3. ESTIMATING THE IMPACT OF QUANTITATIVE EASING ON CREDIT RISK THROUGH AN ARMA-GARCH MODEL

Lucian Liviu ALBU[1]
Radu LUPU[2]
Cantemir Adrian CĂLIN[3]
Oana Cristina POPOVICI[2]

Abstract

In this paper we analyze the impact of quantitative easing policies issued by the European Central Bank, the Bank of England, the Federal Reserve and the Bank of Japan on credit risk, in nine states belonging mainly to the Central and Eastern European area. We use an ARMA-GARCH model to obtain abnormal returns and squared abnormal returns and we compute the values of the t test for each category of returns. The analysis shows that the QE events belonging to the four issuers have an important effect on credit risk in the case of the countries considered in this study.

1. Introduction

In general, central banks base their monetary policy on the control of short-term nominal interest rates that influence the economy in a wide range of ways. This control on the short-term nominal interest rates leads to changes in real short-term rates that modify assets prices and the propensity for lending, consuming or investing.

However, the global turmoil that followed the meltdown of the American sub-prime mortgage market and the distress of the international financial system made clear that in such cases this mechanism is ineffective.

During 2008 and 2009, with the short rates being near the zero lower bound, The European Central Bank, The Bank of England, The Federal Reserve and The Bank of

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[1] *Institute for Economic Forecasting, Romanian Academy*
[2] *The Bucharest Academy of Economic Studies.*
[3] *Institute for Economic Forecasting, Romanian Academy,* E-mail: cantemircalin@gmail.com

Japan, used the lessons learned in the 2000s in Japan and began to consider unconventional monetary policies, referred to in the scientific literature as quantitative easing (QE), in order to catalyze economic growth.

Shiratsuka (2009) defines quantitative easing as a "package of unconventional measures designed to absorb the shocks given to the economy by making use of both the asset and liability sides of the central bank balance sheet", while Fawley and Neely (2013) state their role in increasing the monetary base through asset purchases and lending programs.

The QE policies have raised a powerful wave of interest among academics that have focused mainly on their efficiency in affecting interest rates or financial markets. Despite this interest, there has been little attempt to study the effects of quantitative easing programs on credit risk. The main goal of this paper is to fill that gap and present an analysis of the influence of quantitative easing policies issued by four major central banks on the CDS returns of a series of countries belonging mostly to the Central and Eastern European area, and to show the dynamic of credit risk triggered by this influence.

2. Related Literature

One of the first studies conducted on the Federal Reserve's Large Scale Asset Programs was Doh (2010). Using a simplified version of a preferred-habitat model, the author finds that LSAPs alter the supplies of long-term bonds and, thus, decrease the term premia in long-term bond yields. The author comments that if the risk aversion of arbitrageurs is high (the case of the recent financial crisis), then the LSAPs can produce a bigger decline in term premium.

Joyce *et al*. (2010) study the response of the Bank of England to the global crisis materialised in a programme of large-scale asset purchases that reached £200 billion by the beginning of 2010, aiming to assess the impact of the Bank's QE policy on assets prices. They measure the impact on guild prices and find a reduction of about 100 basic points.

Krishnamurthy and Vissing-Jorgensen (2011) target the effect of the Federal Reserve's "QE1" and "QE2" on interest rates through an event-study methodology, based on both daily and intra-day data. The authors observe an important drop in nominal interest rates on long-term assets considered safe, such as treasuries, agency bonds and highly-rated corporate bonds. Another important result is that the study shows that quantitative easing impacts mortgage-backed securities (MBS) rates successfully during QE1, but not also during QE2, which involves only treasury purchases.

In another event study approach, Gagnon *et al*. (2011) focus on the Federal Reserve's Large-Scale Asset Purchases (LSAP'S) influence on longer-term interest rates of securities. The authors find a reduction in the ten-year term premium, ranging from between 30 to 100 basic points, which they estimate to be in the lower and middle thirds of this interval. Moreover, they find a more powerful effect on agency debt and agency mortgage-backed securities which places the results near those observed by Joyce *et al*. (2010).

Gagnon *et al*. (2011) conclude that the Federal Reserve's LSAP programs were successful in lowering longer-term private borrowing rates, which should lead to stimulation of the economic activity.

Staying in the context of the impact of Federal Reserve's LSAP programs on longer-term U.S. treasury yields, D'Amico *et al*. (2012) demonstrate the capability of large scale assets purchases as a measure of monetary policy. Their estimates show that the first $300 billion LSAP program caried out in 2009 reduced longer-term Treasury yields by 35 basic points. The second program, undertaken between 2010 and 2011 and consisting of $600 billion had the same effect, reducing longer-term treasury yields by about 45 basis points

Similar to the previous studies of Kashyap and Stein (2000) and Hosono (2006), Bowman *et al*. (2011) use bank-level data ranging from 2000 to 2009 to investigate the effectiveness of the Bank of Japan's injections of liquidity into the interbank market in promoting bank lending. They report a solid, positive and statistically significant effect of the quantitative easing policy on credit flow expansion. Nevertheless, the authors consider the expansion rather limited and state that a larger injection of liquidity would have been needed for a consistent boost in bank lending. One interesting result is the fact that, apparently, the small, weak banks benefited more from the quantitative easing policy than other stronger banks.

Vough (2011) also studies the effect of the Federal Reserve quantitative easing on long-term interest rates. Using an ordinary least squares regression analysis on U.S. economic data, the author reports that the quantitative easing policy was successful in lowering mortgage rates. Nevertheless, the results show that the impact on Treasury rates was statistically insignificant.

In a very interesting and ample study, Fratzscher *et al*., (2012) consider the global contagion of the Federal Reserve's quantitative easing since 2007. The results confirm the findings of D'Amico *et al*. (2012) only in relation to the first phase of the policy (QE1). The authors state that these measures triggered a substantial rebalancing of portfolios on a global scale, investors abandoning their positions in emergent market economies and concentration on US equity and bond funds. The authors conclude that this rebalancing led to the appreciation of the US currency and to the lowering of US bond yields, satisfying the Fed's goal of providing liquidity to financial markets and overcoming existing dysfunctions. Results show that, on the other hand, the QE2 program induced an opposite effect influencing the flow of capital towards emerging markets, and did not seem to have lowered sovereign yields.

Another important result of Fratzscher *et al*., (2012) is that the paper demonstrates a spillover effect of the US quantitative easing policy towards a series of emerging markets.

Breedon *et al*. (2012) measure the impact of the initial quantitative easing program used by the Bank of England between 2009 and 2010 and find a significant influence on the bond market. However, the authors state that an aggregate impact of the QE on the economy, in general, remains controversial and has to be demonstrated in the future.

In a similar way, Kapetanios *et al*. (2012) examine the macroeconomic impact of the first part of the British QE policy through a variety of models that include: a large

Bayesian VAR; a change-point structural VAR; and a time-varying parameter VAR. The results indicate that the quantitative easing events had a maximum effect on the level of the real GDP of around 1.5% and a peak effect on annual CPI inflation of 1.25%.

Szczerbowicz (2012) evaluates the impact of all ECB unconventional monetary policies carried out between 2007 and 2012 on bank and government borrowing costs. Using event-based regressions, the paper shows that only a fraction of the ECB unconventional monetary policies diminished significantly borrowing costs of banks and governments, namely the sovereign bond purchases, covered bond purchases and three-year refinancing operations.

3. Data

The input data of the model are composed of two categories of elements: credit default closing prices and the calendaristic dates on which quantitative easing policies were announced.

Figure 1

The aggregate evolution of 5-year CDS closing prices
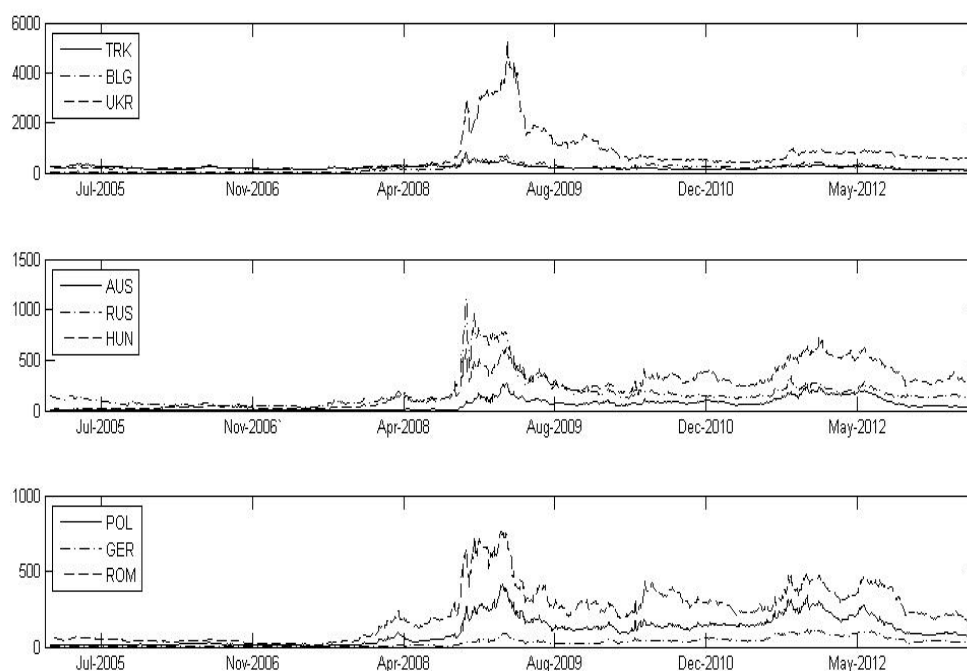
Source: Authors' work.

The CDS data was gathered from the Bloomberg platform and represent 5-year CDS closing prices, for a series of countries belonging mostly to the Central and Eastern

European area. The countries included in this analysis are: Romania, Bulgaria, Austria, Ukraine, Hungary, Poland, Germany, Russia and Turkey. The CDS prices have a daily frequency and stretch from 18.01.2005 to 14.06.2013. The evolution of the CDS prices during the analysis period is shown in Figure 1.

The second category of input data consists of calendaristic dates of the announcements of quantitative easing policies grouped by each of the four issuing central banks. The calendaristic dates were obtained from previous studies such as Fawley and Neely (2013) and Fratzscher *et al*. (2012).

4. Research Methology

For a period of 101 days or 100 returns, we calibrated an ARMA (1, 1) – GARCH (1, 1) model.

$$R_{t+1} = pR_t + q\varepsilon_t + \varepsilon_{t+1}, \ \varepsilon_{t+1} \sim N(0, \sigma_{t+1})$$

$$\sigma_{t+1}^2 = \omega + \sum_{i=1}^{p} \alpha_i R_{t+1-i}^2 + \sum_{j=1}^{q} \beta_j \sigma_{t+1-j}^2$$

Where $\alpha + \beta < 1$

We then calculated the difference to the returns and obtained the error terms on which we calculated the variance. ($\sigma_{estimated}$).

σ_1^2	R_1^2	**E_1**
σ_2^2	R_2^2	**E_2**
σ_3^2	R_3^2	**E_3**
…	…	**…**
σ_{100}^2	R_{100}^2	**E_{100}**
		$e_{stimated}$

For the event period of 41 days (20 days before the event and 20 after), we made predictions of the variances in accordance to the GARCH model. By calculating the differences to the squared returns we obtained the abnormal returns.

σ_{F-20}^2	R_{-20}^2	**AB_{-20}**
σ_{F-19}^2	R_{-19}^2	**AB_{-19}**
σ_{F-18}^2	R_{-18}^2	**AB_{-18}**
…	…	**…**
σ_{F0}^2	R_0	**AB_0**
…	…	**…**
σ_{19F}^2	R_{19}^2	**AB_{19}**
σ_{F20}^2	R_{20}^2	**AB_{20}**

The analysis was carried out for two categories of results – abnormal returns (the difference between the returns predicted by the ARMA-GARCH model and the returns

obtained in each event window) and squared abnormal returns (the difference between the variances predicted by the ARMA-GARCH model and squared returns obtained in the 41 day window of each event.)

In order to have information regarding the statistical significance of those results we calculated the theoretical standard deviations of the abnormal and squared abnormal returns.

For this purpose, in the case of the simple abnormal returns we calculated the standard deviation of the differences between real returns and the theoretic returns corresponding to the ARMA-GARCH model calibrated for the 100 day period before the window corresponding to each event.

In the case of the squared abnormal returns, the theoretic standard deviation was estimated by calculating the standard deviation of the differences between the real squared returns and the estimates of the variances for the 100 day period before the event window.

The next step was the computation of the values of t test, using $\sigma_{estimated}$ for the two categories of abnormal returns.

In order to better observe the effect of the quantitative easing policies on credit risk in the analysed countries, the results of the econometric model were refined through three analyses. The first two aim at the aggregate impact of the QE policies at country level, considering the evolution and magnitude of the impact. The third follows the individual influence of each QE event on credit risk.

5. Results

5.1 Aggregate Impact

The launch of ECB quantitative easing policies exerts an influence on the credit risk of the analysed countries ranging between 73.78% and 86.58%. The most sensitive countries to these policies are Bulgaria and Ukraine, while the smallest effects are visible in the case of Austria.
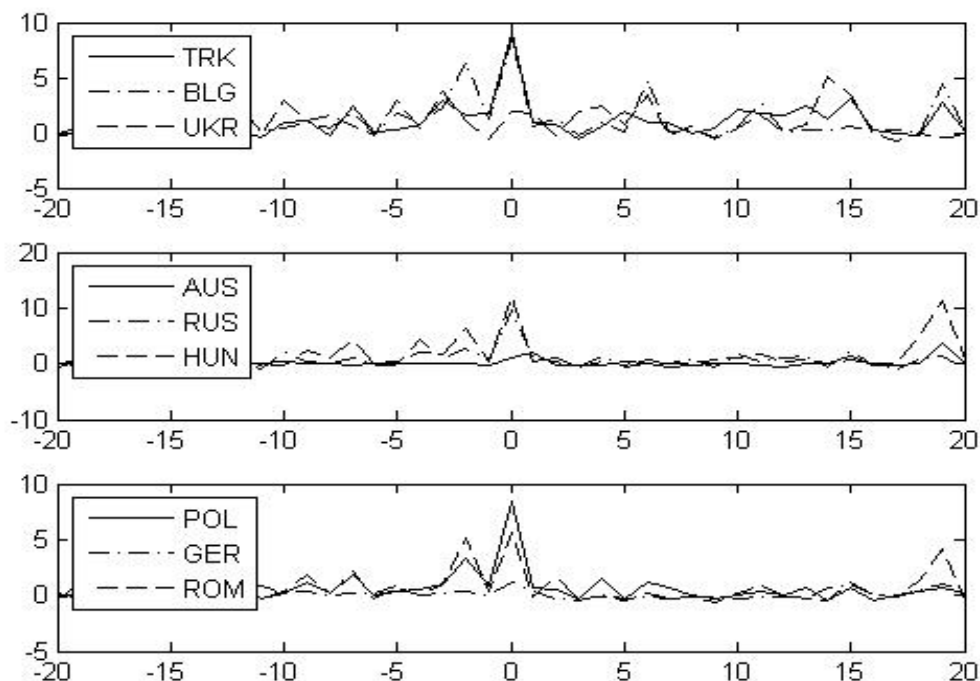
In general, the quantitative easing policies trigger both increases and deteriorations in the level of credit risk associated to the credit default swap instruments. In the case of Turkey, Bulgaria, Austria, Hungary, Poland and Germany, the number of cases when QE leads to the reduction in credit risk is higher than the number of cases when this leads to the rise in this risk. The most efficient impact in lowering credit risk can be observed for Germany.

The results for Romania, Ukraine and Russia show the fact that the QE policies of the ECB led to a rise in credit risk, the greatest effect being visible in Russia. The evolution of the t test values for the abnormal returns of the CDS instruments is shown in Figure 2.

The analysis regarding the square abnormal returns shows a peak value for the Russian CDS instrument. In 69% of the statistically significant cases this influence is positive and represents a rise in the uncertainty of the adequate pricing of the sovereign CDS.

The evolution of the t test values for the abnormal returns of the CDS instruments – ECB
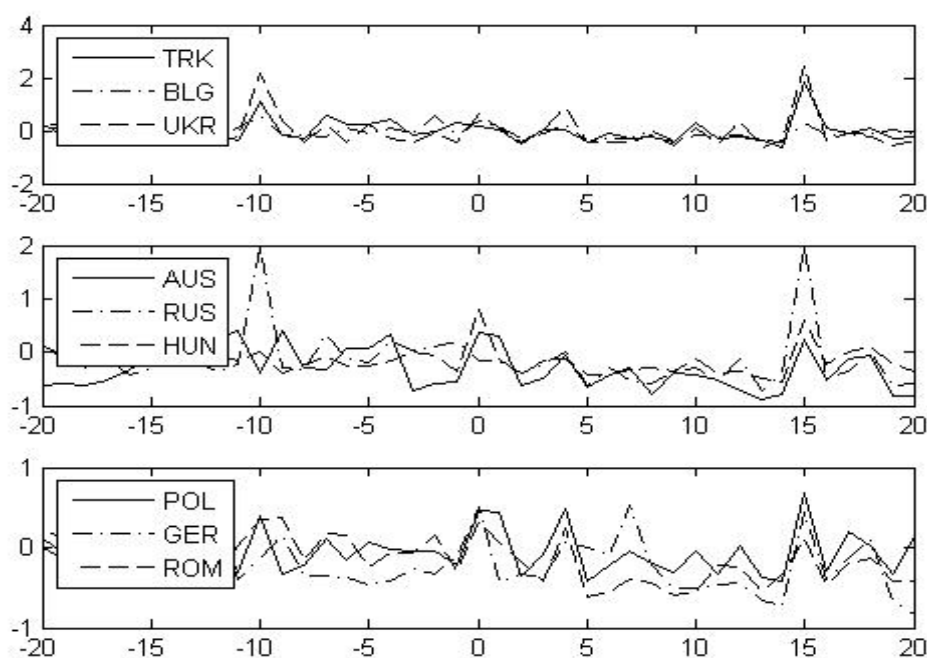

Source: Authors' work.

The quantitative easing policies of the Bank of England influence the dynamic of credit risk in the nine states between 60.31% and 82.03%. These results are lower than those found for the ECB. The most receptive sovereign instruments to these policies are those of Turkey and Bulgaria, while the smallest impact is observed in the case of Ukraine and Germany.

In the case of Romania, Bulgaria, Hungary, Ukraine, Austria, Poland, Russia and Turkey, the main tendency imposed by the Bank of England's quantitative policies is a reduction of credit risk, the number of cases indicating this tendency being superior to those of growth. The greatest impact in credit risk reduction has been found for Hungary. The contrary is observed for the German CDS instrument. Figure 3 shows the evolution of the t test values for the abnormal returns of the CDS instruments for this case.

The evolution of the t test values for the abnormal returns of the CDS instruments – BE

Source: Authors' work.

The largest effect of the British QE on the squared abnormal returns is visible in the case Austria and consists of about 13.52% of the total event days. More than 2/3 of this influence is negative, showing that the degree of uncertainty in pricing the CDS instrument has declined due to the QE policies.

The study of The Federal Reserve's QE initiatives shows an influence ranging from 60.12% to 73.17%. These results are inferior to those obtained in the analysis of the ECB policy, but are similar in value to the results observed for the Bank of England.

The greatest effect of the Fed's QE is visible in the case of Turkey, Ukraine and Romania. On the other hand, the CDS instruments of Austria and Russia show the lowest response.

Symmetrically to the cases discussed above, the Federal Reserve's QE policies determine both increases and deteriorations in the level of credit risk associated to the credit default swap instruments. As for Romania, Turkey, Bulgaria, Austria and Russia, the number of cases in which QE lowers credit risk is far greater than the number of days with a positive relation between the two. The most important reduction level is observed for the Bulgarian CDS instrument. The contrary is observed for Poland, Hungary and Ukraine, the greatest rise in credit risk being visible for Ukraine. Figure 4 shows the evolution of the abnormal returns for the case of Federal Reserve.

Figure4

The evolution of the t test values for the abnormal returns of the CDS instruments – FED
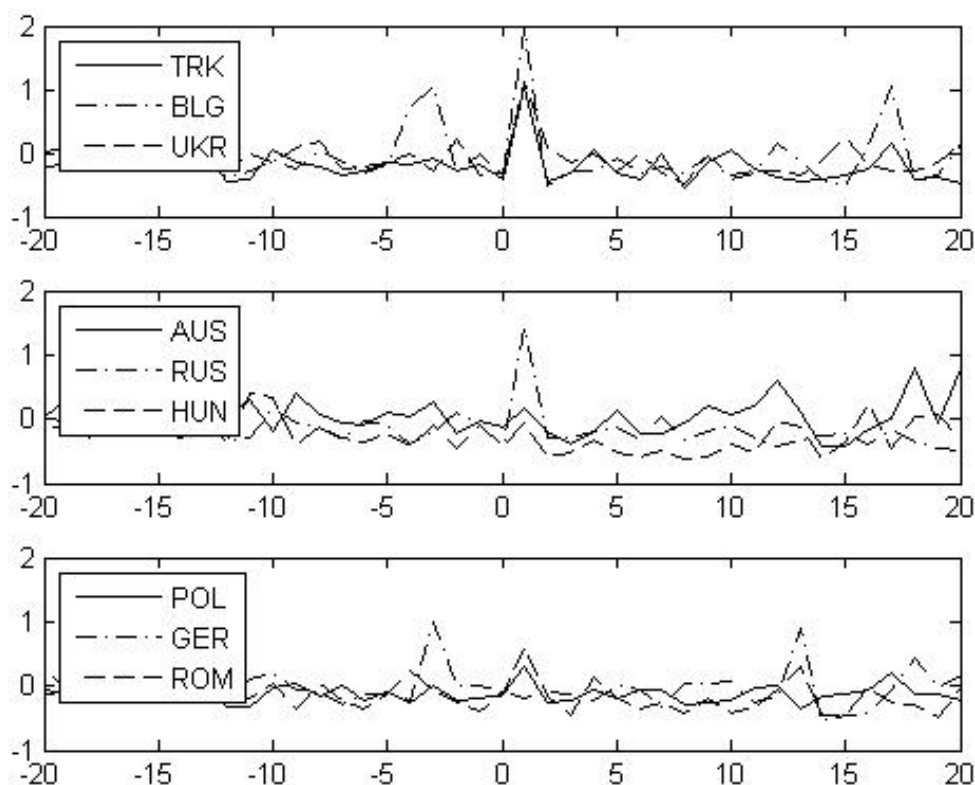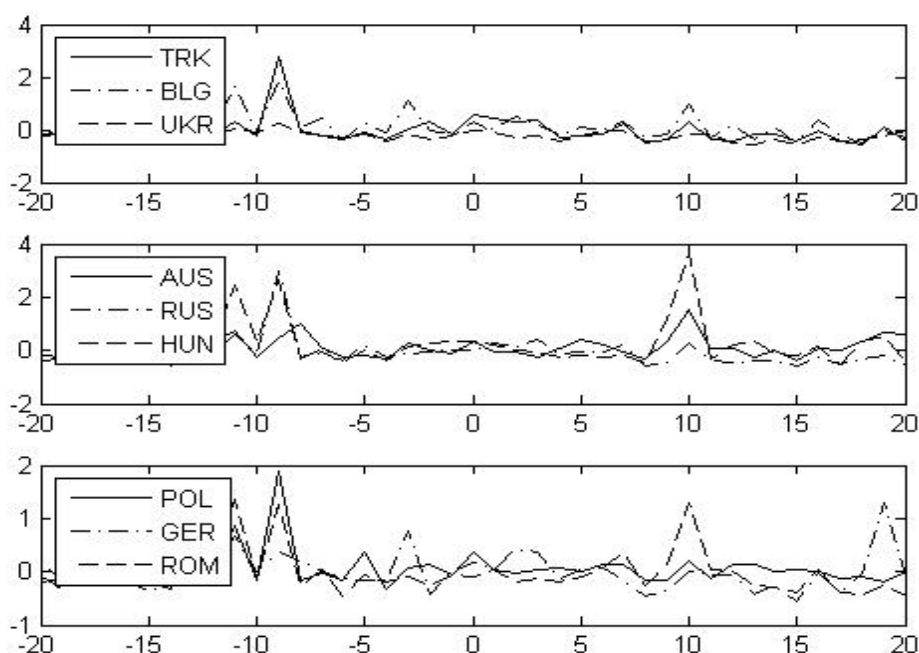

Source: Authors' work.

The results for the Bank of Japan QE policies show an influence above 65.95% and below 80.38%. The results are similar to those obtained for the European Central Bank, and superior to those found for the Bank of England or Federal Reserve.

The most sensitive instruments to the Japanese QE belong to Turkey, Bulgaria and Romania while those belonging to Russia, Germany and Austria have a weaker response.

Besides Ukraine, in the cases of all the other countries the BOJ QE policies show a tendency of credit risk reduction, the strongest effect being obtained for Bulgaria. The evolution of the t test values for the abnormal returns of the CDS instruments induced by the BOJ quantitative easing is shown in Figure 5.

Figure 5

The evolution of the t test values for the abnormal returns of the CDS instruments –BOJ

Source: Authors' work.

5.2 Individual Impact

In the previous analysis we considered the total impact of the QE policies on the CDS instruments. The next step was to investigate which of the 62 events of the four issuers affected credit risk the most.

From the eight QE events studied for the European Central Bank, the results show that the abnormal returns were influenced to the greatest extent by the intention of the ECB to purchase €60 billion in euro-denominated covered bonds followed by the announcements of 12-month longer-term refinancing operations (94.03% of the total event window days). This policy also determines the greatest expansion of credit risk.

The ECB event that triggers the most substantial credit risk reduction is the announcement of the ECB President M. Draghi indicating that the Bank will expand sovereign debt purchases.

The results of the econometric model show that the QE event issued by the Bank of England with the most influence on credit risk is the intention to purchase assets up to £375 billion (91.86%). The event that causes the greatest impact towards the reduction of credit risk is the decision to purchase up to £325 billion in assets, made on February 9th, 2012.

In the case of the 20 Federal Reserve QE measures, the most important influence is associated with the announcement of the QE2 programme (94.57%). An impressive impact for reducing credit risk is induced by the 22 October 2012 announcement of the F.O.M.C members stating that additional monetary accommodation will be available in the next period.

For the Bank of Japan we analysed 23 QE events. Among them, the greatest effect on credit risk was produced by the expansions of the Asset Purchase Facility and fixed rate operations that involved additional ¥5 trillion purchases of assets and an equal increase of the 6-month collateralized loans (96.2%).

Conclusions

In recent years an important amount of academic research was directed to the study of the impact of quantitative easing policies on certain elements of the economic environment.

In this paper, we demonstrate the effect of QE measures belonging to four major central banks on the returns of credit default instruments, and thus on credit risk.

We employ an ARMA-GARCH approach and study the evolution of simple and squared abnormal returns.

Overall, our analysis shows a substantial and statistically significant effect of the QE policies on credit risk and presents the dynamics and the magnitude of this influence.

Acknowledgements

References

Bowman, D. Cai, F. Davies, S. and Kamin, S., 2011. Quantitative Easing and Bank Lending: Evidence from Japan. Board of Governors of the Federal Reserve System, International Finance Discussion Papers, Number 1018.

Breedon, F. Chadha, J.S. Waters, A., 2012. The financial market impact of UK quantitative easing. Oxford Review of Economic Policy, 28(4), pp. 702-728.

D'Amico, S. English, W.B. Lopez-Salido, D. and Nelson, E. 2012. The Federal Reserve's Large-Scale Asset Purchase Programs: Rationale and Effects. Working Paper, Federal Reserve Board, pp. 1-58.

Doh, T., 2010. The efficacy of large-scale asset purchases at the zero lower bound. Economic Review, Q II, pp. 5-34.

Fawley, B.W. Neely, C.J., 2013. Four Stories of Quantitative Easing. Federal Reserve Bank of St. Louis Review, 95(1), pp. 51-88.

Fratzscher, M. Lo Duca, M. and Straub, R., 2012. A Global Monetary Tsunami? On the Spillovers of US Quantitative Easing. Centre for Economic Policy Research.

Gagnon, J. Raskin, M. Remache, J. and Sack, B., 2011. The Financial Market Effects of the Federal Reserve's Large-Scale Asset Purchases. International Journal of Central Banking, 7, 3-43.

Hosono, K., 2006. The "Transmission Mechanism of Monetary Policy in Japan: Evidence from Banks' Balance Sheets. Journal of Japanese International Economics 20, pp. 380-405.

Joyce, M.A.S. Lasaosa, A. Stevens, I. and Tong, M., 2011. The financial market impact of quantitative easing in the United Kingdom. International Journal of Central Banking, 7(3), pp. 113-162.

Kapetanios, G. Mumtaz, H., Stevens, I. And Theodoridis, K., 2012. Assessing the Economy-wide Effects of Quantitative Easing. The Economic Journal, pp. 316-347.

Kashyap, A.K. Stein, J.C., 2000. What Do a Million Observations on Banks Say about the Transmission of Monetary Policy?. American Economic Review, 90(3), 407-428

Krishnamurthy, A. Vissing-Jorgensen, A., 2011. The effects of quantitative easing on interest rates: channels and implications for policy. Brookings Papers on Economic Activity, 2, pp. 215-287.

Shiratsuka, S., 2009. Size and Composition of the Central Bank Balance Sheet: Revisiting Japan's Experience of the Quantitative Easing Policy. Discussion Paper No. 2009-E-25. Institute for Monetary and Economic Studies: Bank of Japan.

Szczerbowicz, U., 2012. The ECB unconventional monetary policies: have they lowered market borrowing costs for banks and governments?. Document Du Travail, Centre D'Etudes Prospectiveset D'informations Internationales.

Vought, L., 2011. The Effect of Quantitative Easing on Long-Term Interest Rates. Senior Honors Theses. Paper 264.