An Inquiry into the Effects of Quantitative Easing in the European Union

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Abstract:

This paper estimates the effect of the newly introduced quantitative easing policy by the ECB. The effects are measured by introducing an expansionary shock to the ECB's balance sheet in an unrestricted VAR model with the use of impulse response functions. The effects of the low oil prices and pre-crisis data are, furthermore, included. The findings suggest that an expansionary shock will increase inflation, but also has a negative effect on output. In addition, an increase in the oil prices will increase the inflation rate, but has an negative effect on output after a period of twelve months.

Table of contents

1. Introduction

Quantitative Easing (QE), the policy of central banks in which they purchase securities in order to stimulate the monetary base and thus economy, has gained a lot of interest over the years. Especially, since the financial crisis of 2007-09. In 2009, the Federal Reserve (FED) initiated their QE program in order to combat the imposed discipline on credit. Other central banks followed and implemented policies such as QE and the option for banks to borrow money at a discount at the central bank (Fawley & Neely, 2013). Nevertheless, as the Euro Area faced multiple crises, the instrument of QE was never used by the European Central Bank (ECB) until March 2015.

Currently, the Euro area faces the dangers of a below target inflation rate and possibly deflation. The risk of deflation include amongst others, that consumers and companies postpone their investment, since prices will be decreasing in the future, leading to less expenditure and, possibly, economic decline. As the economy is intertwined, reduced expenditure could lead to a stagnation of the economy as agents are more inclined to hold onto their money, due to risky prospects. Another reason for consumers and other economic entities to postpone their investment and consumption originates in the interest rate, i.e. the price of consuming now instead of in the future. QE could possibly increase the willingness to spend as it decreases interest rates.

There is, however, a problem (amongst others) with the ECB's QE policy for several European countries. Due to the decrease in interest rates, considering as well that the current interest rates are at around 0%, countries with a fully funded pension system may not be able to meet their pay out commitments. The low and almost negative interest rate limits the pension funds to properly maintain their yield in order to guarantee a specific pension in the future. The low interest rates, furthermore, take their toll on other financial institutions than pensions systems. Companies, such as banks, will have more trouble with their business operations, since the interest rates for deposit accounts for consumers might have to become negative. Banks need to lower these rates as their profits from lending funds has declined due to the low interest rates.

In order to (partially) determine whether or not the positive effects of the QE are worth the negative effects, such as the low yield for pension systems and banks, this paper will research the effect of QE on other macroeconomic variables. There has been extensive research on QE in other regions. It is, nevertheless, a new phenomenon in the Euro Area. Although there has been some research on the effects of QE within the Euro Area, this papers aims to distinguish itself by using more recent data, oil prices and larger time samples. The analysis will be done by use of a Vector Autoregressive (VAR) model, having the research of Boeckx et al. (2014) as precedent. There will be, furthermore, some additional inquiries into the effects of the low oil price, based on the insights of De Vries and Van Marle (2015), and the effects of different sample sizes. The research question for this paper is:

What for effects has QE on inflation and output in the Euro area and how do oil prices affect these effects?

The paper first introduces a review on previous literature on QE and will then continue to discuss the relevant data, methodology and results, which will be divided into different sections according to the samples used. This paper will end with a discussion of the conclusions, limitations to the research and possibilities for future research. Tables and figures are, furthermore, included in the appendix.

2. Literature Review

The process of Quantitative Easing is initiated by the central banks of the respective economies. Central banks purchase assets, such as government bonds and mortgage backed securities, from dealers and other financial institutions in order to free up more liquidity. The idea is that by purchasing these assets, the markets gain more liquidity so financial institutions have less uncertainty when their short term borrowings mature.

QE can work through three different channels (ten Bosch, 2016): The portfolio balance channel works when banks get more access to liquidity, since they can sell more (government) bonds due to QE, which increases their willingness to provide credit. This in turn stimulates the economy as business and other financial institutions have more access to credit. This induces more investment and consumption, and leads to more inflation. The exchange rate channel works by increasing the amount of money supply in the economy, the domestic currency, subsequently, depreciates with respect to foreign currencies. This causes more foreign demand for domestic goods/services as the relative price for domestic goods/services for foreigners decreases. Since there is more demand for domestic goods, the sellers can sell their products for higher prices which leads to a higher prices level and thus imported inflation. The wealth channel works through the increased value of stock and physical assets. This effect is due to investors adding more stock and physical assets to their portfolios as the yield on bonds has decreased due to the QE. This causes the owners of the respective assets to spend more as their wealth has increased, which in turn creates more demand that leads to a stimulation of the economy and increased inflation.

There has been extensive research on the empirical effects of QE, many of which have contradicting results, implications and predictions. De Vries and Van Marle (2015) have questioned the necessity of QE as measure to stimulate demand and inflation. According to these authors QE can be a powerful tool in combatting the negative effects caused by crises, such as the tough discipline imposed by the system. As, however, the economy is recovering from crises, currently stimulated by the low oil prices, QE can have distortionary effects on the financial markets and government fiscal policies. Such distortionary effects could include the effects of the low interest rates, which causes financial institutions' business models to be under stress. They, furthermore, identify the low inflation rates in Eurozone as not as problematic for the real economy.

Gros, Alcidi and de Groen (2015, p. 21) confirm in their literature review on Japan that the effect of QE on demand and inflation is limited. They state: "The most-cited explanations for this effect are the dysfunctional banking sector, which impairs the functioning of the credit channel, and banks' deleveraging."

On account of the portfolio balance channel, which stimulates commercial banks' lending, Thornton (2014) did not find a statistical significant effect between the 10-year Treasury yield and or the term premium and the ten different public debt supply measures in the US. The channel operates through reducing the public debt supply, and thereby effectively creating more market liquidity. He concludes that there exists no empirical support that QE has reduced long-term yields or flattened the yield curve as it should have. Gagnon et al. (2010), however, did find a significant effect of reducing the net supply of assets with a long duration on 10-year premium. The effect was most notable in the mortgage backed securities market. These implications from the US should question the effects that the portfolio balance channel could have on the Eurozone, as they are contradicting one another.

In case of the US, Baumeister and Benati (2012) find positive effects of QE1 on inflation, real output and employment. They estimate that without the unconventional monetary policies of the FED, the economy of the US would have suffered from deflation at 1 percent, a lower real output of 0.9 percent and 0.75 percentage point higher unemployment. Similar results have been found by Chung (2011) et al. according to their model simulations unemployment would have been 1.5 percentage points higher and that QE has prevented deflation. The difference in results could be due to the use of the Fed model and the DSGE model by Chung et al. while Baumeister et al. used a structural VAR.

In the case of the UK, Baumeister and Benati (2012) also find a positive of effect from the implementation of unconventional monetary policy. Their model suggests that without quantitative easing inflation and output growth would have been minus 4 percent and minus 12 percent in the first quarter of 2009.

Following the previous mentioned findings from the literature it can be concluded that QE was effective in combatting the negative effects from the Financial Crisis of 2007-09. The question remains, however, what the effects of the newly implemented QE from the ECB in March 2015 and its limited enlargement in December 2015 will be. De Vries and Van Marle already questioned its need in a recovering economy. Boeckx et al. (2015) predicted in 2015 with the use of the VAR model, which was also used by most of the previous mentioned literature, that the new Public Sector Purchasing Program (PSPP) could stimulate economic growth at around 1 percent and stimulate inflation back to its target rate around 2 percent. This remains, nevertheless, a prediction and makes one wonder whether current data supports it. Gros, Alcidi and de Groen (2015) also stress the need for the QE in the Eurozone, but mainly for the financial markets. They question, however, the impact on the real economy and predict that it will be hard to disentangle the effects from QE from the effects of the oil price. They, furthermore, underline the role of the national debt offices of the participating countries, since the large fiscal deficits financed by the issuance of debt will affect long-term interest rates.

3. Data section

3.1. Data samples comparing to Boeckx

In order to determine whether or not QE has had positive effects on the economy of the Euro area, i.e. assess whether or not Boeckx's forecast was accurate, this paper constructs unrestricted VAR models. These models are based on the six variables used in Boeckx his analysis. By using the same variables as Boeckx used, this paper can compare the respective results of both papers to a larger extend. As an alternative one could use different macroeconomic variables to capture the effects within the economy or financial variables to measure the effects on the financial markets. These variables include the log of seasonally adjusted real output, the log of seasonally adjusted consumer prices, the log of central bank total assets, the level of financial stress as measured by the Composite Indicator of Systemic Stress (CISS), the spread between Euro Over Night Index Average (EONIA) and the Main Refinancing Operations (MRO) rate, and MRO policy rate. The data used in the model consists of monthly samples retrieved from the ECB Statistical Data Warehouse and Eurostat, over a sample period from 2008 till 2016. As Boeckx published his paper in 2014, two analyses will be made. The first one from 2008 till 2014 will be used to compare the results with those from Boeckx. The second one will incorporate the data from 2014 and 2015 in order to extend the analysis over the new time period.

The log of the seasonally adjusted real output of the EA-19, the current nineteen members of the Euro Area, is included as one of the main macroeconomic variables. As the data is published quarterly, interpolation for the real output was needed in order to measure the monthly changes. This was done with the use of Chow-Lin interpolation, with as indicator monthly industrial production. Together with the log of the seasonally adjusted consumer prices, the real output captures the economic developments of the model. The Composite Indicator of Systemic Stress (CISS) captures the financial stress during the sample, by summarizing the information on the financial market. As it is measured and composed weekly, the data has been interpolated to monthly data by taking the average of the respective month. The Euro Over Night Index Average (EONIA) is the interbank rate for the euro area and captures the daily interest rate differentials. As it consist of daily data it has also been interpolated to monthly data by taking its average rate. The Main Refinancing Operations (MRO) policy rate is the rate set by the ECB at which financial institutions can lend freely. This rate has also been interpolated to fit the monthly data sample. The spread between the EONIA rate and the MRO rate captures the premium financial institutions have to pay when they lend from the ECB. At last, the ECB's total assets measures the impact of QE as it increases its balance sheet. The ECB purchases large amounts of assets, government bonds or other securities, in order to provide liquidity to the financial markets. These securities are then displayed on the ECB balance sheet.

Tables 1 and 2 provide the descriptive statistics of the variables used in the two post-crisis sample periods. The CISS indicator increases whenever more systematic stress exists in the economy. The EONIA-MRO spread, furthermore, is mostly negative as the interbank lending rate is usually lower than the MRO policy rate, as the MRO rate is the rate at which financial institutions can lend freely.

Table 1. Descriptive statistics 2008m1-2013m12

	CISS	**Consumer prices log**	**ECB balance sheet log**	**EONIA-MRO Spread**	**Output Log**	**MRO policy rate**
Mean	0.350069	4.553605	14.55416	-0.444898	13.59921	1.479167
Median	0.352763	4.544197	14.49360	-0.491368	13.60433	1.000000
Maximum	0.778375	4.606270	14.94356	0.069783	13.63361	4.250000
Minimum	0.033150	4.497696	14.09412	-0.742900	13.55431	0.250000
Std. Dev.	0.199835	0.033474	0.232703	0.220800	0.023471	1.188079
Observations	72	72	72	72	72	72

Table 2. Descriptive statistics 2008m1-2015m12

	CISS	**Consumer prices log**	**ECB balance sheet log**	**EONIA-MRO Spread**	**output Log**	**MRO policy rate**
Mean	0.288059	4.566452	14.57453	-0.361163	13.61396	1.135417
Median	0.253030	4.572647	14.54496	-0.357128	13.61547	1.000000
Maximum	0.778375	4.611252	14.94356	0.069783	13.68226	4.250000
Minimum	0.033150	4.497696	14.09412	-0.742900	13.55431	0.050000
Std. Dev.	0.204323	0.036673	0.210004	0.242236	0.033623	1.189470
Observations	96	96	96	96	96	96

3.2. Data samples including pre-crisis and oil prices data

In addition to the previous data samples, this paper also uses pre-crisis data samples, in order to understand the effects of adding pre-crisis data. Oil prices are, furthermore, added to the analysis to research whether the low oil prices could cause economic recovery instead of QE. These samples, including oil price data, are also retrieved from the ECB Statistical Data Warehouse and Eurostat. The sample range is from January 2000 till December 2015. The oil prices are reported on a monthly basis and thus do not require any interpolation. Tables 3 and 4 provide the descriptive statistics of the additional sample period and oil prices.

Table 3. Descriptive statistics 2000m1-2015m12

	CISS	**Consumer prices log**	**ECB balance sheet log**	**EONIA-MRO Spread**	**output Log**	**MRO policy rate**
Mean	0.204947	4.487031	14.14624	-0.726681	14.61445	2.673177
Median	0.129360	4.499475	14.10465	-0.552750	14.66091	4.250000
Maximum	0.778375	4.611252	14.94328	0.814211	14.78982	4.250000
Minimum	0.033900	4.317221	13.54276	-2.277000	14.34490	0.050000
Std. Dev.	0.172051	0.091076	0.468507	0.794527	0.120635	1.759565
Observations	192	192	192	192	192	192

Table 4. Descriptive statistics 2000m1-2015m12 including oil prices

	CISS	**Consumer prices log**	**ECB balance sheet log**	**EONIA-MRO Spread**	**output Log**	**MRO policy rate**	**Oil prices log**
Mean	0.204947	4.487031	14.14624	-0.726681	14.61445	2.673177	4.506486
Median	0.129360	4.499475	14.10465	-0.552750	14.66091	4.250000	4.528881
Maximum	0.778375	4.611252	14.94328	0.814211	14.78982	4.250000	5.003409
Minimum	0.033900	4.317221	13.54276	-2.277000	14.34490	0.050000	3.969159
Std. Dev.	0.172051	0.091076	0.468507	0.794527	0.120635	1.759565	0.319631
Observations	192	192	192	192	192	192	192

4. Methodology

4.1 Methodology on Boeckx samples 2008-2013 and 2008-2015

The first part of the methodology consists of using the data sample that was used by Boeckx, in order to determine whether or not this paper can verify Boeckx analysis. Since Boeckx used a more sophisticated method, a Structured VAR, to make his predictions, some differences are bound to exist. It is, however, interesting to investigate whether or not the tendencies of the variables are similar.

In order to get an overview on the effects of different variables on one another, Autoregressive Distributed Lag (ARDL) models for each variable are constructed. This will provide significant coefficients in order to isolate the relationship between them. Contemporaneous effects are assumed to be non-existent, since including them in the VAR would be beyond the scope of this paper. The non-significant coefficients that are removed from the ARDL models are, furthermore, not removed in the VAR as this leaves the scope from an unrestricted VAR as well.

The unrestricted VAR model that is used in this paper for both data samples is represented below in matrix form. It is derived with the use of the econometric textbook from Verbeek (2004).

$$X_t = \beta_0 + \beta_1 X_{t-1} + \beta_2 X_{t-2} + \beta_3 X_{t-3} + \beta_4 X_{t-4} + u_t$$

$$X_t = \begin{pmatrix} X_{1,t} \\ X_{2,t} \\ X_{3,t} \\ X_{4,t} \\ X_{5,t} \\ X_{6,t} \end{pmatrix}$$

X_t denotes the matrix form of the variables used while β_n denotes the coefficients of the respective variables in matrix form. X_1 specifies the CISS, X_2 the log of consumer prices, X_3 the ECB's total assets, X_4 the EONIA-MRO spread, X_5 the log of real output and X_6 the MRO policy rate. ε denotes the respective error term for the dependent variable. The Schwartz criterion, used to determine the optimal amount of lags, recommends the use one lag. For the both data samples, however, the models include four lags, as Boeckx used four lags in his model. In order to stay closer to his original analysis the amount of lags is adjusted. This also provides more sophisticated impulse response functions. The difference between both models is within the time frame of the samples that are used.

Additionally, another model is, however, included to see the results of the use of one lag. This model, using the same variables, is represented in matrix form as such:

$$X_t = \beta_0 + \beta_1 X_{t-1} + u_t$$

$$X_t = \begin{pmatrix} X_{1,t} \\ X_{2,t} \\ X_{3,t} \\ X_{4,t} \\ X_{5,t} \\ X_{6,t} \end{pmatrix}$$

With the use of the VAR one can use impulse response functions to measure the response of $Y_{j.t+s}$ to an impulse in $Y_{1,t}$, while keeping all the other variables dated from t and before constant. This allows measurement of shocks to specific variables in order to understand their relationship. These functions can then be used to compare the model with the model Boeckx used in this paper. This papers simulates an exogenous impulse to the log of the ECB's balance sheet, since QE increases a central bank's balance sheet due to the procurement of government shares and other assets. Boeckx used the same method and in order to compare the impulse response functions, the same impulse of one standard deviation will be used over a period of 24 months

4.2 Methodology on the pre-crisis sample 2000-2015 and 2000-2015 with oil prices

For the 2000-2015 sample which excludes oil prices a similar model to the models of samples 2008-2013 and 2008-2015 is used, including four lags and the same variables. Impulse response functions are also constructed in order to measure the shock to ECB's balance sheet. This allows for a better comparison between the different sample sizes and thus the impact of pre-crisis data can be observed.

For the 2000-2015 sample which includes oil prices the model is slightly changed. It is represented below in matrix form:

$$X_t = \beta_0 + \beta_1 X_{t-1} + \beta_2 X_{t-2} + \beta_3 X_{t-3} + \beta_4 X_{t-4} + u_t$$

$$X_t = \begin{pmatrix} X_{1,t} \\ X_{2,t} \\ X_{3,t} \\ X_{4,t} \\ X_{5,t} \\ X_{6,t} \\ X_{7,t} \end{pmatrix}$$

X_t denotes the matrix form of the variables used while β_n denotes the coefficients of the respective variables in matrix form. X_1 specifies the log of output, X_2 the log of consumer prices, X_3 the CISS, X_4 the log of ECB's total assets, X_5 the EONIA-MRO spread, X_6 the MRO policy rate and X_7 the log of oil prices. ε denotes the respective error term for the dependent variable. The impulse response functions in this model will respond to a one standard deviation in the log of oil prices. This allows for comparison between the effects QE and the low oil price.

5. Results

5.1 ARDL(1) respresentation

In table 5 the ARDL(1) models for the different variables are represented.

Table 5. ARDL(1) estimations of the coefficients, sample 2008-2015

Dependent variable =>	**CISS**	**Prices log**	**ECB total assets log**	**EONIA-MRO spread**	**Output log**	**MRO policy rate**
CISS(-1)	0.972937** (0.029875)		0.088311** (0.028025)			-0.577591** (0.135304)
Prices log(-1)		0.896492** (0.027198)		3.630601** (0.825767)		-2.803858** (0.704911)
ECB total assets log(-1)			0.948062** (0.021251)	-0.463587** (0.107161)	-0.008893** (0.002971)	
EONIA-MRO spread(-1)	0.057086* (0.028798)	-0.007992** (0.002643)		0.683919** (0.061244)	-0.005098** (0.001865)	-0.114746” (0.061801)
Output log(-1)	0.001824* (0.000752)	0.115881** (0.033322)	0.616078** (0.181056)	-0.732103** (0.218817)	1.009607** (0.003180)	0.948485** (0.238262)
MRO policy rate (-1)				0.025726” (0.014248)	-0.001902** (0.000438)	0.975803** (0.017908)
Constant		-1.106642** (0.348504)	-7.647914** (2.395956)			
R-Squared	0.925354	0.982951	0.966897	0.830805	0.987594	0.990333
Adjusted R-Squared	0.923731	0.982389	0.965806	0.823285	0.987185	0.989903
S.E. of regression	0.056530	0.004800	0.037937	0.102206	0.003822	0.115691
Durbin-Watson stat	1.657696	1.932750	1.715957	2.044316	2.495672	1.506280
observations	95	95	95	95	95	95

“, *, **: Significant at 10%, 5% and 1% level, respectively.

For each model, the lagged variable of the response variable has the largest coefficient, and usually the largest t-value. The coefficients that significantly contribute to the CISS seem to be the EONIA-MRO spread and output. Which makes sense since the EONIA-MRO spread measures the difference between the interbank rate and the policy rate. If a large difference exists, which is usually negative since banks will opt for the lower rate, the negative EONIA-MRO spread will indicate a low level of systematic stress as the ECB has not made liquidity more readily available, i.e. reducing the policy rate. The MRO policy rate might not be significant because it is already included in the spread and the difference between both rates might be a better indicator. It is, however, peculiar that the level of output has a positive effect on stress. This might be due to bubbles, which increase output before collapsing. It is, furthermore, interesting to see that the ECB’s balance sheet coefficient is not significant since Boeckx identified a clear relationship between the two variables. This might be due to the implementation of QE as it was introduced in a period of relatively low systematic stress.

The consumer prices appear to respond to output and the spread between the EONIA and MRO rate. Output has a positive effect, which is to be expected according to the wage-price spiral theory. As the demand for goods increases, its prices increases as well, leading to demand for higher wages, which further increase prices. A lower EONIA-MRO spread indicates more liquidity issues on the money markets, indicating periods of crises, which indicate a smaller demand for goods and thus affect prices negatively. It is, however, peculiar that the balance sheet does not affect prices directly. There might, nevertheless, be an indirect effect through the other variables that could increase the price level as theory suggests.

The ECB’s balance sheet is affected largely by output and the CISS. The CISS’ positive effect on the balance sheet can be explained by the interventions the ECB takes whenever the financial system is in peril, thus resulting in a positive relationship. The positive relationship between output and the balance sheet might be due to the recent QE policy, which increased the ECB’s balance sheet while output was increasing.

For the EONIA-MRO spread the consumer prices, ECB’s balance sheet and output have an significant effect. Higher consumer prices indicate economic recovery and correspond to a larger spread. The balance sheet indicates interventions which are necessary in times of crises thus resulting in a lower spread. The negative relationship between output and the EONIA-MRO spread might be due to the low spread in the recent year while economic growth did recover.

Output is affected by the balance sheet, the EONIA-MRO spread and the MRO policy rate. The balance sheet suggests the negative relationship between output and the need for intervention in times of crises. The effect appears to be rather small, however, which might be due to the recent QE policy. The spread’s and MRO’s effects are also relatively small, which might be due to the low rates in 2014 and 2015, while output was increasing. The lagged coefficient of output is, however, larger than one, which might signify a random walk, so caution is advised when interpreting this coefficient.

For the MRO policy rate, the CISS, consumer prices and output have an significant positive effect. A higher CISS suggests more systematic stress, indicating the need for a lower policy rate to ensure liquidity on the financial markets. Lower consumer prices indicate a period of relatively low demand, which are characteristic for crises, resulting in the same lower policy rate for the financial markets. Vis-à-vis, higher output indicates a higher demand and thus a higher policy rate.

5.2 VAR(4) 2008-2013

The VAR(4) model for the sample period 2008-2013 is used to compare the results of Boeckx with those from this paper. His impulse response functions are denoted in the appendix as well as this paper's functions. Boeckx's functions include margins of error as 16th and 84th percentiles of the posterior distribution, whereas this paper's impulse response functions show margins of error of two standard errors. There are, furthermore, differences in the y-axis scale which have to be taken into account, as the scale is in logarithmic levels for output, consumer prices and the balance sheet one should multiply by one hundred for the respective variables. Output, consumer prices and the balance sheet are given in levels so the scale implies a percentage increase, whereas for the other variables the increases are absolute. When comparing the two different impulse response functions there are some clear differences, which will be discussed now.

For output the most crucial difference can be found as output decreases at first and then after 12 months increases with a one standard deviation innovation in the ECB's balance sheet, whereas Boeckx predicts an increase followed by a decrease after 21 months. According to our previous OLS estimations of the coefficients, the ECB's balance sheet has a negative effect on output. Only after several periods the positive effects of other variables starts to have a more positive effect.

The consumer prices show a more similar trend with respect to Boeckx's impulse response functions. Apart from a bit more variation in the first few months, they follow a similar trend on a similar scale. For the CISS, however, our model predicts an increase in stress at first and then a large decline, quite the opposite of Boeckx's CISS. For the ECB's balance sheet there is similar trend by starting of very positively and then becoming negative. The EONIA-MRO spread also shows similar tendencies, by going down first and then recovering. In Boeckx's analysis, however, it also becomes positive. At last, the MRO-policy rate shows a strong decline in the first few months and then recovers to zero, which is in contrast with Boeckx's MRO rate. It is interesting that Boeckx's MRO rate actually increases after the increase in the balance sheet since it normally causes a decrease in the interest rates, as QE makes credit more available just as a lower rate would.

5.3 VAR(4) sample 2008-2015

As for the impulse response functions corresponding to the VAR(4) model with the 2008-2015 data sample, there not many differences compared to the model from 2008-2015. Some effects change their strengths but overall does including the new data have a minimal effect. The accumulated effects are displayed in graph 4. The most important effects display a 1.4 percentage decrease in real output and a 1.3 percentage increase in consumer prices over a period of 24 months. The ECB's balance sheet will, furthermore, increase by twenty percent, while the MRO policy rate decreases by 0.5 percentage point. The decrease in output is a peculiar finding as expansionary monetary policies, through the exchange rate channel, usually cause a depreciation improving an economy's competitiveness. It could, however, be that due to more expensive imports that output growth could decrease. The increase in consumer prices, nevertheless, conforms monetary theory, since the money supply has increased and more inflation is imported, because of more expensive imports. There is, however, the issue with the MRO policy rate, which declines after an increase in the ECB's balance sheet, that could harm pension funds and other financial institutions even more.

5.4 VAR(1) sample 2008-2015

The impulse response functions resulting from the VAR(1) model for the 2008-2015 sample are quite similar to the VAR(4) model with sample 2008-2015. This would be in the line of expectation as the same data is used to construct them. The difference in form is due to the amount of lags used, as the VAR(1) model's impulse response functions are much smoother than the VAR(4)'s. For the output the trend is similar, and thus opposite to Boeckx. The response of output remains negative, however, for 24 months. For the CISS, the pattern is also similar to the VAR(4) but it has a smaller effect since the magnitude is lower. The largest difference can be found in the response of the MRO, as it is moving around zero, whereas the VAR(4) shows a clear negative response. The responses for the prices, the ECB's total assets and the EONIA-MRO spread do not differ to a large extend from the VAR(4) model's responses.

5.5 VAR(4) sample 2000-2015

For the VAR(4) with 2000-2015 sample there exist some differences in comparison to the VAR(4) model with sample 2008-2015. With respect to the impulse response functions, for output there seems to be a much smaller negative effect, which transitions to a positive effect after twelve months. The overall effect on output is, furthermore, relatively small. This might be due to the relatively small balance sheet of the ECB before the financial crisis, since the ECB did not intervene as much as it did after. For the effect on prices there is a decline in the first few months after which it recovers to a positive effect, similar to the other models. The CISS also behaves about the same as the CISS from the VAR(4) with sample 2008-2015. The EONIA-MRO spread and the MRO have the same trend as well as the variables from the other model, while being slightly more positive. The overall effect pre-crisis data had on the analysis consists mainly of nullifying the impulse response functions.

5.6 VAR(4) sample 2000-2015 including oil prices

The VAR(4) model that includes oil prices with sample 2000-2015 has impulse response functions that respond to a one standard deviation impulse to the oil prices, meaning the effect of an increased level of oil prices. The impulse response functions should therefore be interpreted as the effect of a higher oil price. The effects of a lower oil price on output consists of a small decrease in the first thirteen months after which it starts to increase. This effect partly confirms the findings of De Vries and Van Marle, as their impulse response function starts positive and remains positive (2015). The response of prices is a decrease in the price level when the oil price decreases. The CISS decreases as well, indicating less systematic stress. The ECB's balance sheet is also reduced as well as the EONIA-MRO spread. The MRO follows a similar pattern to output, having first a decrease and after fourteen months an increase. These results imply that while QE causes a decline in output and a rise in inflation, as seen in the previous models, the low oil prices could lead to output growth in thirteen months, but also cause a decrease in inflation.

6. Conclusion

According to the impulse response functions generated in this paper, the effects of quantitative easing are both positive and negative for the economy of the Euro Area. As the ECB increases its balance sheet it can come closer it its target inflation rate of two percent, and thus fighting of the risks of deflation. It will, however, also lead to a decrease of real output, a costly trade off. The negative effect of QE on output seems similar to the effect De Vries and Van Marle found. Since inflation targeting is the ECB’s primary objective it might be a policy it is willing to follow. The decrease in output could, furthermore, have distortionary effects on government’s fiscal policies as De Vries and Van Marle pointed out. The positive results previous studies found with respect to the implementation of QE can be explained by the need for liquidity, so financial institutions can keep functioning, in times of crises. As systematic stress has been relatively low since 2013, QE’s necessity can be questioned.

The main differences between Boeckx’s prediction and this paper’s prediction are in the expected response of output and the MRO policy rate, resulting in a different recommended approach to combat inflation. It might be better to implement policies in addition to QE that can increase economic growth, if needed by means of fiscal stimulus. The effects of the low oil price could, furthermore, cause output to grow in time, partly confirming the findings of De Vries and Van Marle. If, however, the oil prices should increase the price level should increase as well, doubting the need for QE.

To conclude, the findings of this paper suggest a more negative outlook on the effects of QE than other papers have found, such as Boeckx. It would be wrong to extrapolate the positive effects QE had in other economies during times of crises to the current situation in Euro Area. As the concrete effects of QE are still relatively unknown, the ECB has embarked on an unknown path with significant risks for financial markets and possibly for the real economy.

7. Limitations

This paper is, however, subject to a number of limitations with the first one having to do with the methodology. One of the issues with construction a VAR model comes from the non-stationarity of the data. Non-stationary independent time-series variables that are regressed upon each other can appear related due to a phenomenon called spurious regression. Since both variables have an upward/downward trend they might be highly correlated, even though no (causal) relationship exists. With the use of the Augmented Dickey Fuller (ADF) test, one can test for stationarity. If the null hypothesis, the respective series has a unit root, is rejected, the series is stationary. A number of variables in this paper are subject to non-stationarity, which could imply that the impulse response functions provide biased results. In order to solve for this issue one would need to construct a restricted VAR analysis or a vector error correction (VEC) if cointegration, which is a stationary long-run relationship between non-stationary variables, exists. It is, however, beyond the scope of this paper to construct such a model as it requires very advanced econometrical knowledge. The results should, therefore, be interpreted with caution and a more sophisticated method should be used to provide conclusive evidence on whether or not Boeckx's results are just.

In addition, Boeckx identified several economic phenomena during his sample period and adjusted his structural VAR model to incorporate these into his model. This allowed for more isolation of the tendencies that the variables cause, which in turn allow for more accurate impulse response functions. During the sample period many interventions have occurred and, therefore, could have biased the natural relationship between the economic variables. The model is, furthermore, not optimized for forecasting purposes and therefore one should approach the results of the impulse response functions with caution when used for deciding on economic policy. At last, the impulse responses to an innovation in output carry the same methodological issues as the analysis mentioned before and should, therefore, also be interpreted with caution.

8. Recommendations for further research

This paper has a number of recommendations for future research. The first being, the use of more sophisticated econometrical models in order to the verify the effects of QE, while taking into account the many interventions into the economy. The constructions of such a structural model would allow for better understanding of the structural relationships between the variables that are used in this paper. It would, furthermore, be interesting to forecast how the economy will be affected by QE in the coming years. At last, it would be worth looking into the effects of a temporary fiscal expansion, with a designed structural model that can also incorporate other environmental factors such as the price of oil, which could be based on what De Vries and Van Marle researched.

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10. Appendix

Figure 1. Impulse response functions ECB's total assets to the VAR(4) sample 2008-2013.

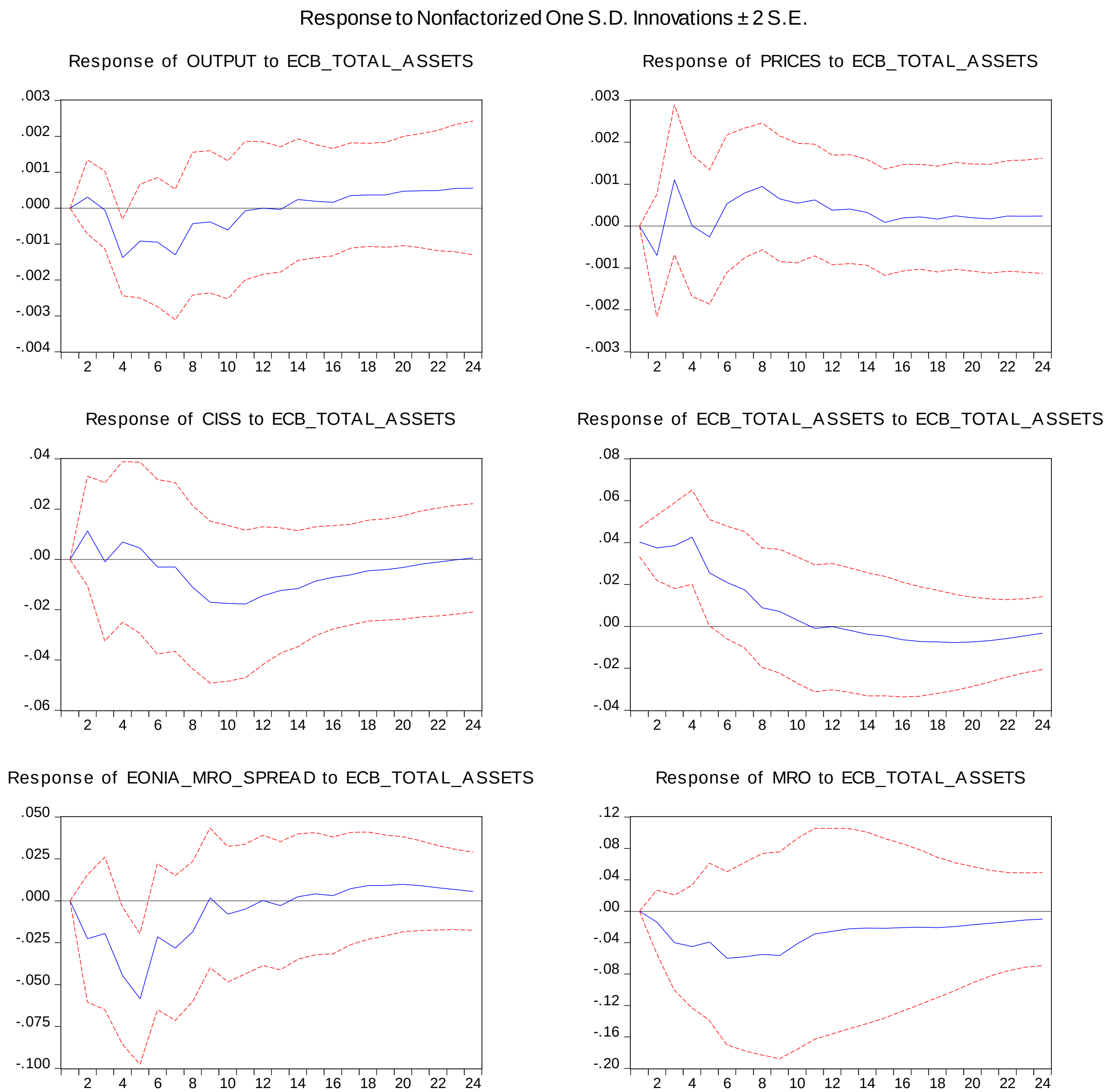
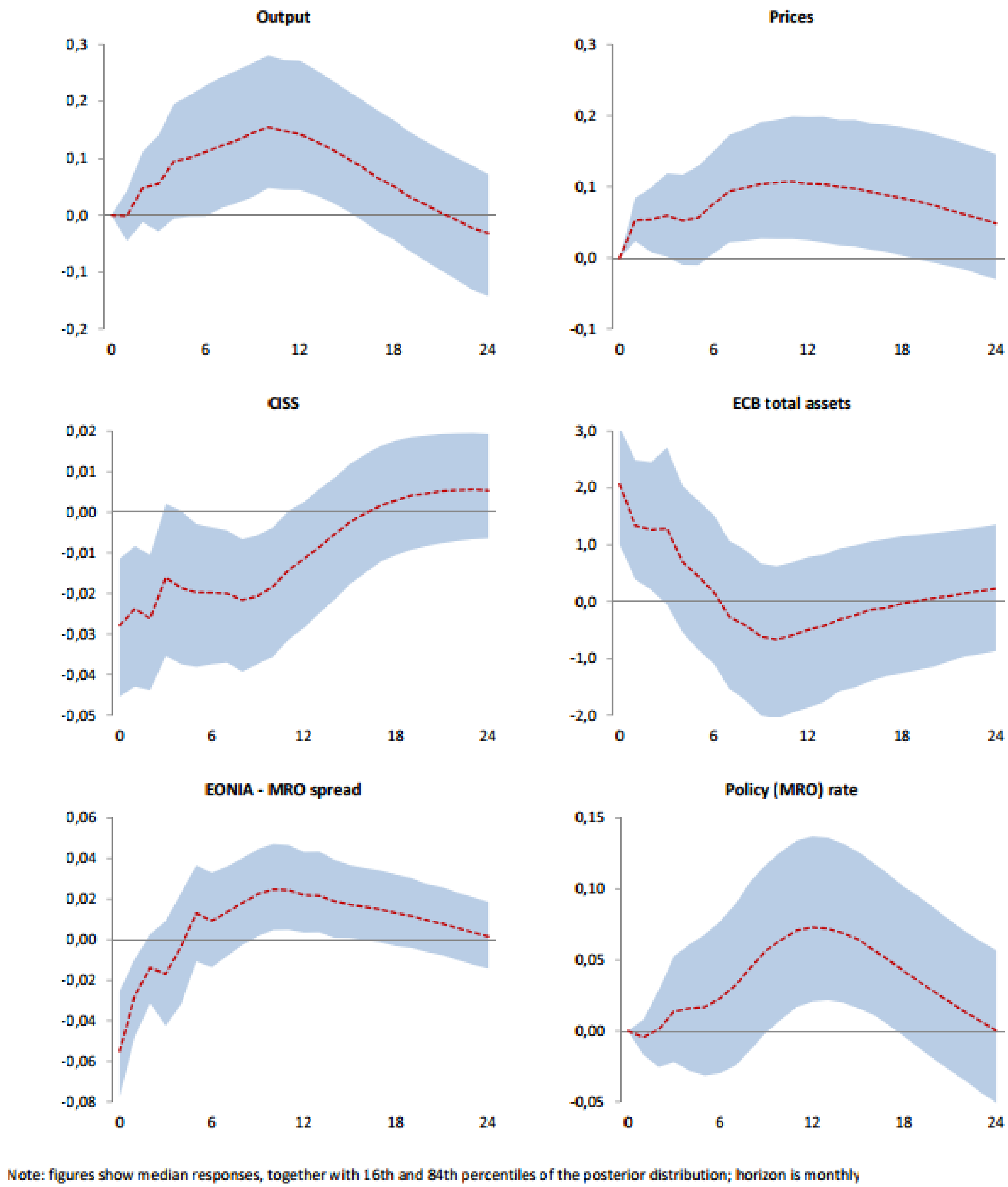


Figure 2. Impulse response functions Boeckx with a one standard deviation innovation in the ECB's total assets.



This figure (3) is retrieved from Boeckx et al. (2014)**.**

Figure 3. Impulse response functions ECB's total assets to the VAR(4) sample 2008-2015.

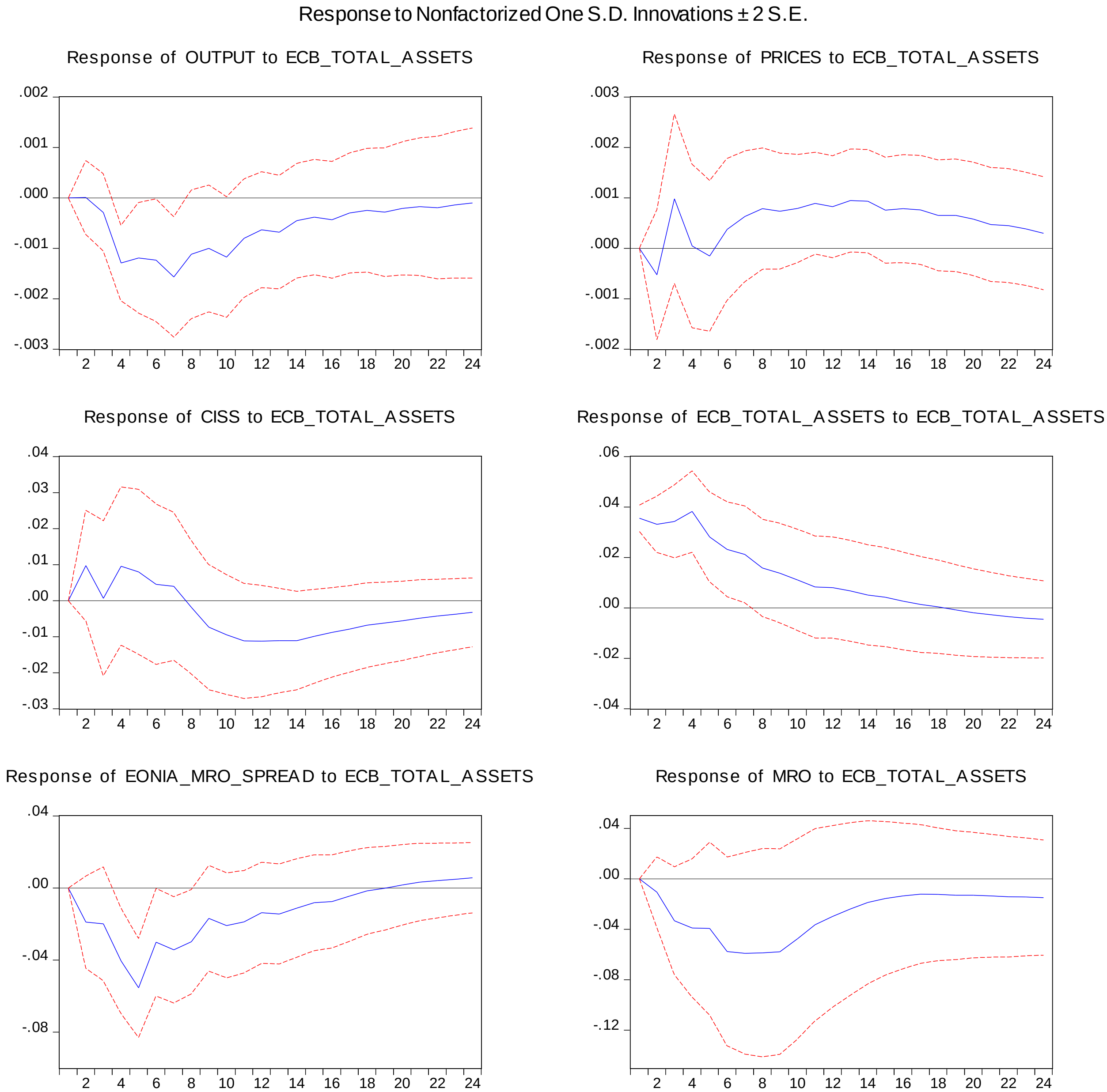


Figure 4. Impulse response functions ECB's total assets to the VAR(1) sample 2008-2015.

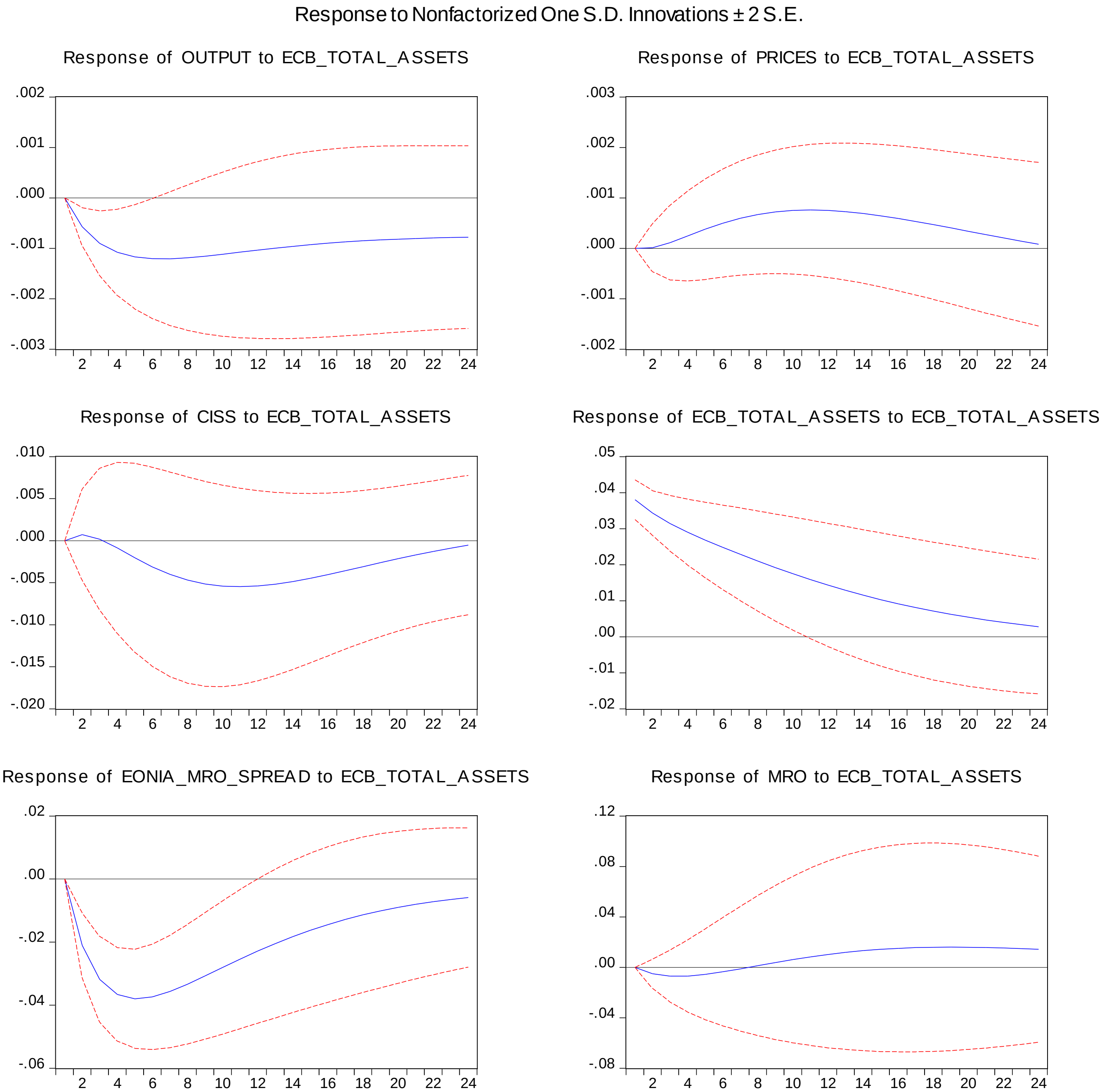


Figure 5. Impulse response functions ECB's total assets to the VAR(4) sample 2000-2015.

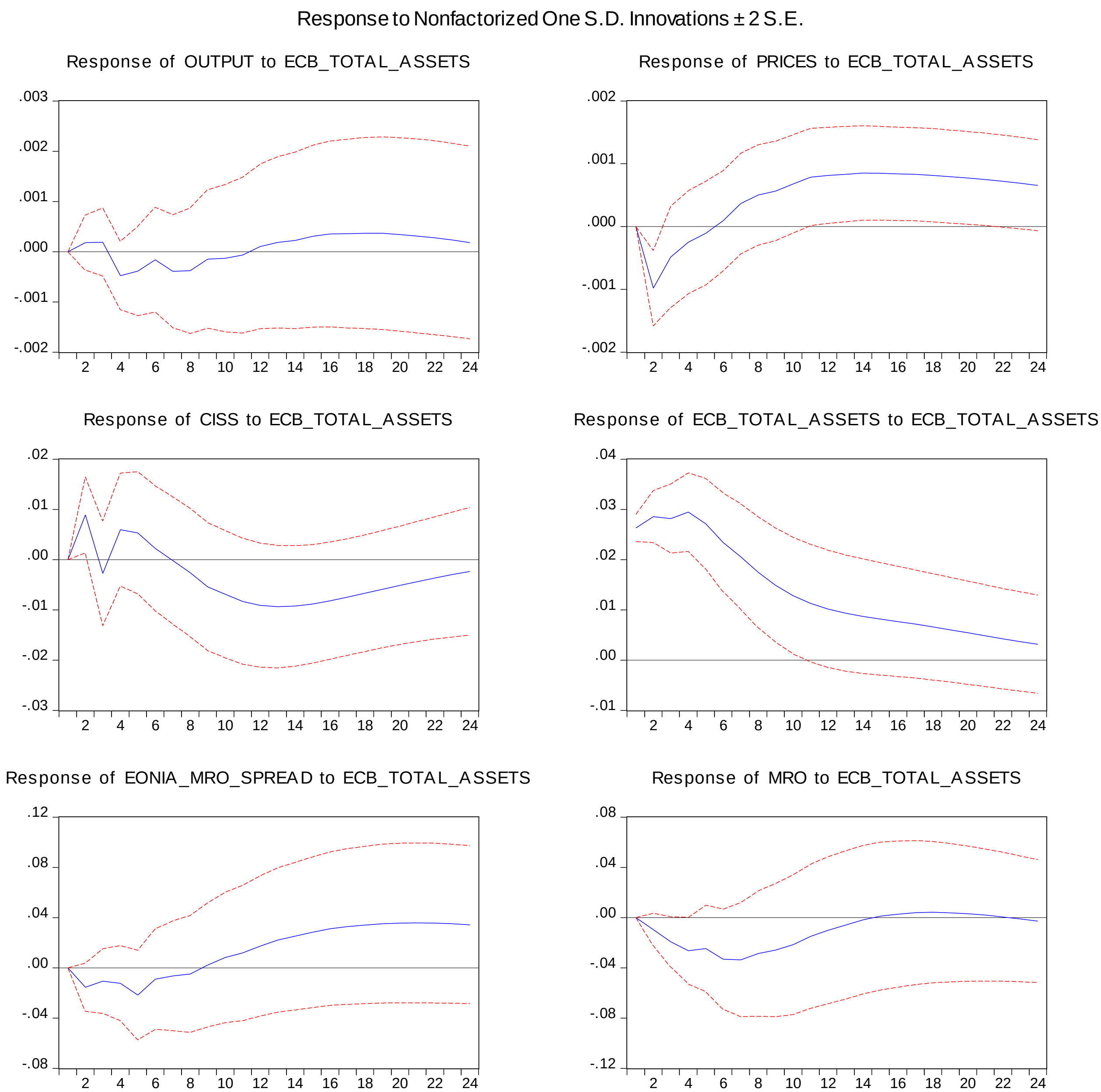


Figure 6. Impulse response functions ECB's total assets to the VAR(4) sample 2000-2015 including oil prices.

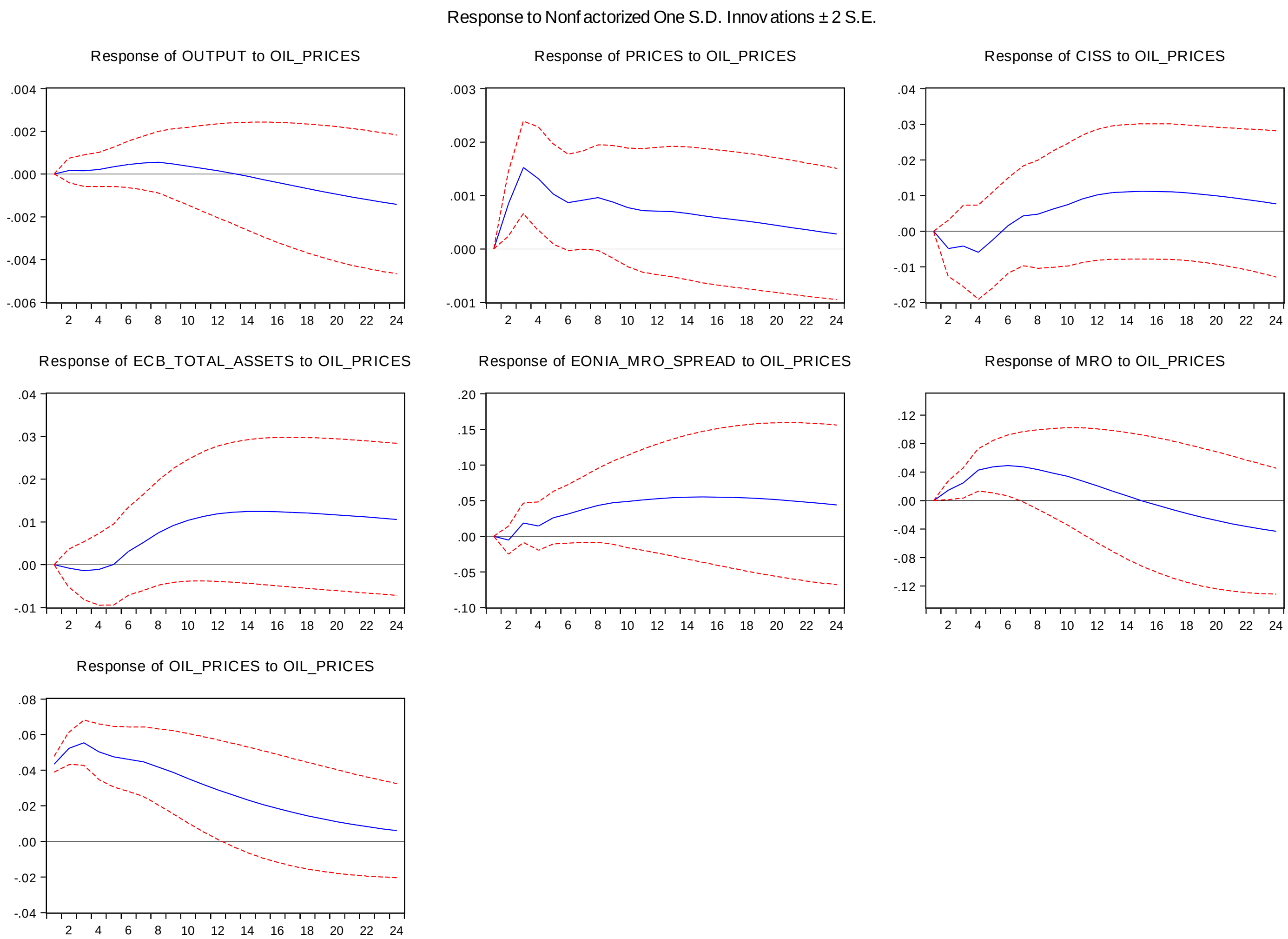


Table 6. Representation of the VAR(4) model sample 2008-2013.

Dependent variable =>	CISS	Prices log	ECB total assets log	EONIA-MRO spread	Output log	MRO policy rate
CISS(-1)	1.151959 (0.16284)	-0.006978 (0.01093)	0.225182 (0.10677)	0.201871 (0.28413)	-0.015029 (0.00770)	-0.496178 (0.30393)
CISS(-2)	-0.409981 (0.22157)	0.010625 (0.01487)	-0.133028 (0.14528)	-0.133028 (0.14528)	0.021076 (0.01048)	0.051984 (0.41354)
CISS(-3)	0.282196 (0.21572)	-0.012565 (0.01448)	-0.035573 (0.14144)	-0.035573 (0.14144)	-0.012565 (0.01448)	0.399868 (0.40262)
CISS(-4)	-0.213370 (0.16194)	0.007738 (0.01087)	0.127647 (0.10618)	0.127647 (0.10618)	0.007738 (0.01087)	0.175531 (0.30225)
Prices log(-1)	0.980535 (1.94974)	0.881196 (0.13086)	2.593213 (1.27841)	4.347210 (3.40197)	0.028053 (0.09223)	-4.411697 (3.63902)
Prices log(-2)	-2.357077 (2.60400)	-0.407079 (0.17477)	-2.845614 (1.70740)	-3.779300 (4.54356)	0.006410 (0.12318)	4.625442 (4.86015)
Prices log(-3)	2.333186 (2.54756)	0.093076 (0.17098)	0.968523 (1.67039)	3.986357 (4.44508)	-0.133624 (0.12051)	-4.610500 (4.75481)
Prices log(-4)	-0.350496 (1.89515)	0.166556 (0.12720)	0.686772 (1.24262)	-3.934987 (3.30673)	0.166556 (0.12720)	1.672932 (3.53713)
ECB total assets log(-1)	0.281072 (0.26947)	-0.017421 (0.01809)	0.932047 (0.17669)	-0.562683 (0.47018)	0.007638 (0.01275)	-0.344876 (0.50294)
ECB total assets log(-2)	-0.446159 (0.34932)	0.054551 (0.02345)	0.123566 (0.22904)	0.147047 (0.60950)	-0.007483 (0.01652)	0.040928 (0.65197)
ECB total assets log(-3)	0.599276 (0.35840)	-0.065304 (0.02405)	0.081238 (0.23500)	-0.636485 (0.62535)	-0.041935 (0.01695)	0.278098 (0.66892)
ECB total assets log(-4)	-0.393250 (0.23862)	0.028903 (0.01602)	-0.279298 (0.15646)	0.795847 (0.41636)	0.027752 (0.01129)	-0.049111 (0.44537)
EONIA-MRO spread(-1)	0.131158 (0.10544)	-0.009131 (0.00708)	0.055183 (0.06914)	0.577626 (0.18398)	-0.001879 (0.00499)	0.218932 (0.19680)
EONIA-MRO spread(-2)	0.009380 (0.13444)	0.012227 (0.00902)	0.020454 (0.08815)	-0.015424 (0.23457)	-0.003883 (0.00636)	-0.390421 (0.25091)
EONIA-MRO spread(-3)	-0.004020 (0.13256)	-0.023826 (0.00890)	0.043648 (0.08692)	-0.215060 (0.23129)	-0.003487 (0.00627)	0.250739 (0.24741)
EONIA-MRO spread(-4)	-0.008936 (0.09285)	0.010623 (0.00623)	-0.109032 (0.06088)	0.277557 (0.16201)	-0.004268 (0.00439)	-0.093254 (0.17329)

Output log(-1)	-1.927473 (3.09444)	0.098999 (0.20769)	0.535989 (2.02897)	16.96823 (5.39929)	0.468091 (0.14638)	-8.572017 (5.77550)
Output log(-2)	-3.311466 (2.90708)	0.372776 (0.19511)	-1.570812 (1.90612)	-16.24637 (5.07238)	0.119472 (0.13752)	19.56966 (5.42581)
Output log(-3)	2.096547 (3.36232)	-0.375668 (0.22567)	-3.043666 (2.20461)	13.54992 (5.86669)	0.520308 (0.15905)	-0.709733 (6.27548)
Output log(-4)	1.396081 (3.44930)	0.238614 (0.23151)	3.712512 (2.26165)	-11.83478 (6.01847)	-0.048354 (0.16317)	-6.532741 (6.43783)
MRO policy rate(-1)	0.171267 (0.11406)	-0.001896 (0.00766)	0.074661 (0.07479)	-0.305587 (0.19902)	0.003006 (0.00540)	1.339850 (0.21289)
MRO policy rate(-2)	-0.163363 (0.19095)	0.015631 (0.01282)	-0.046872 (0.12520)	0.494015 (0.33317)	-2.02E-05 (0.00903)	-0.367838 (0.35639)
MRO policy rate(-3)	0.043521 (0.18708)	-0.034766 (0.01256)	0.089664 (0.12267)	-0.509595 (0.32643)	-0.002263 (0.00885)	0.070010 (0.34917)
MRO policy rate(-4)	-0.036445 (0.11666)	0.019517 (0.00783)	-0.119837 (0.07649)	0.376708 (0.20355)	-0.003130 (0.00552)	-0.112904 (0.21773)
Constant	20.50315 (15.5416)	-3.350036 (1.04310)	0.624638 (10.1903)	-32.51193 (27.1175)	-0.514332 (0.73519)	-37.55261 (29.0070)
R-Squared	0.941356	0.989558	0.977112	0.847888	0.990744	0.991676
Adjusted R-Squared	0.908624	0.983729	0.964337	0.762989	0.985577	0.987030
F-statistic	28.75973	169.7829	76.48716	9.986962	191.7694	213.4448
Schwarz SC	-1.651852	-7.054487	-2.496007	-0.538529	-7.754128	-0.403813
Observations	68	68	68	68	68	68

Table 7. Representation of the VAR(4) model sample 2008-2015.

Dependent variable =>	CISS	Prices log	ECB total assets log	EONIA-MRO spread	Output log	MRO policy rate
CISS(-1)	1.070853 (0.13260)	-0.006546 (0.01117)	0.209301 (0.08738)	0.201413 (0.22156)	-0.010862 (0.00637)	-0.424745 (0.24299)
CISS(-2)	-0.321072 (0.17621)	0.009304 (0.01484)	-0.127150 (0.11611)	0.169163 (0.29442)	0.015343 (0.00847)	0.003293 (0.32289)
CISS(-3)	0.232448 (0.17285)	-0.011456 (0.01456)	0.004117 (0.11390)	-0.442585 (0.28881)	-0.008629 (0.00831)	0.278185 (0.31674)
CISS(-4)	-0.170012 (0.12725)	0.002006 (0.01072)	0.105800 (0.08385)	0.022079 (0.21263)	0.006423 (0.00612)	0.209900 (0.23319)
Prices log(-1)	0.634857 (1.35049)	0.961795 (0.11377)	2.165393 (0.88989)	5.210425 (2.25652)	0.004950 (0.06492)	-4.135979 (2.47471)
Prices log (-2)	-2.712816 (1.89702)	-0.323057 (0.15982)	-2.170952 (1.25002)	-5.396434 (3.16971)	0.026097 (0.09120)	5.800504 (3.47620)
Prices log(-3)	3.018212 (1.89784)	0.028884 (0.15989)	-0.083586 (1.25056)	4.714361 (3.17108)	-0.125898 (0.09124)	-4.415871 (3.47770)
Prices log(-4)	-1.108859 (1.39624)	0.195168 (0.11763)	0.806602 (0.92004)	-3.232909 (2.33296)	0.106939 (0.06712)	1.589212 (2.55854)
ECB total assets log(-1)	0.274399 (0.21474)	-0.014762 (0.01809)	0.932576 (0.14150)	-0.535489 (0.35881)	0.000142 (0.01032)	-0.297935 (0.39350)
ECB total assets log(-2)	-0.444799 (0.27916)	0.054071 (0.02352)	0.106182 (0.18395)	0.255188 (0.46644)	-0.006333 (0.01342)	-0.059946 (0.51154)
ECB total assets log(-3)	0.544038 (0.28158)	-0.058904 (0.02372)	0.091647 (0.18554)	-0.699154 (0.47049)	-0.032019 (0.01354)	0.450798 (0.51598)
ECB total assets log(-4)	-0.371103 (0.18836)	0.028770 (0.01587)	-0.263016 (0.12412)	0.784964 (0.31473)	0.019347 (0.00906)	-0.153030 (0.34516)
EONIA-MRO spread(-1)	0.075687 (0.08562)	-0.007470 (0.00721)	0.039909 (0.05642)	0.671017 (0.14306)	-0.001888 (0.00412)	0.242262 (0.15689)
EONIA-MRO spread(-2)	0.018495 (0.11146)	0.012650 (0.00939)	0.006283 (0.07344)	-0.008744 (0.18623)	-0.003393 (0.00536)	-0.419441 (0.20424)
EONIA-MRO spread(-3)	-0.020811 (0.11062)	-0.018109 (0.00932)	0.038931 (0.07289)	-0.222650 (0.18484)	-0.003821 (0.00532)	0.286853 (0.20271)
	-0.022189	0.010374	-0.110356	0.299614	-0.003513	-0.151196

EONIA-MRO spread(-4)	(0.07692)	(0.00648)	(0.05068)	(0.12852)	(0.00370)	(0.14095)
Output log(-1)	-2.971205 (2.47118)	0.147580 (0.20819)	0.203785 (1.62836)	16.10955 (4.12907)	0.483527 (0.11880)	-7.847239 (4.52832)
Output log(-2)	-2.001673 (2.28730)	0.276681 (0.19270)	-0.907594 (1.50719)	-14.88519 (3.82182)	0.053382 (0.10996)	16.24142 (4.19136)
Output log(-3)	2.026722 (2.56657)	-0.533686 (0.21623)	-1.886809 (1.69121)	11.91196 (4.28846)	-0.533686 (0.21623)	-1.629554 (4.70312)
Output log(-4)	2.384578 (2.79495)	0.196265 (0.23547)	3.011541 (1.84170)	-11.96931 (4.67005)	0.196265 (0.23547)	-5.480872 (5.12161)
MRO policy rate(-1)	0.123585 (0.08956)	0.002531 (0.00754)	0.053956 (0.05901)	-0.201809 (0.14964)	0.000362 (0.00431)	1.378578 (0.16411)
MRO policy rate(-2)	-0.103411 (0.15164)	0.012329 (0.01278)	-0.009605 (0.09992)	0.392967 (0.25337)	0.003127 (0.00729)	-0.464937 (0.27787)
MRO policy rate(-3)	0.023834 (0.14873)	-0.031575 (0.01253)	0.052728 (0.09800)	-0.539634 (0.24851)	-0.001743 (0.00715)	0.211284 (0.27254)
MRO policy rate(-4)	-0.035976 (0.09273)	0.017607 (0.00781)	-0.102339 (0.06111)	0.407432 (0.15495)	-0.004677 (0.00446)	-0.168648 (0.16993)
Constant	8.451862 (7.94610)	-0.687933 (0.66943)	-7.114895 (5.23599)	-19.15397 (13.2770)	-0.672321 (0.38201)	-11.30289 (14.5608)
R-Squared	0.948822	0.987694	0.974519	0.900812	0.995770	0.993035
Adjusted R-Squared	0.930490	0.983285	0.965391	0.865282	0.983285	0.990540
F-statistic	51.75675	224.0540	106.7665	25.35356	657.1239	398.0236
Schwarz SC	-2.090891	-7.038905	-2.925141	-1.064180	-8.160893	-0.879583
Observations	92	92	92	92	92	92

Table 8. Representation of the VAR(1) model sample 2008-2015.

Dependent variable =>	CISS	Prices log	ECB total assets log	EONIA-MRO spread	Output log	MRO policy rate
CISS(-1)	0.880421 (0.05747)	-0.003722 (0.00504)	0.105774 (0.03957)	0.129891 (0.10422)	-0.001675 (0.00387)	-0.502804 (0.12110)
Prices log(-1)	0.064722 (0.63389)	0.870365 (0.05560)	0.396665 (0.43641)	3.186983 (1.14946)	0.070832 (0.04264)	-2.137722 (1.33562)
ECB total assets log(-1)	0.018657 (0.07130)	0.000258 (0.00625)	0.902338 (0.04908)	-0.553212 (0.12929)	-0.015067 (0.00480)	-0.136379 (0.15022)
EONIA-MRO spread(-1)	0.056041 (0.04087)	-0.007592 (0.00358)	-0.037785 (0.02814)	0.581960 (0.07411)	-0.008559 (0.00275)	-0.178154 (0.08612)
output log(-1)	-0.329619 (0.46140)	0.116016 (0.04047)	0.652520 (0.31765)	1.080305 (0.83667)	0.992967 (0.03104)	1.255428 (0.97218)
MRO policy rate (-1)	0.019041 (0.00808)	-0.000350 (0.00071)	0.004419 (0.00556)	0.018132 (0.01465)	-0.001006 (0.00054)	0.972233 (0.01703)
Constant	3.949258 (4.98292)	-0.991325 (0.43706)	-9.312733 (3.43053)	-21.40714 (9.03577)	-0.008723 (0.33522)	-5.273362 (10.4991)
R-Squared	0.931819	0.983203	0.967830	0.841087	0.988658	0.990432
Adjusted R-Squared	0.927170	0.982057	0.965637	0.830253	0.987885	0.989780
F-statistic	200.4460	858.4806	441.2455	77.62731	1278.476	1518.297
Schwarz SC	-2.695226	-7.562620	-3.441829	-1.504874	-8.093165	-1.204668
Observations	95	95	95	95	95	95

Table 9. Representation of the VAR(4) model sample 2000-2015.

Dependent variable =>	CISS	Prices log	ECB total assets log	EONIA-MRO spread	Output log	MRO policy rate
CISS(-1)	0.975404 (0.07795)	0.001133 (0.00614)	0.120650 (0.04425)	-0.270005 (0.19813)	-0.005808 (0.00569)	-0.105556 (0.13354)
CISS(-2)	-0.185502 (0.10312)	0.006255 (0.00812)	-0.094346 (0.05855)	0.588977 (0.26213)	0.007445 (0.00753)	-0.367492 (0.17667)
CISS(-3)	0.140218 (0.10236)	-0.011267 (0.00806)	0.067229 (0.05811)	-0.539526 (0.26018)	-0.008028 (0.00748)	0.299284 (0.17536)
CISS(-4)	-0.030790 (0.07722)	0.003502 (0.00608)	0.001326 (0.04384)	0.204864 (0.19628)	-0.000378 (0.00564)	0.117410 (0.13229)
Prices log(-1)	0.387746 (1.01046)	0.994581 (0.07953)	1.458060 (0.57369)	1.639082 (2.56850)	0.014370 (0.07382)	-0.789585 (1.73116)
Prices log(-2)	-2.088851 (1.38763)	-0.292680 (0.10922)	-1.102079 (0.78783)	-1.696683 (3.52725)	-0.091126 (0.10137)	0.784397 (2.37736)
Prices log(-3)	3.111248 (1.38219)	0.056735 (0.10879)	0.262224 (0.78475)	-1.730388 (3.51343)	-0.125396 (0.10098)	-2.095925 (2.36804)
Prices log(-4)	-1.357761 (0.98185)	0.133030 (0.07728)	0.191845 (0.55745)	0.844953 (2.49580)	0.099719 (0.07173)	0.785793 (1.68216)
ECB total assets log(-1)	0.338475 (0.14317)	-0.037323 (0.01127)	1.085681 (0.08128)	-0.587461 (0.36392)	0.006873 (0.01046)	-0.362515 (0.24528)
ECB total assets log(-2)	-0.745206 (0.21554)	0.059912 (0.01697)	-0.070228 (0.12237)	0.841686 (0.54789)	-0.000310 (0.01575)	0.149970 (0.36928)
ECB total assets log(-3)	0.834444 (0.22065)	-0.025381 (0.01737)	0.096940 (0.12527)	-0.357081 (0.56087)	-0.033498 (0.01612)	0.092254 (0.37802)
ECB total assets log(-4)	-0.475842 (0.13977)	0.010070 (0.01100)	-0.197017 (0.07935)	0.245021 (0.35528)	0.028376 (0.01021)	0.108353 (0.23946)
EONIA-MRO spread(-1)	0.002294 (0.03369)	-0.000724 (0.00265)	0.003011 (0.01913)	0.905253 (0.08563)	0.002470 (0.00246)	0.063975 (0.05772)
EONIA-MRO spread(-2)	0.027175 (0.04546)	0.000920 (0.00358)	0.001960 (0.02581)	0.283684 (0.11555)	-0.001611 (0.00332)	-0.112201 (0.07788)
EONIA-MRO spread(-3)	-0.005047 (0.04624)	-0.005626 (0.00364)	0.038278 (0.02625)	-0.150591 (0.11754)	0.001332 (0.00338)	0.044910 (0.07922)

EONIA-MRO spread(-4)	-0.007529 (0.03175)	0.004921 (0.00250)	-0.040376 (0.01802)	-0.059482 (0.08070)	-0.003077 (0.00232)	-0.000833 (0.05439)
Output log(-1)	-1.997560 (1.22959)	-0.032313 (0.09678)	0.191942 (0.69810)	5.899561 (3.12552)	0.770535 (0.08983)	-0.593597 (2.10659)
Output log(-2)	-1.480563 (1.26496)	0.237028 (0.09957)	0.445937 (0.71819)	-9.505920 (3.21544)	-0.065815 (0.09241)	9.344009 (2.16720)
Output log(-3)	1.678561 (1.23226)	-0.234561 (0.09699)	-1.165709 (0.69962)	5.693508 (3.13232)	0.487162 (0.09002)	-6.454861 (2.11118)
Output log(-4)	1.994517 (0.87696)	0.084033 (0.06903)	0.271478 (0.49790)	-1.471969 (2.22918)	-0.145089 (0.06407)	-1.610900 (1.50246)
MRO policy rate(-1)	0.076238 (0.05102)	0.003546 (0.00402)	0.063454 (0.02897)	0.466463 (0.20651)	0.003541 (0.00373)	1.229131 (0.08742)
MRO policy rate(-2)	-0.083595 (0.08124)	0.006264 (0.00639)	-0.031095 (0.04612)	-0.377281 (0.19908)	0.000987 (0.00594)	-0.165257 (0.13919)
MRO policy rate(-3)	0.078863 (0.07832)	-0.015578 (0.00616)	-0.000242 (0.04447)	0.019674 (0.12727)	-0.003343 (0.00572)	-0.016437 (0.13418)
MRO policy rate(-4)	-0.063725 (0.05007)	0.005702 (0.00394)	-0.028116 (0.02843)	-6.828222 (4.84475)	-0.002733 (0.00366)	-0.077182 (0.08578)
Constant	-2.374656 (1.90594)	-0.406619 (0.15002)	1.283381 (1.08210)	-6.828222 (4.84475)	-0.236112 (0.13924)	-3.874389 (3.26535)
R-Squared	0.937524	0.998530	0.997217	0.980986	0.999261	0.998258
Adjusted R-Squared	0.928325	0.998314	0.996807	0.978187	0.999152	0.998002
F-statistic	101.9164	4614.256	2433.455	350.4091	9183.102	3892.998
Schwarz SC	-2.753924	-7.837888	-3.886058	-0.888080	-7.987018	-1.677140
Observations	188	188	188	188	188	188

Table 10. Representation of the VAR(4) model sample 2000-2015 including oil prices.

Dependent variable =>	CISS	Prices log	ECB total assets log	EONIA-MRO spread	Output log	MRO policy rate	Oil prices log
CISS(-1)	0.988266 (0.07959)	-0.000315 (0.00606)	0.122049 (0.04515)	-0.229155 (0.19908)	-0.006809 (0.00580)	-0.146144 (0.13354)	-0.108553 (0.07412)
CISS(-2)	-0.215200 (0.10748)	0.007594 (0.00818)	-0.094314 (0.06097)	0.451031 (0.26883)	0.008454 (0.00784)	-0.301242 (0.18034)	0.061636 (0.10009)
CISS(-3)	0.157659 (0.10611)	-0.009319 (0.00808)	0.067094 (0.06019)	-0.397971 (0.26541)	-0.008493 (0.00774)	0.266722 (0.17804)	0.090129 (0.09881)
CISS(-4)	-0.023110 (0.07929)	-1.77E-05 (0.00604)	0.006608 (0.04498)	0.144922 (0.19833)	-0.000158 (0.00578)	0.084430 (0.13304)	0.014795 (0.07384)
Prices log(-1)	0.874182 (1.09654)	0.892814 (0.08350)	1.716130 (0.62202)	1.143336 (2.74275)	-0.000775 (0.07996)	-2.766128 (1.83988)	-1.779960 (1.02113)
Prices log(-2)	-2.607754 (1.47099)	-0.229041 (0.11201)	-1.055630 (0.83443)	-3.336147 (3.67937)	-0.076865 (0.10726)	1.835658 (2.46817)	1.157587 (1.36983)
Prices log(-3)	3.334335 (1.45388)	0.083254 (0.11071)	0.223928 (0.82472)	0.377180 (3.63656)	-0.143705 (0.10602)	-2.536506 (2.43946)	-0.138973 (1.35389)
Prices log(-4)	-1.657610 (1.05300)	0.106415 (0.08018)	0.045425 (0.59732)	-0.626040 (2.63384)	0.082025 (0.07678)	1.518623 (1.76682)	0.316290 (0.98058)
ECB total assets log(-1)	0.313753 (0.14499)	-0.034614 (0.01104)	1.078128 (0.08225)	-0.630424 (0.36266)	0.006905 (0.01057)	-0.290936 (0.24328)	-0.071655 (0.13502)
ECB total assets log(-2)	-0.694465 (0.22043)	0.052951 (0.01678)	-0.048942 (0.12504)	0.896087 (0.55137)	-0.002216 (0.01607)	-0.036822 (0.36987)	-0.285465 (0.20527)
ECB total assets log(-3)	0.778636 (0.22592)	-0.022106 (0.01720)	0.092829 (0.12815)	-0.564606 (0.56508)	-0.033489 (0.01647)	0.209733 (0.37906)	0.538233 (0.21038)
ECB total assets log(-4)	-0.453182 (0.14271)	0.009216 (0.01087)	-0.204738 (0.08095)	0.376881 (0.35696)	0.028128 (0.01041)	0.086815 (0.23945)	-0.153149 (0.13290)
EONIA-MRO spread(-1)	0.008599 (0.03530)	-0.001690 (0.00269)	0.009779 (0.02003)	0.898958 (0.08831)	0.001813 (0.00257)	0.023654 (0.05924)	-0.015291 (0.03288)

EONIA-MRO spread(-2)	0.019169 (0.04649)	0.000369 (0.00354)	8.86E-06 (0.02637)	0.238908 (0.11628)	-0.001897 (0.00339)	-0.096161 (0.07800)	0.000131 (0.04329)
EONIA-MRO spread(-3)	-0.007161 (0.04657)	-0.004963 (0.00355)	0.036844 (0.02642)	-0.142385 (0.11649)	0.001403 (0.00340)	0.054870 (0.07815)	0.048055 (0.04337)
EONIA-MRO spread(-4)	-0.005792 (0.03257)	0.005644 (0.00248)	-0.043711 (0.01847)	-0.027649 (0.08146)	-0.002507 (0.00237)	0.013513 (0.05464)	-0.041859 (0.03033)
Output log(-1)	-2.140897 (1.24785)	-0.030000 (0.09502)	0.101275 (0.70785)	5.480077 (3.12123)	0.774733 (0.09099)	-0.016985 (2.09377)	1.034068 (1.16204)
Output log(-2)	-1.212069 (1.29403)	0.234873 (0.09853)	0.462407 (0.73404)	-8.181872 (3.23673)	-0.066627 (0.09436)	8.803149 (2.17125)	-0.171745 (1.20504)
Output log(-3)	1.625830 (1.24711)	-0.245477 (0.09496)	-1.177793 (0.70743)	5.148044 (3.11936)	0.493465 (0.09094)	-6.273687 (2.09251)	-0.989107 (1.16134)
Output log(-4)	1.970120 (0.89255)	0.107690 (0.06796)	0.314317 (0.50631)	-1.267341 (2.23253)	-0.141131 (0.06508)	-1.611929 (1.49761)	0.426564 (0.83117)
MRO policy rate(-1)	0.087569 (0.05365)	0.000378 (0.00409)	0.075869 (0.03043)	-0.139665 (0.13419)	0.002632 (0.00391)	1.156506 (0.09002)	-0.022838 (0.04996)
MRO policy rate(-2)	-0.092255 (0.08203)	0.007426 (0.00625)	-0.030869 (0.04653)	0.444718 (0.20517)	0.001092 (0.00598)	-0.147368 (0.13763)	0.061425 (0.07638)
MRO policy rate(-3)	0.076726 (0.07965)	-0.014696 (0.00607)	-0.008038 (0.04518)	-0.334123 (0.19923)	-0.003938 (0.00581)	0.005596 (0.13365)	0.085866 (0.07417)
MRO policy rate(-4)	-0.066902 (0.05082)	0.006006 (0.00387)	-0.030905 (0.02883)	0.014092 (0.12710)	-0.002172 (0.00371)	-0.056493 (0.08526)	-0.125759 (0.04732)
Oil prices log(-1)	-0.112463 (0.09107)	0.019630 (0.00693)	-0.018987 (0.05166)	-0.125947 (0.22779)	0.003890 (0.00664)	0.333222 (0.15281)	1.204557 (0.08481)
Oil prices log(-2)	0.119470 (0.13744)	-0.006930 (0.01047)	-0.033804 (0.07796)	0.656953 (0.34376)	-0.005363 (0.01002)	-0.182917 (0.23060)	-0.151000 (0.12798)
Oil prices log(-3)	-0.057104 (0.13734)	-0.015405 (0.01046)	-0.003956 (0.07791)	-0.665166 (0.34353)	0.002976 (0.01001)	0.120540 (0.23044)	-0.172081 (0.12790)
Oil prices log(-4)	0.062366 (0.09618)	0.008140 (0.00732)	0.043998 (0.05456)	0.316170 (0.24058)	0.003553 (0.00701)	-0.189883 (0.16139)	0.083100 (0.08957)
Constant	-2.537398 (1.93948)	-0.419741 (0.14768)	1.404613 (1.10018)	-8.175557 (4.85120)	-0.260955 (0.14143)	-4.241429 (3.25425)	-2.628346 (1.80610)
R-Squared	0.938353	0.998643	0.997259	0.981834	0.999273	0.998352	0.983978
Adjusted R-Squared	0.927496	0.998404	0.996776	0.978635	0.999146	0.998061	0.981157
F-statistic	86.43512	4178.225	2065.703	306.9116	7810.386	3439.528	348.7465

Schwarz SC	-2.655865	-7.806094	-3.789758	-0.822258	-7.892678	-1.620784	-2.798370
Observations	188	188	188	188	188	188	188