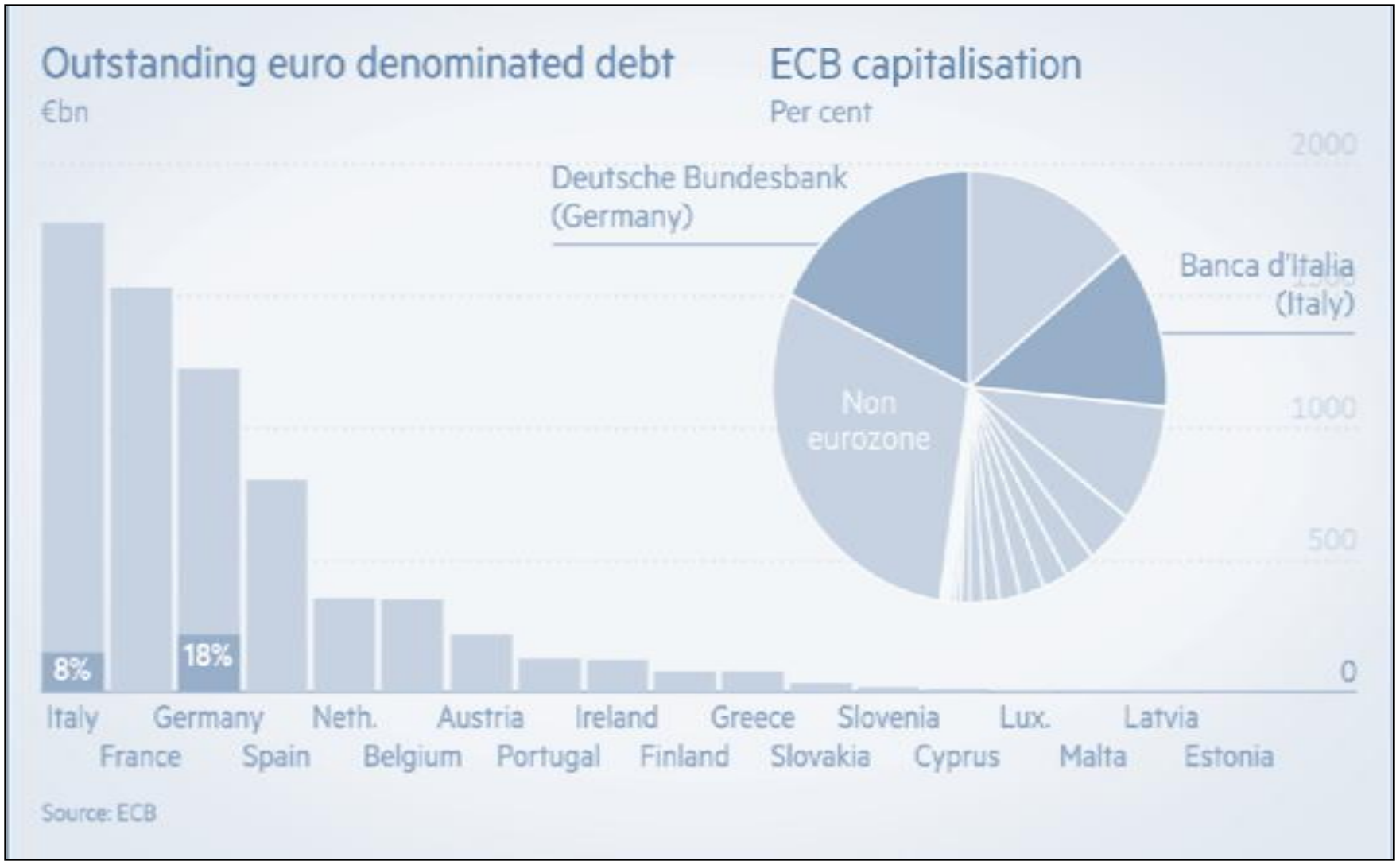
"*The Governing Council of the European Central Bank announced on January 22nd an expanded asset purchase programme aimed at fulfilling the ECB's price stability mandate (addresses the risks of a too prolonged period of low inflation).*

The programme will encompass the asset-backed securities purchase programme (ABSPP) and the covered bond purchase programme (CBPP3), which were both launched in 2014. ***Combined monthly purchases will amount to €60 billion****. They are intended to be carried out until* ***at least September 2016*** *and in any case until the Governing Council sees a sustained adjustment in the path of inflation that is consistent with its aim of achieving inflation rates below, but close to, 2% over the medium term*".

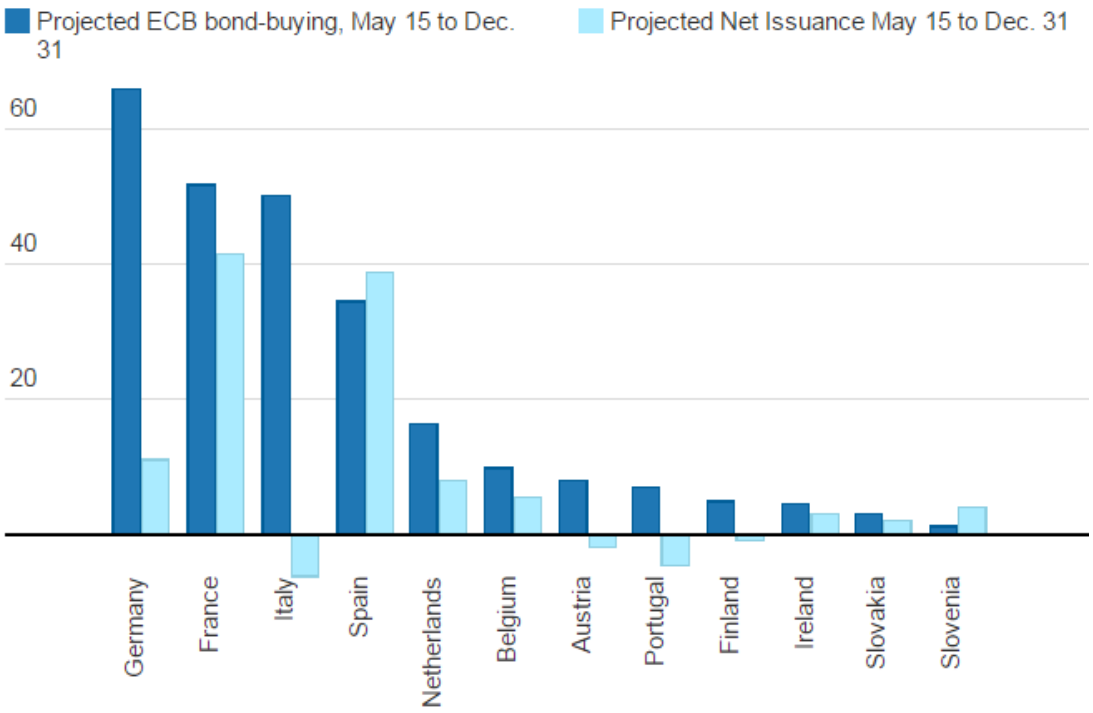
6. EUROPE'S QE QUANDARY

"***The ECB will buy bonds issued by euro area central governments, agencies and European institutions in the secondary market.***

With regard to the sharing of hypothetical losses, the Governing Council decided ***that purchases of securities of European institutions*** *(which will be 12% of the additional asset purchases, and which will be purchased by NCBs)* ***will be subject to loss sharing****.* ***The ECB will hold 8% of the additional asset purchases****. This implies that 20% of the additional asset purchases will be subject to a regime of risk sharing*".


Outstanding euro denominated debt
€bn
ECB capitalisation
Per cent
Deutsche Bundesbank (Germany)
Banca d'Italia (Italy)
Non eurozone
2000
1000
500
0
8%
18%
Italy
Germany
France
Spain
Neth.
Belgium
Austria
Portugal
Ireland
Finland
Greece
Slovakia
Slovenia
Cyprus
Lux.
Malta
Latvia
Estonia
Source: ECB

MORE BUYING THAN SELLING

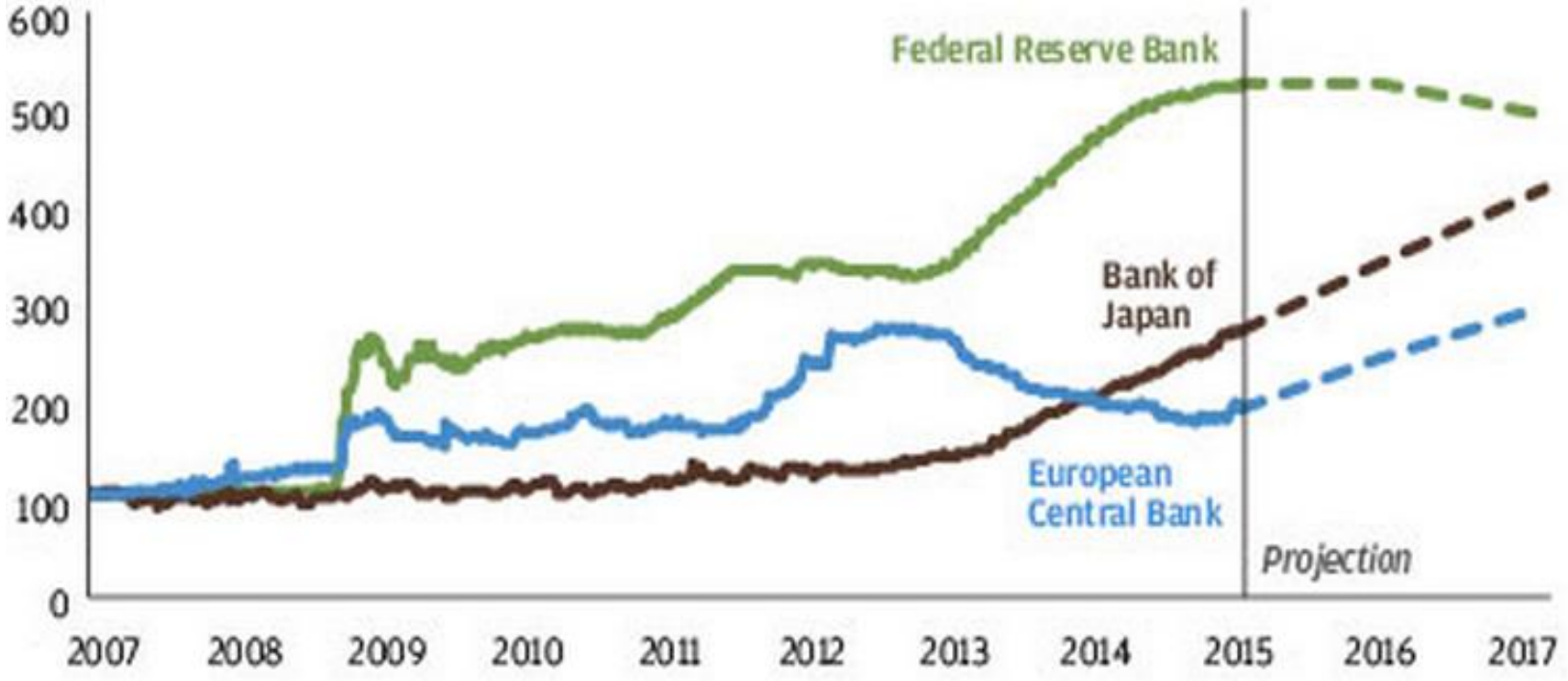


Amounts of bonds the ECB is forecast to buy between May 15 and year-end versus the amount of net bond issuance from selected euro area governments, euro billions. *Source: Deutsche Bank*

Source: European Commission

ECB poised to expand balance sheet by €1.1 trillion

Index (January 2007 = 100)



Source: FRB, ECB, BoJ, J.P. Morgan Private Bank Economics. January 22, 2015.

8. CONCLUSIONS

There is a major interdepency between the 2 unconventional monetary policies: qe and forward guidance. It is extremely difficult to estimate each component's impact but the model shows that if the Fed increases it's assets by 1% of nominal GDP then, the real gdp goes up by 0,002% and inflation by 0,0017%.

The net stimulus to real activity and inflation was limited **by the gradual nature of the changes in policy expectations** (for example, in forward guidance from using „*for some time*" in 2011, to explicit thresholds: below 6,5% unemployment rate in 2013) and term premium effects, as well as by **a persistent belief on the part of the public that the pace of recovery would be much faster than proved to be the case**.

8. CONCLUSIONS

In the wake of a new crisis, rather than taking years to change their perceptions of the FOMC's and ECB's implicit policy rule and their expectations for the likely size of the eventual expansion of the Federal Reserve's and ECB's asset holdings, financial market participants and the public may adjust their expectations immediately.

One can reasonably argue that the major central banks are **likely to have a somewhat greater ability to mitigate the effects of a future crisis than they did at the start of the current one, as long as the public anticipates that they will once again aggressively deploy their unconventional policy tools**.

9. BIBLIOGRAPHY

- **Clayes G**., (2004), The (not so) unconventional monetary Policy of the European Central Bank since 2008, preparated by Policy Department for the Monetary Dialogue discussions in the Economic and Monetary Affairs Committee (ECON)
- **Engen, E., Laubach, T. and Reifschneider, D**. (2015). The Macroeconomic Effects of the Federal Reserve's Unconventional Monetary Policies. Finance and Economics Discussion Series Divisions of Research & Statistics and Monetary
- **Hayashi, F. and Koeda, J.**, (2014). Exiting from QE. NBER.
- **Lütkepohl, H. (2005).** New Introduction to Multiple Time Series Analysis.
- **Swanson, E., and Williams, J.** (2013). Measuring the Efffect of the Zero Lower Bound On Medium- and Longer-Term Interest Rates. Federal Reserve of San Francisco.
- **Weale, M., and Wieladek, T.** (2014). What are the macroeconomic effects of asset purchases? Bank of England.
- **Woodford, M.** (2012). Methods of Policy Accomodation at the Interest-Rate Lower Bound. Columbia University.

THANK YOU!