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Unconventional monetary tools adopted by the ECB and the FED from 2008 until 2014

Master dissertation

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Declaration of authorship

I, Lenka Setkova hereby declare that the thesis Unconventional Monetary tools adopted by the ECB and the FED from 2008 until 2014 was written by myself and that all presented results are my own, unless stated otherwise. The literature sources are listed in the Literature Review section.

Prague, September 30th, 2015

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Signature

Abstract

Both the ECB and the Fed implemented various unconventional measures in response to the last crisis. While the ECB's policies were based on direct lending to banks, the FED adopted large-scale asset purchases. According to the empirical evidence these policies had economically beneficial effects in the US and the Eurozone but these measures have also certain spillovers which scope and exact impacts are quite difficult to estimate. There have been already many papers focusing on cross-border impacts of the FED's policies, but far less studied the spillovers of the ECB's policies. This work provides a theoretical background concerning the unconventional monetary policies implemented by the ECB and the FED after 2008 and analyse the impacts of ECB's policies on six particular countries outside euro area. The Impulse Responses of output, inflation, domestic interest rate and exchange rate are analyzed via block-restricted VAR model. My results confirm that euro area monetary policy does have an impact on non-euro area countries, although the response of macroeconomic variables in analysed countries are heterogeneous and also differ in the period before and after September 2008. Countries seem to be indeed affected more by conventional monetary policies until September 2008, but the euro-area monetary policy spills over via unconventional policies after September 2008. Overall, the ECB's policies affect economic activity outside euro area, but does not have significant impact on inflation. Furthermore, the exchange rate just initially drops in response to monetary tightening, but this reaction usually does not last for more than four months.

List of Abbreviations

ABS	Asset-backed securities
AEs	Advanced economies
BOE	Bank of England
BOJ	Bank of Japan
BPP	Bond Purchase Program
CI	Confidence Interval
EU	European Union
EMEs	Emerging Market Economies
FED	Federal Reserve Bank
FOMC	Federal Open Market Comittee
FRAP	Fixed-Rate Tender, Full-Allotment Programs
FROs	Fixed-rate operations
GDP	Gross-domestic product
HFI	High frequency identification
HICP	Harmonized index of consumption prices
HICPX	HICP inflation excluding food and energy
IMF	International Monetary Fund
LSAP	Large-scale asset purchase
LTRO	Long-term refinancing operation
MBS	Mortgage-backed securities
MCI	Monetary Condition Index for the Euro area
MRO	Marginal-rate operations
OIS	Overnight Indexed Swap
OIR	Overnight Interest Rate
OMT	Outright Monetary Transactions
QE	Quantitative easing
SMP	Securities Markets Program
UMP	Unconventional Monetary Policy
U.S.	United States
VAR	Vector Autoregressive model
ZLB	Zero lower bound

Abbreviations of econometrics variables

MCI   Monetary Condition Index (so called "shadow rate")

F1 1st factor of MCI that represents the conventional monetary policy

F2 2nd factor of MCI that represents the unconventional monetary policy

3M   3-month Euribor

ip   The Industrial Production Index

cpi   The HICP

rate   3-month interbank interest rate

excr   Exchange rate

shez   Shadow rate by Wu and Xia (2014) for the Euro Area

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Introduction

Before the current financial crisis hit, it was generally assumed that with a single target (inflation stability) and a single instrument (policy rate) of monetary policy can perform almost perfectly. When the time of "Great Moderation"[1] suddenly expired, the crisis has shown that inflation and output stability cannot guarantee macroeconomic stability.[2]

Since 2008, monetary policy becomes a real challenge. Redistribution of liquidity among financial and depository institutions was limited, central banks could hardly control short-term interest rates in the interbank market, transmission mechanisms of monetary impulses were distorted.

Implementing unconventional monetary tools, central banks try to provide economies with further stimulus. They can have many forms (albeit being mostly about expanding banks' balance sheets) and they did exist even before the burst of the current financial crisis in 2008 but I will concentrate on those implemented after 2008. However, the UMP implemented by major central banks have impacts not only on the domestic economies, but spill over towards foreign economies. Especially capital flows can have unfavorable impacts on global macroeconomic stability. UMP can result in lower foreign long-term interest rate, encouraging investors towards more risky assets (with higher yields) and appreciation of the foreign currency. As the exchange rate strengthens on the back of strong inflows, traded goods sector loses competitiveness that can cause an allocation of capital and labor which is costly to reverse back once the exchange rate swings back.[3]

In this paper, I am going to focus on the reaction of the FED and the ECB on these problems that is on the unconventional monetary tools, describe their essence and survey the evidence of their effectiveness. Although both banks have slightly different origins, institutional structure and monetary-policy framework, the most important objective is maintaining price stability. As far as the ECB is concerned, inflation in the Harmonized Index of Consumer Prices less than 2 percent per year, in the medium turn, is the primary objective. In contrast, the FED has a dual mandate, where inflation and growth are at the same level of importance.

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[1] Bernanke, B. S.: The Great Moderation. Speech at the meetings of the Eastern Economic Association, Washington, DC, February 20, 2004 [online]. The Federal Reserve Board [2015-09-22]. http://www.federalreserve.gov/BOARDDOCS/speechES/2004/20040220/default.htm

[2] Blanchard, O., Dell' Ariccia, G., Mauro, P. Rethinking Macro Policy. IMF Staff Position Note, February 12, 2010, SPN 10/03. Pp. 2-5.

[3] Blanchard, O., Dell' Ariccia, G., Mauro, P. Rethinking Macro Policy II: Getting Granular [online]. IMF Staff Discussion Note, April 15, 2013 [2015-09-26]. Pp. 7. https://www.imf.org/external/pubs/ft/sdn/2013/sdn1303.pdf

This work is practically divided into two main blocks, theoretical and empirical one. The theoretical part is derived by a number of papers that already analyzed the theoretical background of unconventional monetary policies. I chose the most relevant classification and characterization of UMP in respect to the second part of this work. As far as the transmission channels of UMP is concerned, apart from the most pronounced channels, I also mention channels that are typical for EMEs. I tried to briefly describe both the UMP of the ECB and the FED, albeit I dedicated more space to UMP of the ECB as they did not primarily rely on LSAP programs and were different in several aspects (purpose, impact, transmission channels). This part covers also reference to selected empirical papers dealing with the issue of global spillovers of FED's and ECB's (using different approaches) UMP after 2008 to show that various results are coming from usage of different models and that the monetary easing and resulting ultra-low interest rates have significant impact not only on the economies where the UMP were implemented, but also on the EMEs. I need to stress out that I am going to analyze monetary policy tools implemented after 2008 and only until 2014.[4]

The empirical block focuses on the topic of so called shadow rate, its construction and the impact of UMPs on real macroeconomic variables when working with this kind of rate. A literature review related to this topic is followed by the description of block-restricted VAR model. The core paper for my empirical model is the one by Claeys et al.[5] I adhered to the idea of analyzing the spillover of the UMP of the ECB on the 6 countries outside Euro area. I tracked the changes of Impulse Responses to shocks to 3-month Euribor, MCI, conventional and unconventional policies when experimenting with data, dividing them into pre- and post- September 2009 period and finally comparing the Impulse Responses of the shock to shadow rate constructed by Claeys et al.[6] and the one by Wu and Xia[7] (for euro area). The results come just before the conclusion. Therefore, the aim of this work is to provide a theoretical basis for the global impact of UMP adopted by the ECB and the FED in "post-Lehman Brothers" period and then analyze the spillover effect of UMP of the

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[4] That is, I am not going to cover the (real) QE program announced by the ECB in January 2015. The reason is that at the time writing this work, there is still not enough evidence for objective assessment of the implications of this program and also in the empirical part of this work, I will be working with data till 2014.

[5] Babecká Kucharčuková, O., Claeys, P., Vašíček, B.: Spillover of the ECB's Monetary Policy Outside the Euro Area: How Different is Conventional from Unconventional Policy? [online]. CNB Working Paper Series15/2014. ©Czech National Bank, December 2014. [2015-08-20].http://invenio.nusl.cz/record/180948/files/nusl-180948_1.pdf

[6] Babecká Kucharčuková, O., Claeys, P., Vašíček, B. Note No. 5. Pp 9-13

[7] Wu, C. J., Xia D. F.: Measuring the Macroeconomic Impact of Monetary Policy at the Zero Lower Bound [online]. CQER Working Paper 14-02, June 2014. Federal Reserve Bank of Atlanta. [view. 2015-08-15] http://faculty.chicagobooth.edu/jing.wu/research/pdf/wx.pdf

ECB to six countries outside Euro area via looking at the dynamic responses of selected macro-variables to shocks to 3-month Euribor, so called shadow rate, conventional and unconventional monetary policy.

One can find many papers analyzing the global spillovers of the FED unconventional monetary policies, but less in case of the ECB, particularly calculating with shadow rates (or some sort of monetary condition index). As three Central European countries and three advanced economies countries are studied the nature of the selected countries indicate obtaining heterogeneous results. All three countries are closely connected with EU, but have their own monetary policies, differently developed financial markets and are subjected to different endogenous factors.

1 Conventional vs. Unconventional Monetary Policy

As far as the ECB is concerned, monetary policy is conducted according to its "two-pillar" strategy, which comprises monetary and economic analysis. Longer term monetary analysis (money and liquidity conditions) is built upon the information gathered from shorter term economic analysis (economic and financial conditions). Practically, monetary policy acts by setting a target for the overnight interest rate in the money market and adjusting the supply of central bank money to that target through open market operations.[8]

The ECB's open market operations cover main refinancing operations (one-week liquidity-providing operations) and longer-term refinancing operations (three-month liquidity-providing operations). While the MROs are used to steer short-term interest rates, manage liquidity situation and to signal the monetary policy stance in the euro are, the purpose of LTROs is to provide additional, longer-term refinancing to the financial sector[9]. By steering the level of the interest rates, the ECB can manage the liquidity conditions in money markets and pursue its primary objective.
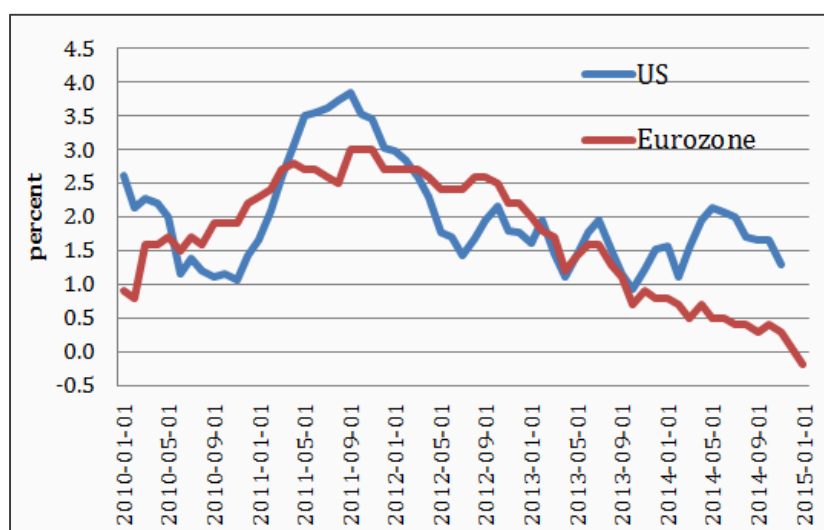
When looking at the Figure 2, one can notice that just before the last crisis hit, the inflation in Eurozone reached its maximum of 4.1 percent (twice the target level set by the ECB), then falling down sharply, reaching the lowest level of -0.6 percent in July 2009. The reference value was reached again in December 2010. Then, however, inflation rate was sinking again, indicating further downswing in the economic activity in the EU despite the several UMP that the ECB adopted[10]. In comparison, inflation in US has been more volatile, but has been permanently at least above 1 percent, while the inflation in Euro area reached even negative values in January 2015.

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[8]Smaghi, B. L.: Conventional and unconventional monetary policy [online]. Keynote lecture at the International Center for Monetary and Banking Studies, Geneva, 28 April 2009, [2015-09-22].
https://www.ecb.europa.eu/press/key/date/2009/html/sp090428.en.html
[9]Ecb.europa.eu. Open market operations [online]. ©2015, European Central Bank. [2015-07-31] https://www.ecb.europa.eu/mopo/implement/omo/html/index.en.html
[10]During 2014, the ECB was constantly unable to keep inflation close to its target and therefore implemented in January 2015 an open-ended quantitative easing program in a way the FED did in its third round of QE in September 2012.

Figure 1: Comparison of inflation in the US and the Eurozone

Source: De Grauwe, P., Ji, Y. Quantitative easing in the Eurozone: It's possible without fiscal transfers [online]. In: Voxeu.org. January 15, 2015, [2015-09-26]. http://www.voxeu.org/article/quantitative-easing-eurozone-its-possible-without-fiscal-transfers

Just before the last crisis hit, the HICP reached its maximum of 4.1 percent (twice the target level set by the ECB), then falling down sharply, reaching the lowest level of -0.6 percent in July 2009. The reference value was reached again in December 2010. Changes in the indirect taxes caused higher inflation rate (with comparison to 2010 and 2011). Then, however, inflation rate was sinking again, indicating further downswing in the economic activity in the EU despite the several UMP that the ECB adopted.

Under the other ECB's instrument, minimum reserve requirements, banks are obligated to hold compulsory deposits with NCBs. As the central bank is setting the quantity and the terms on which reserves are supplied at the margin, the central bank is effectively setting the "price" of reserves, expressed by the overnight rate. In normal times, overnight rate should closely match the desired level of interest rate. Thus, before the crisis, monetary policy could be conducted without any huge expansions in central bank's balance sheet.

As for the FED, because of the "dual mandate", meaning targeting not only price stability, but also maximum employment, system in US is slightly different. U.S. monetary policy is executed by the Federal Reserve System through market for balances that are held by depository institutions at the respective Federal Reserve Bank.

The FED implements monetary policy via controlling the federal funds rate (rate at which depository institutions trade balances at the Federal Reserve) that is set by the Federal Funds Rate Committee. Supply and demand for balances are managed by open market operations, reserve requirements and discount window facility.

Purchases of short-term debt securities (government bonds, corporate bonds, municipal bonds, collateralized securities, zero-coupon securities via open market operations) affect not only the short-term interest rates but also the monetary base. Monetary base can be expanded by buying bonds from the public or by lending money to the public, resulting in an increase of the amount of currency and bank reserves in the economy. This can have beneficial effect on economy through **asset price channels** and **credit channels**. Buying bonds by central bank means rising their price, thus lowering the interest rate and stimulating consumption and investments.

Credit channels work via eliminating some financial frictions, namely adverse selection and moral hazard, which discouraging borrowing. But once the interest rates hit lower zero bound, additional, unconventional measures had to be adopted, with specific form depending on their economic conditions and central banks' goals. „In general, unconventional measures can be defined as those policies that directly target the cost and availability of external finance to banks, households and non-financial companies"[11]. While the "conventional" monetary policy has the largest effects on short-term interest rates, unconventional monetary policy has bigger effect on long-term rates. But a given decline in log-term interest rates induced by monetary policy had a larger effect on stock prices in the conventional monetary policy than in unconventional policy.[12]

Unconventional monetary policy actions could be, in general, divided into three main groups[13]:

   a) large-scale liquidity support to banks
   b) forward guidance of ultra-low policy rates over extended policy horizons
   c) large-scale financial market interventions (massive assets purchases)

In any case, central banks used theirs balance sheet to influence broader financial conditions, thus changing the size and composition of their balance sheets.

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[11]Smaghi B. L.: Conventional and unconventional monetary policy [online]. Keynote lecture at the International Center for Monetary and Banking Studies, Geneva, 28 April 2009, [2015-09-22].
https://www.ecb.europa.eu/press/key/date/2009/html/sp090428.en.html

[12]Rogers, J. H., Scotti Ch., Wright J. H.: Evaluating Asset-Market Effects of Unconventional Monetary Policy: A Cross-Country Comparison [online]. International Finance Discussion Paper No. 1101, March 2014. Board of Governors of the Federal Reserve System. [2015-09-18].
http://www.federalreserve.gov/pubs/ifdp/2014/1101/ifdp1101.htm

[13]Pattipeilohy, Ch., Van den End, J. W., Tabbae M., Frost J., de Haan J.: Unconventional monetary policy of the ECB during the financial crisis: An assessment and new evidence [online]. Working Paper No. 381. De Nederlandsche Bank NV. The Netherlands, Amsterdam, May 2013, [2015-05-09].
http://www.dnb.nl/binaries/Working%20Paper%20381_tcm46-291731.pdf

Figure 2: FED and ECB balance sheets
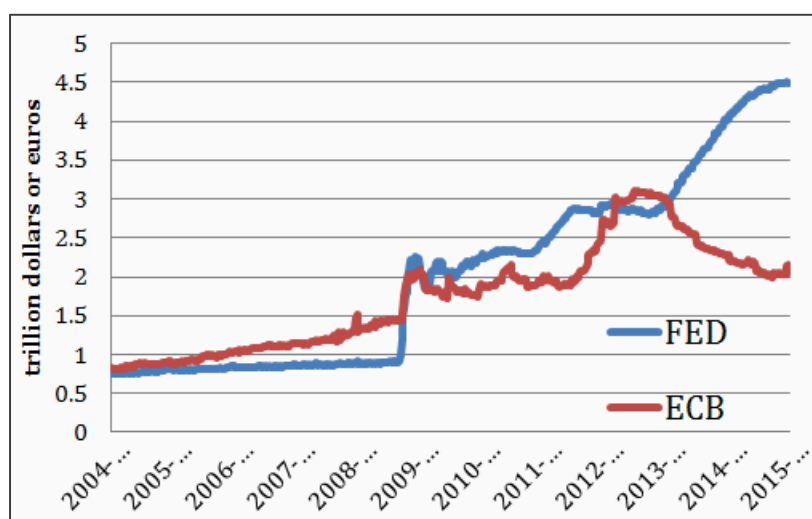
Source: De Grauwe, P., Ji, Y. Quantitative easing in the Eurozone: It's possible without fiscal transfers [online]. In: Voxeu.org. January 15, 2015, [2015-09-26]. http://www.voxeu.org/article/quantitative-easing-eurozone-its-possible-without-fiscal-transfers

Theoretically, one can make a distinction between quantitative and qualitative easing[14]. Quantitative easing covers expansion of the central bank balance sheet without changing the composition of the asset side of a balance sheet. Just central bank reserves are accumulated. On the other hand, qualitative easing leads to the changes in the composition of asset holdings. Considering all the various unconventional tools implemented after 2008 implies a combination of both quantitative and qualitative easing.

In the following section, I am going to explain the main channels of transmission of monetary policy. One should realize that there can be numerous way how to identify and classify these channels, mostly depending on what one wants to focus. These channels cannot be considered only separately as they are tightly interconnected. Particularly, signaling channel relates to interest rate expectations and forward policy guidance can be considered as a part of signaling channel. I will also mention the transmission channels for EMEs separately as it relates to the empirical studies in section 2.3.

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[14]Lenza, M., Lucrezia, R., Pill H.: Monetary policy in exceptional Times [online]. Working Paper No. 1253. European Central Bank. Frankfurt am Main, October 2010, [2015-05-09]. https://www.ecb.europa.eu/pub/pdf/scpwps/ecbwp1253.pdf

1.1 Transmission channels of UMP

a) Interest rate expectations

This channel is very simple, but very important. If people expect the inflation to be higher, they will act as if the today's inflation rate is actually lower, leading to lower real interest rate. Lower real interest rate is stimulating investments and consumption, boosting demand and real output (however, for long-run stable growth, productivity should go up, which cannot be reached just by monetary policies).

Interest rate expectations can be influenced mostly by "forward policy guidance", which is a monetary tool that the FED has been using already for many years and the ECB started using this tool officially in 2013.[15]

Forward guidance stands for a central bank's communication in a way to effectively influence the people's expectation about future policy rates. Practically, forward guidance stands for central banks' announcements concerning future policy actions, press releases, speeches, presentations.

With reference to Campbell[16] et al. there are basically two forms of policy guidance, namely Delphic and Odyssean. Delphic forward guidance is used to make the central bank's policy strategy more clear to public as it is simply central bank own projections about future policy actions in response to their projected inflation and GDP. Odyssean forward policy guidance lying in the effective commitment of a central bank to keep policy are lower than the policy rule recommends. This type of forward policy guidance is used mainly when the short-term interest rate is constrained at its ZLB. In this way I would say that even the ECB has been using the Delphic forward guidance for many years.

According to the New Keynesians, long-term interest rates define the output gap and inflation rate. If we assume that future (expected) short-term rates are equal to the long-term rates, then policymakers are able, via committing to some level of the future policy rate (and thus affecting the expectations about future short-term policy rate), control for long-term interest rates, consequently defining the output gap and inflation rate. In this way, forward policy guidance is assumed to be effective.[17]

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[15]Coeuré, B.: The usefulness of forward guidance. Speech before the Money Marketeers Club of New York, New York, 26 September 2013 [online]. [2015-09-22].
https://www.ecb.europa.eu/press/key/date/2013/html/sp130926_1.en.html
[16]Campbell, J.R., Evans C., Fisher J.D.M., Justiniano A.: Macroeconomic Effects of Federal Reserve Forward Guidance [online]. Brookings Papers on Economic Activity, Spring 2012, [2015-07-28].
http://www.brookings.edu/~/media/Projects/BPEA/Spring%202012/2012a_Evans.pdf
[17]However, this Framework does not take into account nominal rigidities.

Gürkaynak et al.[18]found evidence that the FED's forward policy guidance (particularly FOMC statements) have immense effects on asset prices. This indicates that the FED is able to define the path for the funds rate even several years into the future[19], thus proving to be unhindered in its ability to successfully conduct monetary policy. The same is stated by Walsh[20]: "Even a long period during which the nominal interest rate is anticipated to be around zero, does not need to diminish the central bank's ability to affect current spending if it is able to affect either expectations of future inflation or the future real rate once the nominal rate has been raised above zero."

b) Portfolio-rebalancing

"The efficacy of this channel depends on the imperfect substitutability among private sector's balance sheet items and on that changes in the supply of private assets and liabilities have on individual decisions"[21].Imperfect substitutability is described by the preferred-habitat theory[22].Yields of the different groups of assets are driven by the changes in the net supply of these assets and it is the central bank that is changing the net supply of assets of a given maturity. "By implication, the portfolio balance channel suggests that term premiums, and consequently long-term Treasury yields, can be reduced through LSAPs or by purchasing longer-term securities while simultaneously selling an equal quantity of shorter-term securities."[23]According to Walsh[24] "balance sheet policies, incorporating both the size and composition of assets and liabilities may also provide signals about the future path of real interest rates and therefore constitute a means of implementing forward guidance".

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[18]Gürkaynak, R. S., Wright J. H.: Do Actions Speak Louder Than Words? The response of Asset prices to Monetary Policy Actions and Statements [online]. International Journal of Central Banking, 2005, 1, 55_93, [2015-09-18]. Pp 87. http://www.ijcb.org/journal/ijcb05q2a2.pdf

[19]Which, as has been already mentioned, has an impact on market expectations of future policy actions, consequently influencing the longer-term interest rates.

[2020]Walsh, E. C.: Monetary policy transmission channels and policy instruments [online]. University of California, Santa Cruz, May 2014, [2015-09-24]. Pp 4.
http://people.ucsc.edu/~walshc/MyPapers/Walsh_ChannelsandInstruments.pdf

[21]Cecioni, M., Ferrero, G., Secchi, A.: Unconventional monetary policy in theory and in practice [online]. Occasional Papers series No. 102. Banca D'Italia Eurosistema. Italy, September 2011, [2015-09-08]. Pp 18. http://www.bancaditalia.it/pubblicazioni/qef/2011-0102/QEF_102.pdf

[22] Modigliani, F. and Sutch, R.: Innovations in Interest-Rate Policy". American Economic Review, American Economic Association, 56(1/2): 178-198, May, 1966.

[23]Thornton, D.L. QE: Is There a Portfolio Balance Effect? [online]. Federal Reserve Bank of St. Louis Review. First Quarter 2014, 96(1). [2015-08-10]. © 2014, The Federal Reserve Bank of St. Louis. Pp 68. https://research.stlouisfed.org/publications/review/2014/q1/thornton.pdf

[24]Walsh, E. C.: Monetary policy transmission channels and policy instruments [online]. University of California, Santa Cruz, May 2014, [2015-09-24]. http://people.ucsc.edu/~walshc/MyPapers/Walsh_ChannelsandInstruments.pdf

The real effect of this channel has been already questioned by several researchers. According to Thornton[25], there is no empirical evidence for reducing long-term yields. He estimated the relationship between a variety of measures of the public's debt holding and various yield measures and concluded that "QE ends up having no effects, except for those associated with any new forward guidance that it signals".

c) Signalling

Particularly quantitative easing should work as a credible commitment of a central bank to keep interest rates low. According to the expectations hypothesis, forward rates should be equal to expected future short rates, consequently affecting all bond market interest rates (which in turn depends on bond maturity). Shift in the yield curve can be the result of two factors: a) central bank's commitment to keep rates at zero[26]; b) falling term premium. A fall in yields concentrated in forward rates two or three years can be the result of signalling channel. On the other hand, as central bank is probably not able to provide credible forward guidance for more than four years, a fall in yields that is concentrated in forward rates five and more years indicated a decline in term premium. Krishnamurthy[27]proved that the signalling effects of QE2 were more important than the asset purchases themselves. Therefore, it can be suggested that just changing the maturity structure of debt would not have such an impact if it had not been for signalling channel. Together with signalling effect is going so called *announcement effect*. Financial markets always react quite briskly to central banks' announcements and press conferences. After FOMC meeting in May 2013, some investors supposed that quantitative easing programme could be finished earlier than initially expected, thus driving the term premium higher. Interest rate uncertainty increased as well.[28]

One way how to estimate the announcement effect is via monetary policy surprise. Monetary policy surprise can be defined as the difference between the central bank's announcement concerning the short-term interest rate and the ex-ante expectation

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[25]Thornton, D.L. QE: Is There a Portfolio Balance Effect? Federal Reserve Bank of St. Louis Review. First Quarter 2014, 96(1).Pp 69

[26]Eggertsson G., Woodford M.: The Zero Bound on Interest Rates and Optimal Monetary Policy [online]. International Monetary Fund, Princeton University, June 26, 2003. Pp.6, [2015-07-26]. http://www.columbia.edu/~mw2230/BPEA.pdf

[27]Krishnamurthy, A., Vissing-Jorgensen, A.: The Effects of Quantitative Easing on Interest Rates: Channels and Implications for Policy. Brookings Papers on Economic Activity [online]. National Bureau Of Economic Research Working Paper No. 17555, October 2011,[2015-09-08]. http://www.nber.org/papers/w17555.pdf

[28]Bloomberg.com. Treasurey Term Premium Increases to 2-Year High: Chart of the Day. Bloomberg Business [online]. July 8, 2014. ©2015 Bloomberg L.P. [2015-07-27]. http://www.bloomberg.com/news/articles/2013-07-08/treasury-term-premium-increases-to-2-year-high-chart-of-the-day

of this announcement.[29]Gertler is pointing out that "holding constant the size of the response of the Funds rate, impact of a monetary policy surprise on economic activity depends on the degree of news from guidance embedded in the shock."[30]Gertler et al.[31]found out (using VAR and HFI analysis) that monetary policy responses induce "modest" movements in short rates, but this leads to large movements in credit costs (caused by the reaction of term premium and credit spreads) and economic activity. The speed of transmission of the UMP of the FED and the ECB is differs, mostly because of the different nature of the unconventional measures adopted by each of the central bank.[32]

Monetary policy decisions transmit to **Emerging Market Economies** usually via portfolio-rebalancing channel, signalling channel and exchange rate channel. By buying up the longer-duration assets and herewith reducing their supply to private investors, interest rate is going down and investors start searching for a yield among emerging-markets assets. This supresses risk premiums, lifts asset prices and loosens financial conditions.If the policymakers make signals that the future domestic policy rates will be still lower than expected, capital can flow into EMEs, leading to appreciation of their currencies and depreciation of the domestic currency, cutting down the domestic demand for foreign-produced goods and services, which negatively influences emerging-market exports.

According to Gürkaynak[33] "the effects of monetary policy shocks on Exchange rates and foreign interest rate are very important, as they represent unintended policy spillovers". On the other hand, if the U.S. or euro are demand is really boosted by unconventional policies, it can offset the exchange rate effect and support domestic demand for goods and services from EMEs. Identifying and assessing cross-border effects of unconventional tools is rather difficult because of the different sensitivity of countries to global push (U.S. monetary policy, global liquidity, risk aversion, etc.) and pull factors (domestic monetary and fiscal policy, macroprudential rules, etc.) and significant heterogeneity across different

[29]Kuttner, N.K.: Monetary Policy and Asset Price Volatility [online]. June, 2011, [2015-07-28].
http://web.williams.edu/Economics/wp/KuttnerMonetaryPolicyAndAssetPriceVolatility.pdf
[30]Karadi, P., Gertler, M.: Monetary Policy Surprise, Credit Costs and Economic Activity [online]. NYU, ECB, CEPR, October 2013. [2015-07-28]. Pp 5.
http://www.econ.nyu.edu/user/gertlerm/GertlerKaradi2013Oct3draftd-3.pdf
[31]Karadi, P., Gertler, M.: Monetary Policy Surprise, Credit Costs and Economic Activity [online]. Note No. 30
[32]Babecká Kucharčuková O., Claeys P., Vašíček B.: Spillover of the ECB's Monetary Policy Outside the Euro Area: How Different is Conventional From Unconventional Policy? CNB Working Paper No. 15/2014. © Czech National Bank, December 2014. Pp 17.
[33]Gürkaynak, R. S., Wright J. H.: Do Actions Speak Louder Than Words? The response of Asset prices to Monetary Policy Actions and Statements [online]. International Journal of Central Banking, 2005, 1, 55_93, [2015-09-18]. Pp 17. http://www.ijcb.org/journal/ijcb05q2a2.pdf

types of assets and countries.[34]Krishnamrthy[35] identifies also other transmission channels such as Risk Channel, Liquidity Channel, Safety Channel and Prepayment Risk Premium Channel.

Government bond markets have a key role in transmission of the monetary policy to the real economy, having an impact on the prices at the same time, for several reasons. Interest rate on government bonds serves as a benchmark for determining the interest rates paid on bonds issued by financial and non-financial corporations (also known as "price channel").

When the bond markets does not work correctly, then also central bank's official rates are not projected correctly in the longer-term interest rates, which have determinate impact on people's decision, thus influencing significantly price stability and credibility of central bank. Impaired bond market leads to lower government bond prices, very high interest rates, causing high losses to the financial and non-financial sectors via deteriorating their investment portfolios.

Consequently, commercial banks need to recapitalise their portfolios which hinders their ability to provide loans (to households). These are all the reasons why central banks introducing non-conventional monetary tools focusing on supporting market liquidity and collateral availability, stimulating the issuance of new securities (thus providing new lending to the real economy), facilitating credit provisions to the real economy, enhancing functioning of the monetary policy transmission mechanism. It is clear that these objectives cannot be reached just by one tool.

[34]Cerutti E., Claessens S., Puy D.: Push Factors and Capital Flows to Emerging Markets: Why Knowing your Lender Matters More Than Fundamentals. IMF Working Paper WP/15/127. © International Monetary Fund, June 2015 [2015-09-08]. http://www.imf.org/external/pubs/ft/wp/2015/wp15127.pdf
[35]Krishnamurthy, A., Vissing-Jorgensen, A., Gilchrist, S., Philippon, T.: The Effects of Quantitative Easing on Interest Rates: Channels and Implications for Policy. Brookings Papers on Economic Activity [online]. Brookings Institution Press, 2011. Pp. 215-287. [2015-07-26].

2 ECB's and FED's UMP

At the onset of the financial crisis, instead of large-scale asset purchases that were implemented by the FED, BOJ, BOE, ECB used specific bank loans. This seemed appropriate, taking into account greater importance of banks (in contrast to bond markets in USA), that were hit quite severely. Increase in the frequency and size of its longer-term refinancing operations and conducting all liquidity-providing operations seemed to be vital for alleviating funding risk and providing financing support[36].

In 2011, economic situation was getting worse again, massive indebtedness of some European countries was brought to light, which was manifested in higher uncertainty, concerns regarding the sovereign debt crisis and sustainability of public finances. Tensions coming out from Greece, Ireland and Portugal, started spreading increasingly to Italy and Spain. In August 2011, ten-year government bond spreads reached record highs in most euro are countries (Figure 3). As a result, liquidity conditions in the sovereign bond markets of several euro area countries deteriorated very sharply. Increasing uncertainty regarding the global outlook for economic growth, tensions in euro area sovereign bond markets and other looming issues lead to considerable slowdown in stock markets (Figure 4).

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[36]Ecb.europa.eu. European Central Bank Monthly Bulletin, June 2009. Governing council decisions on non-standard measures [online]. ©European Central Bank, Frankfurt Am Main, June 2009, Pp. 9-10, [2015-07-31]https://www.ecb.europa.eu/mopo/decisions/html/mb200906_pp9_10.pdf?ffe56df298089dfcef6063c6fdc01635

Figure 3: Ten-year government bond spreads in Eurozone vis-à-vis Germany (basis points)
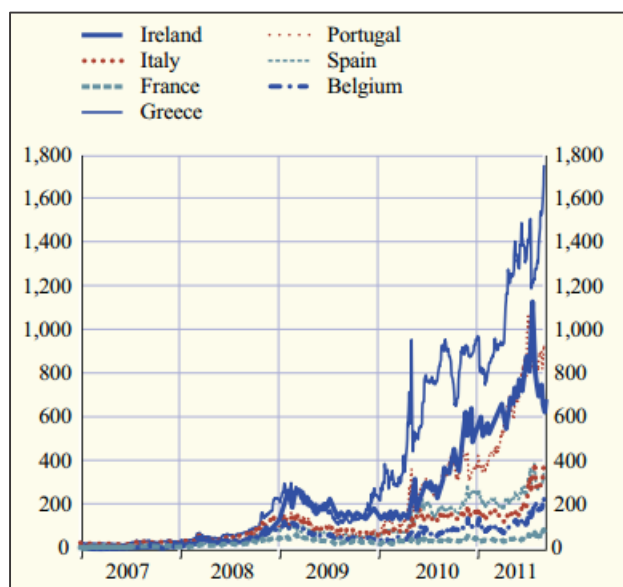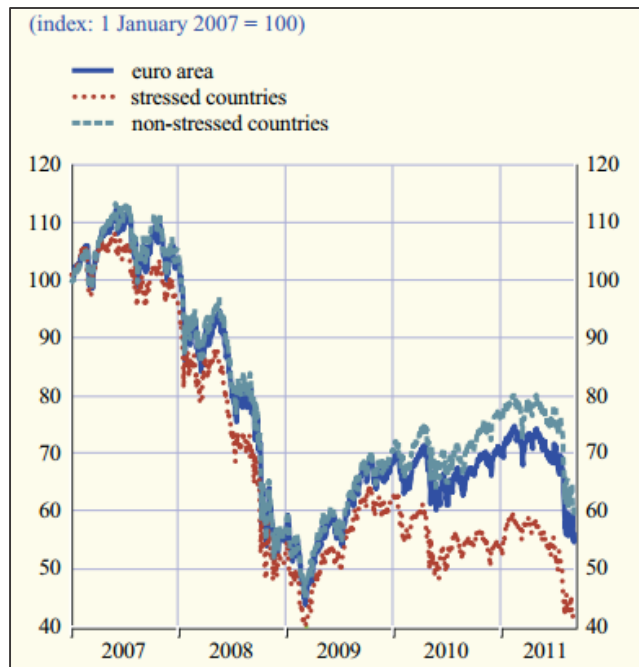

Source: ECB Monthly Bulletin, September 2011, Box 5 [online].
©European Central Bank, Frankfurt Am Main, June 2009,
[2015-07-23].
https://www.ecb.europa.eu/pub/pdf/other/box5_mb201109en.pdf
?f09794af1fde65a2dc6c0bbd1a32791c

Figure4: Path of Stock Prices in the Eurozone

Source: ECB Monthly Bulletin, September 2011, Box 5 [online].
©European Central Bank, Frankfurt Am Main, June 2009,
[2015-07-23]. Pp. 47-50.
https://www.ecb.europa.eu/pub/pdf/other/box5_mb201109en.pdf
?f09794af1fde65a2dc6c0bbd1a32791c
Note: Stressed countries being those where tensions in sovereign
debt market were more serious (Greece, Ireland, Portugal, Spain,
Italy); last observation September 7, 2011

Furthermore, extremely positive economic environment and expectations prior to the crisis encouraged irresponsible behavior by many European governments in a sense that needed fiscal consolidations and structural reforms were postponed. The ECB cut its benchmark interest rates, but was reluctant to adopt UMP in the form of large-scale asset purchases, as the FED did. Instead the Governing Council announced the program of Outright Monetary Transaction (OMT) in 2012.

In comparison to FED's UMP actions, ECB's UMP tools did not always lead to expanding the balance sheet. Although ECB's balance sheet increased as a consequence of LTRO and SMP programs (in 2011), the maturing of securities purchased within the CBPP and prepayments of LTRO loans resulted in a decrease of ECB's balance sheet.[37] Moreover, in 2008 and 2011 the ECB even raised its interest rate (which probably further deepen the Eurozone crisis)[38].This kind of monetary tightening with subsequent monetary easing (cutting interest rates) is depicted in Figure 5.

Figure 5: ECB's main interest rates (%)
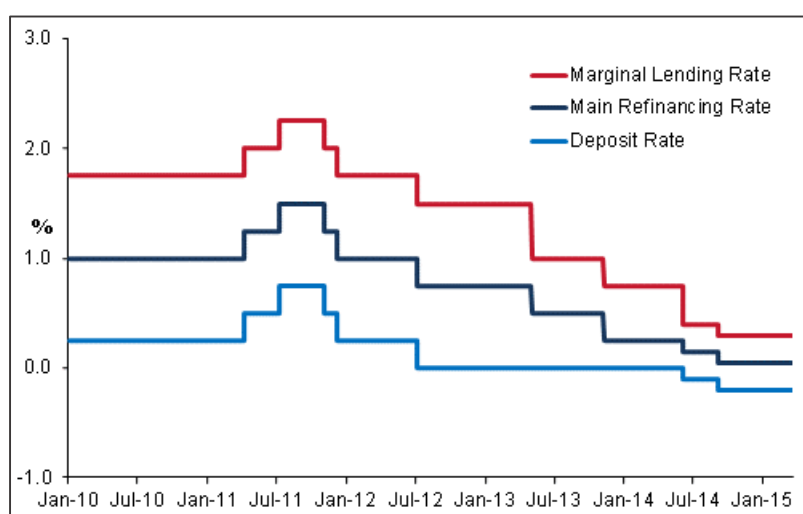
Source: FocusEconomics.com. ECB leaves key rates unchanged [online].
March 5, 2015, [2015-09-26]. http://www.focus-
economics.com/countries/eurozone/news/monetary-policy/ecb-leaves-
key-rates-unchanged-begins-purchase-of-euro

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[37]Babecká Kucharčuková, O., Claeys, P., Vašíček, B.: Spillover of the ECB's Monetary Policy Outside the Euro Area: How Different is Conventional from Unconventional Policy? [online]. CNB Working Paper Series 15/2014. ©Czech National Bank, December 2014. [2015-08-20]. Pp 13.
http://invenio.nusl.cz/record/180948/files/nusl-180948_1.pdf
[38]Beckworth, D.: The Origins of the Eurozone Monetary Policy Crisis. In: Macro and Other Market Musings [online]. 2015-03-02 [2015-08-27]. http://macromarketmusings.blogspot.cz/2015/03/the-origins-of-eurozone-monetary-policy.html

Since the ECB is a multinational institution and purchasing sovereign debt of different nations were not embedded in the Maastricht Treaty, it primarily kept off quantitative easing programs in a way the FED did.

In the following two sections, I am going to specify the main UMP implemented firstly by the ECB, then by the FED. They differ in the nature, purposes and the financial amounts. The FED was more aggressive in steering the interest rates then the ECB.

2.1 The ECB

a) Fixed-Rate Tender, Full-Allotment Programs (FRFAP)

As the financial conditions and perceived counterparty risk deteriorated, Euribor/overnight indexed swap widened so much that it hit a high of 198 basis point. The ECB reacted with its FRFAP, which simply meant lending as much as the banks in euro area wanted at a fixed-rate tender, expanding the list of eligible collateral at the same time (as the banks have to have a required collateral).

b) Securities Markets Program (SMP)

SMP was initiated to ensure the liquidity in dysfunctional market segments. This program was targeting at the securities markets and improving a monetary policy transmission mechanism. As the ECB wanted to leave liquidity conditions unaffected by this program, the liquidity provided through the SMP was re-absorbed by the special liquidity-absorbing operations until June 2014. On 5 June 2014, the ECB suspended the weekly *fine-tuning operation*s (reverse transactions, foreign exchange swaps or the collection of fixed-term deposits) sterilising the liquidity injected by the programme and the last operation was allotted on 10 June 2014[39].

c) Covered bond purchase programme (CBPP)

The ECB implemented two CBPP (May 2009 and October 2012) in the form of outright purchases amounting to €76.4 billion. Covered bond were purchased in the secondary market from financial institution which had issued covered bonds in the primary market. This programme was aimed to improve liquidity in the private debt security markets, further

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[39]ECB.europa.eu: Terminated programmes [online]. Monetary policy instruments. Asset purchase programmes. ©2015, European Central Bank. [2015-07-23]
https://www.ecb.europa.eu/mopo/implement/omt/html/index.en.html

easing of credit conditions (by narrowing the spreads of covered bond yields over those on government bonds) and encouraging new issuances in the primary markets.

d) Outright Monetary Transactions (OMT)

The purpose of this tool was to restore the transmission of monetary policy to the real economy. OMT means buying government debt of shorter maturities from investors (not directly from governments) and it is conducted solely on secondary markets.

e) Longer-Term refinancing operation

Governing council decided in December 2011 to provide euro are markets with additional two longer-term refinancing operations with a maturity of three years to support the supply of credit to the euro area economy, boost the banks' lending to households and non-financial corporations and therefore maintain the price stability. More than €1 trillion[40] was borrowed and as a result, funds from MROs spilled toward LTOs. As a result, funds from MROs spilled toward LTOs. The overall expansion of the ECB's assets is shown in Figure 6.[41]

Table 1: Information about LTROs in 2011

Announcement day	Allotment date	First date for early repayment	Maturity day
20 Dec. 2011	21 Dec. 2011	22 Dec. 2011	29 Jan. 2015
28 Feb. 2012	29 Feb. 2012	27 Feb. 2013	26 Feb. 2015

Source: Ecb.europa.eu. ECB announces measures to support bank lending and money market activity [online]. ECB, 8 December 2011. ©European Central Bank, Frankfurt am Main. [2015-08-01]. https://www.ecb.europa.eu/press/pr/date/2011/html/pr111208_1.en.html

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[40] Ecb.europa.eu. Open market operations [online]. © 2015European Central Bank, [2015-07-31]. https://www.ecb.europa.eu/mopo/implement/omo/html/index.en.html
[41]As has been already mentioned, the repayments of these operations then caused ECB's balance sheet to decrease (monetary tightening instead of needed easing).

Figure 6: ECB's assets composition (€ Billions)
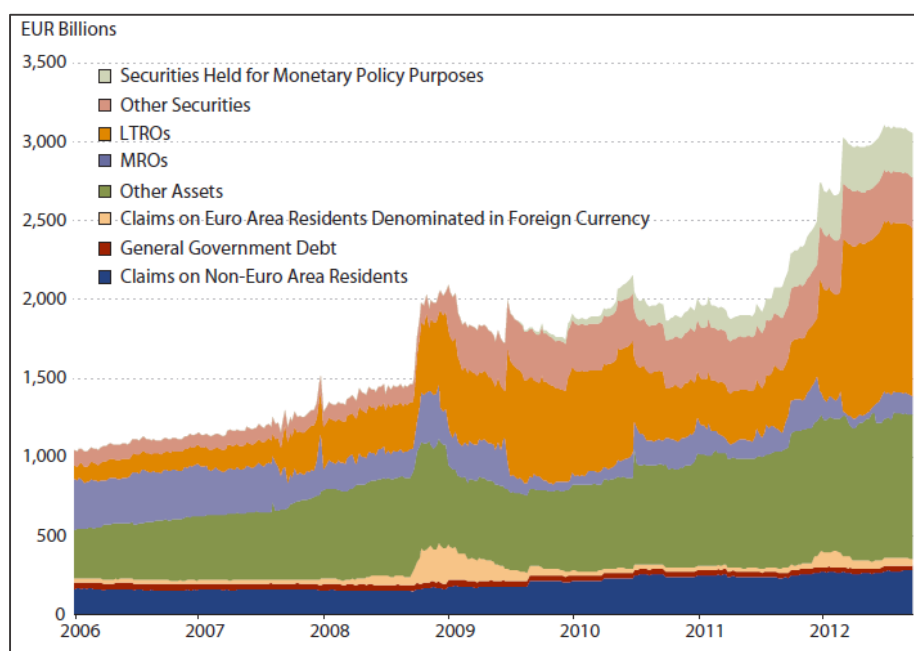
Source: Fawley B. W, Neely Ch. J.: Four Stories of Quantitative Easing [online].
Federal Reserve Bank of St. Louis Reviews. January/February 2013, 95(1), pp. 51-88.
[2015-31-07]. https://research.stlouisfed.org/publications/review/13/01/Fawley.pdf
Note: ECB's assets can be divided into two groups: a) those held for monetary
purposes, which include covered bonds and sovereign debts; b) other purposes

According to Szczerbowicz[42] both CBPP programs reduced interest rates and spreads
on covered bond, sovereign bond and also money market spreads. On the other hand, 3-year
LTRO reduced bank refinancing cost, but did not lead to smaller government borrowing
costs.

f) Forward Guidance on the key ECB's interest rates

After the Governing Council's meeting on 4th July 2013, ECB communicated that it expects
the inflation to remain at the same, lower level for some extended period of time. As the ECB
recorded throughout the first half of 2013 significant volatility in money market interest rate,
it decided to communicate more precisely about the outlook for price stability, its assessment
and how it can evolve conditional on further market development to reach more stable market
environment and to "calm down" market expectations. One measure of market expectations
about the overnight index swaps are forward rates based on overnight index swaps. As one
can see from the Figure 7 these rates have shifted significantly upwards.

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[42]Szczerbowicz, U.: the ECB unconventional monetary policies: have they lowered market borrowing costs for
banks and governments? [online]. CEPII Paper No. 2012-36, December 2012, [2015-09-28]. Pp 3-4.
http://www.cepii.fr/PDF_PUB/wp/2012/wp2012-36.pdf

Once the volatility has increased, expectations regarding the stance of monetary policy become extremely vulnerable to exogenous shocks.

Figure 7: Path of forward rates based on OIS
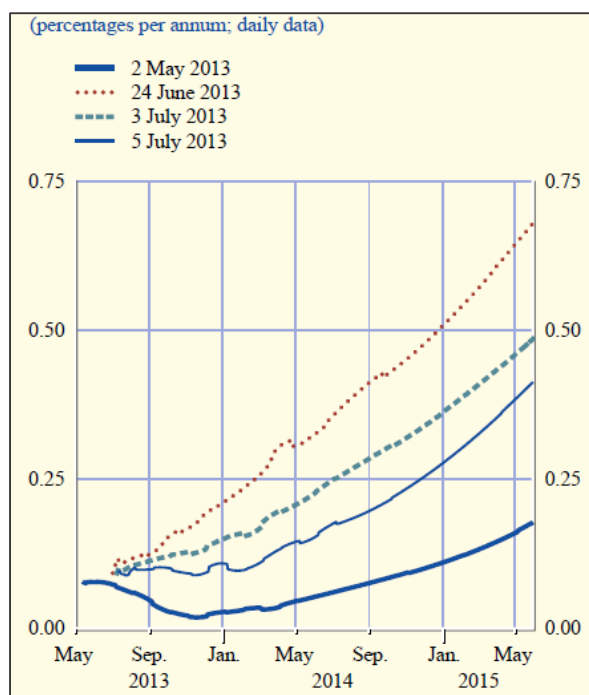
Note: On this chart is visible, that after Governing Council's decision to start actively using forward guidance, forward rates based on overnight index swap declined.
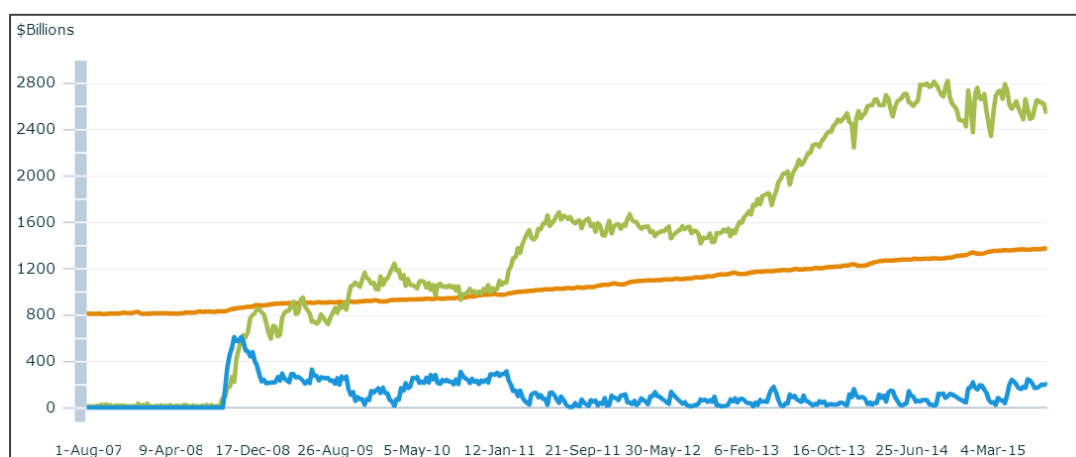
2.2 The FED

Basically, the FED unconventional monetary policy actions can be divided into two main groups which are large-scale asset purchases and forward policy guidance.

a) Large-scale asset purchases (Quantitative Easing)

FOMC sets the target for the FED funds rate (overnight interbank interest rate), thus influencing the market interest rates, investing, borrowing, etc. In December 2008, the target was set to the range from 0.00 to 0.25 percent. Therefore, the FED started buying the financial assets in exchange for reserves not with the aim of influencing short-term interest rate, but to target the level of purchases. This lead to dramatic increase in the FED's liabilities, mostly reserves, which can be seen on the figure below.

Figure 8: Selected liabilities of the Federal Reserve ($ Billions)

Note: Green line = reserve balances; orange line = currency in circulation; blue line = treasury balance
Source: Federalreserve.gov. Credit and liquidity programs and the Balance sheet [online]. Board of Governors of the Federal Reserve System. [2015-08-18].
http://www.federalreserve.gov/monetarypolicy/bst_recenttrends.htm

LSAP were introduced because of several reasons, for example to provide additional liquidity to key credit markets, lower borrowing costs, reinforce the role of the FED as a lender of last resort. Basically, quantitative easing programmes aim at stimulating investment and consumption by reducing longer-term yields[43].Financial assets included in LSAP were mainly mortgage-back securities (MBS), Treasury bonds and Government-sponsored enterprises bonds (GSEs). There have been three main waves of QE: a) QE1 in 2009(purchases of agency debt in amount of USD 200 billion and agency MBS in amount of USD 1.25 trillion), b) QE2 in November 2010 (purchases of Treasury securities in amount of USD 600 billion), c) QE3 in September 2012 (purchases of agency MBS and Treasury securities for unspecified period). "While the first two programs were for fixed amounts, the third one was and open-ended program, in which the FOMC said that the purchases would continue at a certain pace until a particular objective was achieved."[44]Changes in the asset-side of the Fed's balance sheet can be seen on the Figure 9. Significant increase in the holding Treasuries, Agency Debt and MBS is apparent. Also, there has been an increase in the longer-

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[43]Woodford, M.: Monetary Policy in the information economy [online]. NBER Working paper series No. 8674. National Bureau of Economic Research. Cambridge, December 2001, [2015-07-31].
http://www.nber.org/papers/w8674.pdf

[44]Bullard**,** J.: President's Message: A comparison of Unconventional Monetary Policy in the U.S. and Europe [online]. Federal Reserve Bank of St. Louis, April 2015 [2015-09-24].
https://www.stlouisfed.org/publications/regional-economist/april-2015/a-comparison-of-unconventional-monetary-policy-in-the-us-and-europe

term securities that the FED holds on its balance sheet in comparison to short-term Treasury bills[45].

Figure 9: Selected assets of the Federal Reserve ($ Billions)
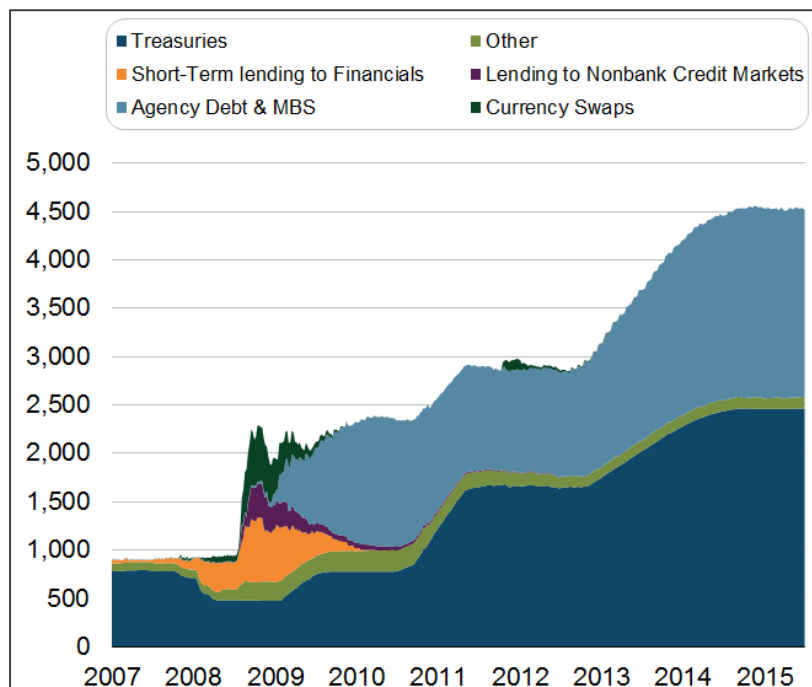
Note: "Other" = other assets, Float, Gold Stock, SDRs, Currency
outstanding
Source: Federal Reserve Bank of Atlanta. Economic & Financial Highlights
[online]. September 02, 2015, [2015-09-26].
https://www.frbatlanta.org/economy-matters/economic-and-financial-
highlights/federal-reserve.aspx?pub_year=2015

Whatever monetary policy action the FED implements, it will influence not only asset prices in U.S., but also across the world. For example, Chen et al.[46] proved that the LSAP program lead to boosting the asset prices across the world (in the shorter-run).

According to Fratzcher et al.[47] QE1 policies lead to portfolio rebalancing out of EMEs and AEs into US funds and US dollar appreciation. Contrarily, QE2 induced shift of the capital into EMEs. Also, rebalancing towards riskier assets was stronger under QE2.

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[45] Peersman, G.: The Effectiveness of Unconventional Monetary Policies [online]. Global Financial Institute Paper No. 11, October 2013, [2015-09-28].
https://deutscheawm.com/assetdownload/3c8856f4c3ac49f8bf84d799658e125a/gert_PDF_final2.pdf
[46] Chen, Q., Filardo A., He D., Zhu F.: International Spillovers of Central Bank Balance Sheet Policies [online]. BIS paper No. 66-16. [2015-07-30]. http://www.bis.org/publ/bppdf/bispap66p.pdf
[47] Fratzcher, M., Lo Duca, M., Straub, R.: A global Monetary tsunami? On the spillovers of US Quantitative Easing [online]. ECB Working Paper No 1557/June 2013. ISSN: 1725-2807. [2015-
08 16]. https://www.ecb.europa.eu/pub/pdf/scpwps/ecbwp1557.pdf

b) Forward Policy Guidance

Gavin, Keen, Richter and Throckmorton[48] examined the economic effects of forward guidance when the policy rate is stuck at zero lower bound by computing forward guidance as a new shock to the monetary policy rule. They found out that the effect of this policy tool is considerably limited. During "normal times", when the policy rate is above zero, conventional monetary actions are more powerful. During a deep recession, accompanied by slow recovery expectation, effect of forward guidance is questionable because the policy rate is likely to remain at its ZLB anyway.

By contrast, Wu and Xia[49], while estimating their shadow policy rate (will be discussed later), also estimated expected ZLB duration and then compared the market's expectation about the ZLB duration with the real FOMC announcements to be sure that their estimated ZLB duration serves as a proxy for forward policy guidance. Their results are that a one year increase in the expected ZLB duration leads to 0.1% decrease in the unemployment rate and increase in the capacity utilization by 0.2%.

Gürkaynak et al.[50] also hold the opinion that forward policy guidance has a significant (positive) effect on the economy. They found out an evidence that the FED's forward policy guidance (particularly FOMC statements) have immense effects on asset prices. This indicates that the FED is able to define the path for the funds rate even several years into the future[51], thus proving to be unhindered in its ability to successfully conduct monetary policy.

2.3 Empirical studies on macroeconomic effects

There are a lot of studies and research papers investigating the effects of unconventional monetary tools (quantitative easing particularly) on financial variables. Interestingly, there have not been many papers examining the effects of unconventional monetary tools on real economic variables. Obvious concentration of financial variables was most likely because

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[48]Gavin, T. W., Keen D. B., Richter W.A., Throckmorton A.N.: The Limitation of Forward Guidance [online]. Federal Reserve Bank Of St. Louis Working Paper Series. St. Louis, September 2014. [2015-07-28]. https://www.ecb.europa.eu/events/pdf/conferences/141006/s4_Gavin.pdf?a508ee0312bc50ce8d0a9f2d64f35a47

[49]Wu, C. J., Xia D. F.: Measuring the Macroeconomic Impact of Monetary Policy at the Zero Lower Bound [online]. CQER Working Paper 14-02, June 2014. Federal Reserve Bank of Atlanta, USA. [2015-08-15]. Pp 20 – 23. http://faculty.chicagobooth.edu/jing.wu/research/pdf/wx.pdf

[50]Gürkaynak, R. S., Wright J. H.: Do Actions Speak Louder Than Words? The response of Asset prices to Monetary Policy Actions and Statements [online]. International Journal of Central Banking, 2005, 1, 55_93. [2015-09-18]. Pp 87. http://www.ijcb.org/journal/ijcb05q2a2.pdf

[51]Which, as has been already mentioned, has an impact on market expectations of future policy actions, consequently influencing the longer-term interest rates, which in turn influences investments and demand.

of the prevailing belief that larger and stable the financial sector, better the economic growth.[52] Problem with most of the existing research papers is that even though they try to estimate the macro-effects of UMP actions, they do this via changes in various financial variables (changes in yields, spreads, etc.). Very often, researchers concentrated on measuring market responses to the major policy announcements[53]. As the financial markets are significantly globalized, the responses of the financial variables tend to be almost immediate and significant, but these responses can hardly indicate the impacts on real economy. On top of that, I did not find many papers analyzing possible scenarios once the FED's monetary policy normalizes[54].

Researchers commonly try making models as simple as possible, but taking into account how complicated the current financial markets are, it is obvious that we are not able to capture the cost or benefits fully. Also, most of the papers focus on effects and spillovers of unconventional actions implemented by FED, not the ECB. In the below section, I am going to mention few authors that tried to analyze macro-effects of unconventional monetary tools either by the FED or by the ECB, focusing more on global spillovers of UMP as the literature review relating specifically to my empirical part is in the following section.

Interesting paper analysing global spillovers of the FED's unconventional monetary policies since 2007 has been done by Lo Duca at al.[55]. Authors concentrated on shifts in financial markets, namely, they are focusing on estimating the effects of FED's UMPs on different types of bonds and equities (thus redefining portfolio flows) across different groups of countries. Both the FED's announcements and policy actions are analysed. The findings suggest that actions are even more influential (as for the portfolio allocation) than the announcements. This is in contrast to the findings of Gürkaynak et al.[56] who concluded that statements are of a greater significance.[57] Further, controlling

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[52]Levine, R.: Finance and Growth: Theory and Evidence [online]. NBER Working Paper No. 10766, September 2004. National Bureau of Economic Research. Cambridge, September 2004, [2015-08-18]. http://www.nber.org/papers/w10766.pdf

[53]Shocks to policy rates or changes in yield curve were used to measure the effects.

[54]Meaning the reactions of financial markets and possible macro-variables responses to liftoff of the FED's interest rate.

[55]Fratzcher, M., Lo Duca, M., Straub, R.: A global Monetary tsunami? On the spillovers of US Quantitative Easing [online]. ECB Working Paper No 1557/June 2013. ISSN: 1725-2807. [2015-08-16].https://www.ecb.europa.eu/pub/pdf/scpwps/ecbwp1557.pdf

[56]Gürkaynak, R. S., Wright J. H.: Do Actions Speak Louder Than Words? The response of Asset prices to Monetary Policy Actions and Statements [online]. International Journal of Central Banking, 2005, 1, 55_93. [2015-09-18]. http://www.ijcb.org/journal/ijcb05q2a2.pdf

[57]Concretely, authors studied the effect of U.S. monetary policy on asset prices and tested whether these effects are captured mostly by changes in the federal funds rate. They concluded that more significant factors are "current federal funds rate target" and "future path of policy" (forward guidance). The reason for these opposing

the exchange rate and implementing Capital Account policies apparently does not prevent from the spillovers. Also, FED's policy measures proved to intensify the pro-cyclicality of capital flows to EMEs, having even larger effects on asset prices with comparison to capital flows. Furthermore, while the first phase of FED's QE (2008 – 2009) was marked by portfolio flows out of EMEs into US funds, the second phase triggered a portfolio rebalancing in the opposite direction. Testing for countries' heterogeneity, it turns out that QE have different affects, depending on how strong are the institutions in the particular country, how central bank reacted, etc.

Engen et al.[58] applied survey data from the Blue Chip Economic Indicators to find out changes in private-sector perceptions of the implicit interest rate rule that the Federal Reserve would use following liftoff from the effective lower bound. Main focus is targeted to the effects of unconventional monetary actions on the changes in term premium and in private-sector expectations. They emphasize several key findings. Firstly, FOMC will probably pursue a more accommodative policy. Secondly, as the QE and Forward Policy Guidance both change the perception of the implicit interest rate rule, they exert a downward pressure on real long-term interest rates over time, which, in combination with downward pressure on term premium (caused by asset purchases), leads to overall eased financial conditions.

In the second half of 2012, as a response to the worsening overall economic situation, the ECB launched Outright Monetary Transactions in secondary sovereign bond markets. Researchers in the ECB[59] adopted an event study approach to estimate the macroeconomic effects of the announcements on government bond yields in France, Germany, Italy and Spain. They found out evident impact on the financial sector. Chart below (Figure 10) illustrates a decrease in the bond yields in Italy and Spain, but a muffled effect in France and Germany. Vertical gridlines are the three main OMT announcements.

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findings may be because while the Fratzcher et al. concentrated on portfolio-rebalancing effects, this paper focuses on longer-term Treasury yields and they used different model. But of course, the portfolio-rebalancing channel of transmission of UMP is the result of different asset-prices and yields so it is still interesting that authors found out different results.

[58]Engen, E., Laubach, T., Reifschneider D.: The Macroeconomic Effects of the Federal Reserve's Unconventional Monetary Policies. Finance and Economics Discussion Series No. 2015-005. Federal Reserve Board. Washington, D.C., January 2015.

[59]Altavilla, C., Giannone, D., Lenza, M.: The financial and macroeconomic effects of the OMT announcements. Working Paper Series, No. 1707. European Central Bank. Frankfurt Am Main, August 2014. ISBN: 978-92-899-1115-3.

Overall conclusion is that OMT announcements were followed by increased economic activity, consumer prices and bank loans in Italy and Spain. Although France and Germany were also positively affected, the effect on these two countries was more modest.

Figure 10: Differences in Two-year bond rates (daily frequency)
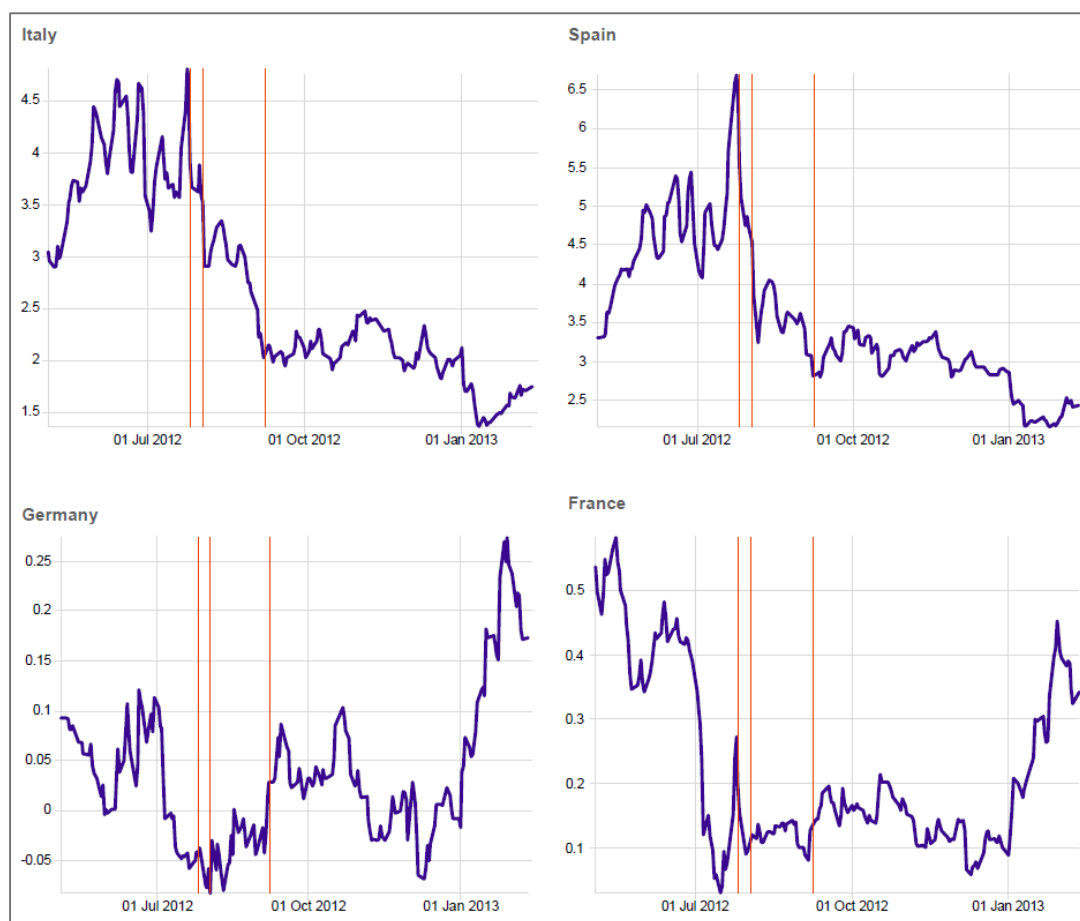
Source: The financial and macroeconomic effects of OMT announcements. ECB Research Bulletin No. 22 [online]. Summer 2014, No. 22, [2015-07-26]. Pp 13.
https://www.ecb.europa.eu/pub/pdf/other/researchbulletin22.en.pdf?f11f997918ddc4d6e40e81fa09f85 6ab

Peersman[60] tried to identify, using structural VAR model, unconventional monetary policy shocks as innovations to bank credit orthogonal to ECB's monetary policy and analyze the transmission mechanism of this shock. According to his research, output did not react as much as it would have reacted during "normal times" using "conventional" monetary policy. As far as inflation is concerned, permanent and delayed response of prices is found out. However, he analyzed only the unconventional measure influencing the banking sector, not direct lending of central banks in private markets.

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[60]Peersman, G.: Macroeconomic Consequences of Different Types of Credit Market Disturbances and Non-Conventional Monetary Policy in the Euro Area. ECB Working Paper Series No. 1397 [online]. European Central Bank, Frankfurt am Main, Germany, November 2011, [2015-07-27].
https://www.ecb.europa.eu/pub/pdf/scpwps/ecbwp1397.pdf?9a7abc39df2a87c1b8efae982feb556f

Another interesting paper, focusing on euro area, has been done by Fratzscher et al.[61]. Authors found out positive spillovers (in the short term) to global markets (advanced as well as emerging markets) induced by increasing equity prices, lowering risk aversion and credit risk which in turn had also a positive impact on confidence. According to their research, liquidity projections affected equity prices both in the "core" and in the "periphery". The ECB's policies also lowered market fragmentation in bond markets. Significant portfolio rebalancing across assets and countries was not found, which is in contrast to the FED's unconventional monetary actions which such a rebalancing did cause. They emphasize that preserving macro-financial stability is crucial.[62]

Comparing all the mentioned papers and empirical results, impacts of UMP of the FED and the ECB has been different and the results depend on the estimated model, time period (as far as the FED is concerned, apparently different stages of QE programs deliver different results, particularly concerning capital inflows/outflows; as for the ECB, its various instruments with different aims lead to heterogeneous results even within the euro area), financial markets, domestic monetary policies. We can state that overall, financial conditions were eased but the unconventional monetary actions has resulted in appreciation of other currencies vis-à-vis the dollar[63], global ultra-low long-term interest rate, which is one of the most important transmission channel of global spillovers of UMP (implemented not only by the FED and the ECB, but also by BOJ and BOE[64]) in EMEs. Whether the announcements or the actions are more influential cannot be unambiguously stated as different researches arrive at different conclusions, depending again on the model and variables analyzed.

Cheap interest rates encouraged sovereign and corporate borrowers to issue an unprecedented $253 in long-dated bonds so far this year (2015). This means that investors still believe

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[61]Fratzscher, M., Lo Duca, M., Straub R.: ECB Unconventional Monetary Policy Actions: Market Impact, international Spillovers, Transmission Channels [online]. 15th Jacques Polak Annual Research Conference, International Monetary Fund, Washington, DC, USA. November 2014, [2015-08-03]. https://www.imf.org/external/np/res/seminars/2014/arc/pdf/fratzscher_loluca_straub.pdf

[62]International spillovers are also mentioned in Bernanke, B.: Challenges of the Global Financial System: Risks and Governance under Evolving Globalization [online]. Speech at a High-Level Seminar sponsored by Bank of Japan – International Monetary Fund, Tokyo, Japan, October 14, 2012, [2015-09-21]. http://www.federalreserve.gov/newsevents/speech/bernanke20121014a.htm

[63]Rogers, J. H., Scotti Ch., Wright J. H.: Evaluating Asset-Market Effects of Unconventional Monetary Policy: A Cross-Country Comparison [online]. International Finance Discussion Paper No. 1101, March 2014. Board of Governors of the Federal Reserve System. [2015-09-18]. Pp 17. http://www.federalreserve.gov/pubs/ifdp/2014/1101/ifdp1101.htm

[64]Stupnytska, A.: Strong dollar throws up challenges. In: The OMFIF Bulletin. September 2015, Vol. 6, Ed. 8, Pp 13.

in stagnant global growth and prolonged low inflation environment[65]. Furthermore, the global growth has not significantly risen. The IMF reduced its growth projection for 2015 from 3.5 to 3.3 per cent. The growth forecast for the US has been cut down as well, from 3.1 percent to 2.5. At least the outlook for the Eurozone has improved, rising from 1.6 to 1.7 percent.[66] Apparently, considering the current situation, I would say that global monetary easing saved the US and EU from a great collapse[67], but monetary policy can hardly substitute the technological progress and boost the growth in the medium run.

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[65]Moore, E., Jackson, G.: Record $253bn in long-dated debt issued this year [online]. In: Ft.com, August 9, 2015, [2015-09-23]. http://www.ft.com/intl/cms/s/0/3e7a32a8-3d2a-11e5-bbd1-b37bc06f590c.html#axzz3mMusuq95

[66] Guigliano, F.: IMF lowers global growth forecast but plays down Greece crisis, July 9, 2015 [online]. In: Ft.com. [2015-09-23]. http://www.ft.com/intl/cms/s/0/97603b08-261c-11e5-bd83-71cb60e8f08c.html#axzz3iIzghDqL

[67]„Large-scale interventions were critical in preventing unfettered financial instability and a potential deflationary spiral." Hanoun, H (2012). Monetary policy in the Crisis: Testing the Limits of Monetary policy. In: Pattipeilohy Ch. et al.: Unconventional monetary policy of the ECB during the financial crisis [online]. DNB Working Paper No. 381. De Nederlandsche Bank NV. Amsterdam, May 2013. [2015-08-26]. Pp 2. http://www.dnb.nl/binaries/Working%20Paper%20381_tcm46-291731.pdf

3 Empirical Part: Spillover of the ECB's UMP

3.1 Related Literature

Being able to track real transmission of monetary policy require identifying the monetary policy shock. Usually, policy changes are evaluated using VAR models, which results are often that policy shocks do not lead to boosting output. Because of living in a so called "global village" with interconnected financial market, we need to identify the spillover effects of the monetary policy decisions of major central banks not only on the advanced countries but particularly on emerging market economies as they seem to be very sensitive to external shocks. Maćkowiak[68]found out that spillover effects of US monetary policy shocks on emerging markets account for a significant variance in the aggregate price level and real aggregate output and that this kind of shock lead to quick and strong short-term interest rate and exchange rate movements.

Once the policy rates hit ZLB, they are no longer a good policy indicator. Consequently, several authors have already attempted to construct a "shadow policy rate", which would correspond to the standard policy rate during normal times but is able to turn negative and record the real interest rate more reliable because it is not constrained by the ZLB. According to Bauer and Rudebusch[69]are shadow rates far better at evaluating the impact of monetary policy shocks, forecasting performance and the likely liftoff from the ZLB (and subsequent policy tightening). They also emphasize inclusion of macroeconomic factors when constructing shadow rate. Christensen and Rudebusch[70] show that that shadow rate are rather sensitive to underlying assumptions and specifications (concretely to the number of factors included in the estimation). Both papers practically based on the Krippner model[71] and in that way they concentrated on yield curve data.

[68]Maćkowiak Bartosz: External Shocks, U.S. Monetary Policy and Macroeconomic Fluctuations in Emerging Markets [online]. SFB Discussion Paper 2006-026. Department of Economics, Humboldt-Universität zu Berlin, Germany. [2015-08-15]. http://sfb649.wiwi.hu-berlin.de/papers/pdf/SFB649DP2006-026.pdf

[69]Bauer D., M., Rudebusch D. G.: Monetary Policy Expectations at the Zero Lower Bound [online]. FRBSF Working Paper 2013-18. Federal Reserve Bank of San Francisco, May 2015, [2015-08-15]. http://www.frbsf.org/economic-research/files/wp2013-18.pdf

[70]Christensen, J. H. E., Rudebusch D. G.: Estimating Shadow-Rate Term Structure Models with Near-Zero Yields. FRBSF Working Paper 2013-07 [online]. Federal Reserve Bank of San Francisco, June 2013, [2015-08-15]. http://www.frbsf.org/economic-research/files/wp2013-07.pdf

[71]Krippner, L.: A model for interest rates near the zero lower bound: An overview and discussion [online]. Reserve Bank of New Zealand Analytical Notes, September 2012, [2015-09-30]. ISSN 2230-5505. http://www.rbnz.govt.nz/research_and_publications/analytical_notes/2012/an2012_05.pdf

Lombardi and Zhu[72]constructed a dynamic-factor-based shadow rate, using a variables associated with different types of monetary policy operations such as interest rates, monetary aggregates, reserves, the FED's asset holdings. Their monetary policy indicator captures both unconventional and conventional monetary policy stances. According to their research, shadow rate turned negative in early 2009 (around 3%), but not as rapidly as it would be expected indicated by Taylor rule. Shadow rate get back above zero in May 2010, then sinking again.

Wu and Xia[73]assumed that there are some latent factors that determine changes over time in interest rates of different maturities where the dynamics of these factors follow simple linear equations. Overnight interest rate represents a linear function of these factors. The actual OIR is the maximum of the shadow rate and a positive lower bound on interest rate[74]. Thus, they constructed shadow rate that is correlated with a lagged macro variables[75] in a similar way as was the FED funds rate before the crisis. This is the evidence that their shadow rate can substitute the fed funds rate credibly once the fed funds rate hits ZLB. Then, they tried to estimate the impact of UMP on the selected macro variables. They found out that if it were not for the expansionary monetary policy, industrial production index would have been 101 instead of 101. 8; capacity utilization would be 0.3% lower and unemployment even 1% higher than actually observed. The actual US shadow policy rate is pictured below (Figure 11) and one can notice that the rate was -1.28% on July 21, 2015.Recently, they constructed also a shadow rate for Euro area (see Figure 12), which stood at -0.96% in May 2015. One can notice that this shadow rate reached negative values around December 2011 when LTROs program was implemented and again in July 2012 after Mario Draghi's commitment to do "whatever it takes" to preserve the euro. It is also apparent, that ECB did not reach as accommodative monetary policy as FED did.

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[72]Lombardi, M., Zhu, F.: A shadow policy rate to calibrate US monetary policy at the zero lower bound. BIS Working Paper No 452. Bank for International Settlements, June 2014. ISBN 978-9131-531-4. ISSN 1682-7678.
[73]Wu, C. J., Xia D. F.: Measuring the Macroeconomic Impact of Monetary Policy at the Zero Lower Bound [online]. CQER Working Paper 14-02, June 2014. Federal Reserve Bank of Atlanta. [2015-08-15] http://faculty.chicagobooth.edu/jing.wu/research/pdf/wx.pdf
[74]That is max $(\underline{r}, s_t)$; therefore, once the interest rate hits zero lower bound, shadow rate can track the real path of the interest rate.
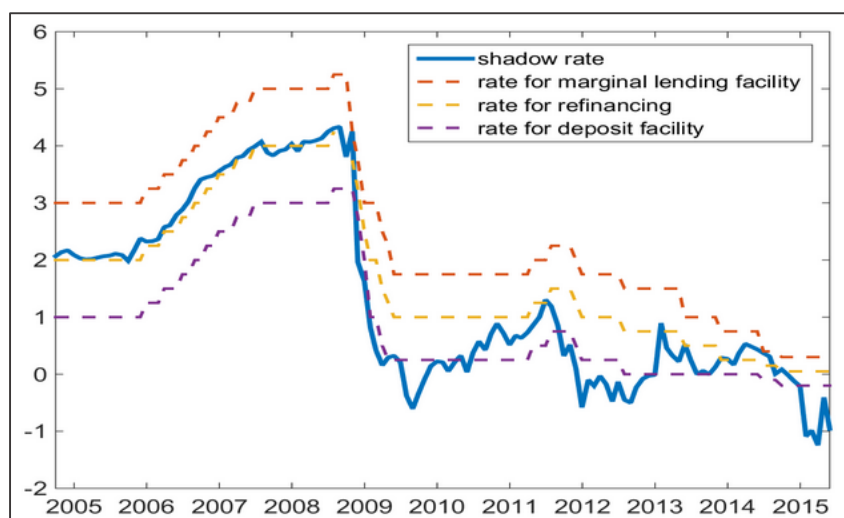[75]They focus on policy rate, industrial production, CPI, capacity utilization, unemployment and housing starts which cover both the real activities and price levels.

Figure 11: Wu-Xia's US Policy Rate
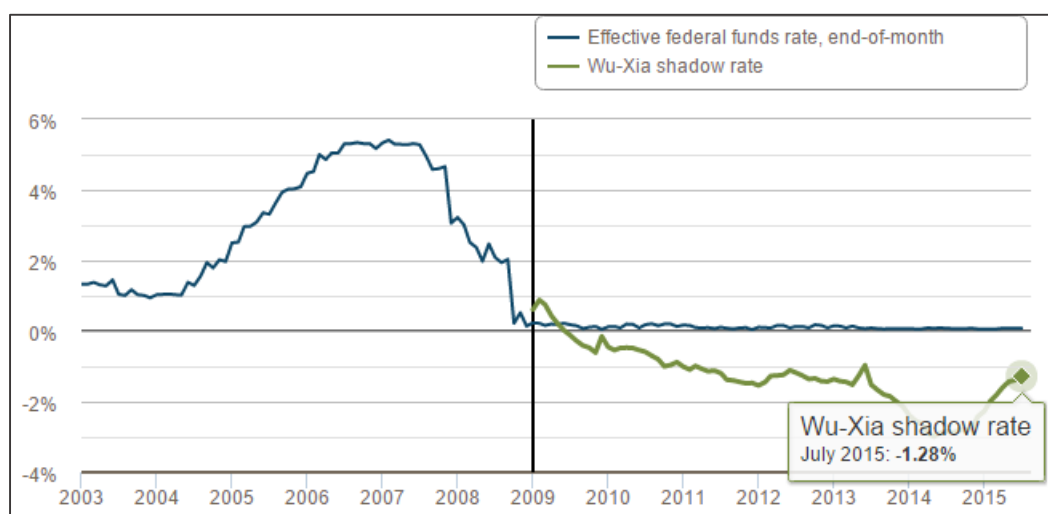
Figure 12: Wu-Xia's ECB Shadow Rate

A crucial paper for conducting the empirical part of this dissertation is the one by Claeys et al.[76] Authors studied the impact of ECB monetary policy on real macroeconomic variables in six small open countries outside the Eurozone (Czech Republic, Hungary, Poland, Denmark, Sweden, UK), using a block-restricted VAR model. They also estimated their own

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[76]Kucharčuková Babecká, O., Claeys, P., Vašíček, B.: Spillover of the ECB's Monetary Policy Outside the Euro Area: How Different is Conventional from Unconventional Policy? [online]. CNB Working Paper Series 15/2014. ©Czech National Bank, December 2014, [2015-08-20]. http://invenio.nusl.cz/record/180948/files/nusl-180948_1.pdf

Shadow Rate[77] and subsequently, using Minimum Partial Average method, took out from its first two factors to be able to tell the effects of conventional (first factor) and unconventional (second factor) monetary policy separately. The first factor turned out to be driven by interest rate developments, while the second one by ECB balance sheet items.

The spillovers to the countries outside the Eurozone turned out to be heterogeneous. When studying the responses to a positive shock to the 3-month Euribor, a drop in industrial production in all six countries is observed. As for the responses of prices, price puzzle[78] is found for Czech Republic, Hungary, Poland and Sweden. Domestic interest rates react quickly, almost immediately (although the response period differs among the subjected countries). Exchange rate depreciates in all countries but for Denmark. Shocks to MCI and the first factor (conventional monetary policy) bring almost the same results as the shock to 3-month Euribor. On the other hand, responses to the shock to the second factor (UMP) are heterogeneous across countries.

Eichenbaum and Evans[79] analysed the effects of monetary shocks to federal funds rate. Following the contractionary monetary policy shock, real GNP, employment and retail sales persistently declines, unemployment increases and there is a sharp, persistent declines in commodity prices and strong liquidity effect, namely rise in the federal funds rate and a fall in various measures of money.

3.2 VAR model

Often, structural VAR models are employed to identify the structural innovations in order to analyze the dynamic responses of the model to these shocks (where structural innovations are identified by imposing suitable restrictions). I replicated the two-country model of Claeys et al.[80]:

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[77] To be more concrete, they constructed a Monetary Condition Index, based on factor analysis, to account for overall monetary conditions in the euro are, based on monetary variables contained in five major blocks: a) Interest rates, b) Monetary aggregates, c) Selected asset items from the ECB balance sheet, d) Selected liabilities form the ECB balance sheet, e) Exchange rate.

[78] Price puzzle means higher rates as the consequence of higher inflation. Authors point out that one of the reasons for this price puzzle is high correlation of business cycles within the EU

[79] Eichenbaum, M., Evans Ch. L.: Some Empirical Evidence on the Effects of Shocks to Monetary Policy on Exchange Rates [online]. The Quarterly Journal of Economics, Vol. 110, No. 4, November 1995, Pp. 975 – 1009, [2015-09-24].
http://pages.stern.nyu.edu/~dbackus/GE_asset_pricing/EichenbaumEvans%20QJE%2095.PDF

[80] Kucharčuková Babecká, O., Claeys, P., Vašíček, B.: Spillover of the ECB's Monetary Policy Outside the Euro Area: How Different is Conventional from Unconventional Policy? [online]. CNB Working Paper Series

$$A(L)y(t) = \varepsilon(t),$$

Which can be re-written in the following form:

$$A(L) = \begin{bmatrix} A_{11}(L) & A_{12}(L) \\ A_{21}(L) & A_{22}(L) \end{bmatrix}, y(t) = \begin{bmatrix} y_{1(t)} \\ y_{2}(t) \end{bmatrix}, \varepsilon(t) = \begin{bmatrix} \varepsilon_1(t) \\ \varepsilon_2(t) \end{bmatrix},$$

With exogenous block: $A_{21} = 0$,

Where ε_1 is a vector of structural disturbances of external origin (Euro area) and ε_2 is a vector of structural disturbances of domestic origin; vector y contains m_1 exogenous variables and the m_2 endogenous variables. Subscript 1 always corresponds to the Euro area and subscript 2 stands for the domestic economy. Domestic economy is assumed to be a small open economy. This is a kind of standard VAR model, enabling us to examine the spillover effects of ECB policies.

The endogenous block of the VAR consists of the industrial production index, the HICP, the 3-month interbank interest rate and the exchange rate of the domestic currency vis-à-vis the euro, while the exogenous block is made of the Euro area's industrial production index, the HICP and the monetary instrument (Choleski ordering[81]). Assumption of block exogeneity imposes recursive order on the system (thus contemporaneous causality is restricted) in a way that domestic shock do not affect the external variables. Analyzed are the Forecast Impulse Responses[82] to shock in the 3-month Euribor, the MCI, the first and the second factor[83]. To get exactly the same results as Claeys et al.[84] did, I firstly worked with 3 lags, a shift dummy from September 2008, bootstrapped data via Efron Percentile with CI 67%[85] and run

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15/2014. ©Czech National Bank, December 2014 [2015-08-20]. Pp. 14
http://invenio.nusl.cz/record/180948/files/nusl-180948_1.pdf

[81]Choleski decomposition is a sort of orthogonalisation as the original shocks are transformed into recursive, orthogonal shocks. One has to be cautious when ordering the variables as the results (lower triangular matrix) varies with the ordering of the variables. Orthogonalisation is used for better interpretation of the dynamic relationships within the data as the residuals from the VAR are broken up into linear combinations of independent, not correlated, shocks (as can be otherwise obtained by structural shocks in SVAR models). Consequently, VAR system is recursive and we can observe clear chain of causality among surprises in the variables (shock occurs just in one variable at a time). If the shocks were not independent, then the disturbance terms would cover all the influences.

[82]Impulse responses collect the effect of an exogenous shock (innovation) in one variable on the same or all of the other variables. Granger-causality cannot deal fully with the interactions between the variables of a system.
[83]Both factors are used in the VAR at the same time, but the first factor comes before the second factor to imply that shocks to the second factor are orthogonal to those in the conventional factor.
[84]Kucharčuková Babecká, O., Claeys, P., Vašíček, B.: Spillover of the ECB's Monetary Policy Outside the Euro Area: How Different is Conventional from Unconventional Policy? [Online]. CNB Working Paper Series 15/2014. ©Czech National Bank, December 2014, [2015-08-20]. Pp. 15 – 20.
http://invenio.nusl.cz/record/180948/files/nusl-180948_1.pdf
[85]This means bootstrapping confidence bands which makes them asymmetric.

the VAR for 48 periods[86].A constant is always used as a deterministic variable in my VAR models. The data cover the time period from January 1999 to June 2014.

Checking the stationarity via ADF test[87], the time series for the industrial production index and the HICP turned out to be different by country (for details see the Table A in Appendix). When plotting my time series, I would expect at least the industrial production index and the HICP to be more volatile in EMEs than in AEs[88] but I did not find the evidence for this. Interestingly, the plots of the industrial production index and the HICP (particularly after 2003) of Czech Republic and Euro are look very similar. Consequently, I used the HP filter[89]to make the time series of the industrial production index and the HICP stationary and look at how the Impulse Responses change. Another "benefit" of using the HP filter is that it creates the output gap out from the industrial production index. Working with output gap, one should then obtain better responses of inflation[90].Further, I replaced in my VAR models HICP with inflation rate. This should ameliorate the informational ability of my model as the HICP basically covers just the prices for a basket of goods for a particular month. On top of that, even though I did not find the exchange rates non-stationary (using ADF test), I tried to use the first differences of the logarithmic exchange rate in order to make my VAR models more reliable and consequently worked just with this form of exchange rate. Consequently, for each country, I made the Impulse Responses for period before and after September 2008 separately. When analyzing Impulse Responses separately for time period before and after September 2008, I did not succeed in showing the Impulse Responses to shocks to F1 and F2 in Poland as the matrix was suddenly not positive definite.[91]Finally, I compared the Impulse responses to shock to MCI (so called shadow rate) constructed

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[86]I indeed got the same outputs.

[87]I also tried KPSS test (where the null hypothesis is opposite to the ADF test – stationarity), but since this lead to confusing results, I decided hold on to the ADF test.

[88]Duncan, R.: A simple Model to Teach Business Cycle Macroeconomics for Emerging Market and Developing economies [online]. June 29, 2015 [view. 2015-08-29]. http://www.ohio.edu/PEOPLE/duncanr1/file/model3.pdf

[89]Hodrick-Prescott Filter is used to disentangle the cyclical and trend component of a variable, thus avoid misinterpreting the relationship between variables. Since this filter captures medium term trends, it is better than just linear de-trending. Higher the value of lambda, smoother the trend component, the more of the data the cyclical components account for. Mathematically:

$y_t = \tau_t + c_t$

$min(y_t - \tau_t)^2 + \gamma[(\tau_{t+1} - \tau_t) - (\tau_t - \tau_{t-1})]^2$

[90]Razzak, W. A., Dennis, R.: The output gap using the Hodrick-Prescott filter with a non-constant parameter [online]. 1999, [2015-09-24]. http://razzakw.net/paper5.pdf

[91]I did not find my matrix to be singular but I think that my eigenvalues estimates became negative because of the Choleski decomposition and consequently my variables were treated as collinear even though I did not find evidence for collinearity among my variables

by Claeys et al.[92] with those to shadow rate by Wu, Xia[93]. I downloaded the time series of the shadow rate by Wu, Xia from the Federal Reserve Bank of Atlanta website.[94] In all cases, I am going to focus just on the impulse responses for the non-euro area countries.

For each of the presented tables, I obtained the impulse responses of the selected macro-variables (the industrial production index/output gap, HICP/Inflation, 3-month domestic interbank interest rate, Exchange rate) to various shocks by estimating a corresponding VAR model[95]. The logic of the tables is as follows: the columns represent the shocks to 3-month Euribor, MCI, F1 and F2 (almost always in this ranking) while the rows represent the responses of industrial production (output), consumer price inflation, short-term interest rate and exchange rate (exactly in this ranking).

3.3 Results

All the reported results refer to the detailed country plots in the Appendix[96]. Firstly, I plotted my time series and found out significant trends in almost all variables. Therefore, I started de-trending the data using HP filter. Ravn & Uhlig[97] suggest the optimal value of lambda for monthly data to be 129600. I tried 200, 1600 (the default value), 80000, 129600. Interestingly, the results were not noticeably different when using different values of lambda hence I followed the Ravn & Uhlig suggestion.

Using HP filter for the industrial production index and the HICP did not really change the Impulse Responses in all countries. As an example, Impulse responses in Denmark with and without HP filter are shown in Table B. Then, I looked at Orthogonal Impulse Responses[98] which deliver again almost the same outputs. This time, I chose Czech Republic as an illustration (Table C). Since apparently most of the dynamics of Impulse Responses

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[92]Kucharčuková Babecká, O., Claeys, P., Vašíček, B.: Spillover of the ECB's Monetary Policy Outside the Euro Area: How Different is Conventional from Unconventional Policy? [Online]. CNB Working Paper Series 15/2014. ©Czech National Bank, December 2014, [2015-08-20]. Pp. 15 – 20.

[93]Wu, C. J., Xia D. F.: Measuring the Macroeconomic Impact of Monetary Policy at the Zero Lower Bound [online]. CQER Working Paper 14-02, June 2014. Federal Reserve Bank of Atlanta. [2015-08-15] http://faculty.chicagobooth.edu/jing.wu/research/pdf/wx.pdf

[94]Frbatlanta.org. Wu-Xia Shadow Federal Funds Rate. Center for quantitative economic research. September 3, 2009 [2015-09-04]. https://www.frbatlanta.org/cqer/research/shadow_rate.aspx

[95]For example, to obtain Impulse Responses to shock to 3M Euribor in Czech Republic, I selected my variables (ipez, cpiez, rateez, ipcz, cpicz, ratecz, excrcz) and then plotted the Impulse Responses of "ipcz", "cpicz", "ratecz", "excrcz" to shock in "rateez" (bootstrapped by Efron Percentile).

[96]I made all my econometric analysis in JMulti software.

[97]Ravn, O. M., Uhlig, H.: On Adjusting the Hodrick-Prescott Filter for the frequency of observations [online]. The Review of Economics and Statistics, May 2002, 84(2): 371 – 380. [2015-09-07]. http://faculty.georgetown.edu/mh5/class/econ489/Ravn-Uhlig.pdf

[98]Innovations of size one standard deviations.

finishes after 36th period and also, the Efron Percentile of 67% seems to be unreasonably wide, I conducted further analysis with 90% Efron Percentile for 36 periods and 3 lags[99]. Also, as one can notice when not using the first differences of the logarithmic exchange rate, the responses of exchange rate are quite dynamics[100], leading to immediate appreciation that lasts for at least five months and price puzzle is very often present. But usually, domestic economies use their policies to prevent strong volatility of the exchange rate.

As has been announced in the previous section, the following Impulse Responses (Table D – I) are obtained from VAR models with HP filter for the industrial production index (thus obtaining output gap), the first differences of the logarithmic exchange rate and HICP is replaced by inflation rate. However, having my variables transformed in this described manner, I was not able to obtain Impulse Responses for Hungary and Poland from VAR model containing 3 lags, but just 2 lags as otherwise the error terms became cointegrated and I was supposed to use the VECM[101] model.

The usage of first differences of the logarithmic exchange rate induce not only totally different reaction of the exchange rates but also lead to elimination of the price puzzle in most of the cases. This corresponds to the Peersman[102] finding that stronger exchange rate effect is translated in a smaller price puzzle. Considering the whole time period, the response of output to monetary tightening is a quick decrease, reaching the bottom approximately after one year. Exception is Sweden, where the response of output to shock to short-term interest rate is practically zero, but is very similar to other countries in case of shocks to MCI, F1 and F2.

However, I did not find significant response of inflation[103] to subjected shocks for all countries except the UK where the original reaction is even the rise in inflation (in response to shock to 3-month Euribor, MCI and F1) with the subsequent fall (after the first quarter)[104]. This finding is also similar to one of Peersman[105] that prices react more sluggishly and start to fall significantly just several quarters after the fall in output.

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[99]3 lags are optimal according to Akaike and Hannah-Quinn criterion.

[100]This finding is in compliance to what found out Mackowiak (Mackowiak, B (2006)), namely that monetary policy shock affects quickly and strongly the short-term interest rate and the exchange rate. Although, this was for emerging markets.

[101] VECM = Vector Error Correction Model

[102]Peersman, G., Smets, F. The monetary Transmission mechanism in the euro area: more evidence from VAR analysis. ECB Working Paper No. 91, December 2001. ISSN: 1561-0810. Pp 18

[103]Just rather modest tendency towards disinflation.

[104]But the price puzzle is presented.

[105]Peersman, G., Smets, F. The monetary Transmission mechanism in the euro area: more evidence from VAR analysis. Note No. 102.

The strongest reaction is apparently by interest rates. Domestic interest rates rise immediately and strongly in response to all the shocks, peaking usually during the first quarter and then falling back down. This result is expected as it is supported by other empirical evidence[106].

As for the exchange rate, the very initial appreciation (or a small-sized deviation from zero in case of Sweden) in almost all countries can be found, but the effect is again practically zero just after first two months.

The responses[107] to Shock to 3-month Euribor are basically the same as the responses to F1 for all countries but for the Sweden, where the responses to shocks to MCI and F2 are more similar.[108] This proves that the F1 indeed correspond to conventional monetary policy. Also, domestic interest rates react more briskly to 3-moth Euribor and F1 in Czech Republic, Hungary and Poland. In case of UK and Denmark, interest rates react to all shocks in a same way[109] but in case of Sweden, opposite reactions are seen, namely quicker reactions of interest rate to MCI and F2 (which could be an evidence that for Sweden, the overall monetary condition index is better indicator of the transmission of Eurozone's monetary policy and that Sweden is more influenced by balance-sheet operations than by conventional monetary policy). On the other hand, shock to F2 does not produce particularly different reactions (from those to F1, MCI and 3-moth Euribor). In Czech Republic and Denmark just the immediate drop in inflation and tendency to disinflation during first year after the shock is more visible, there is almost no reaction of variables to shock to F2 in case of Hungary and Poland and only output mildly fall in response to shock to F2 in case of UK; in other countries, shock to F2 has a very subdued effect on output in all countries.

When analyzing the Impulse Responses to shocks separately for period before and after September 2008, heterogeneous results are obtained, but is clear that monetary policy is transmitted differently to studied countries in examined periods. Considering firstly the period until September 2008, I look at whether the shock to 3-month Euribor is transmitted in a similar way as the shock to MCI to find out whether, under "normal times", the 3-month Euribor is a good proxy for the overall monetary policy conditions

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[106]For exampleEichenbaum, M., Evans Ch. L.: Some Empirical Evidence on the Effects of Shocks to Monetary Policy on Exchange Rates [online]. The Quarterly Journal of Economics, Vol. 110, No. 4, November 1995, Pp. 975 – 1009. [2015-09-24]. http://pages.stern.nyu.edu/~dbackus/GE_asset_pricing/EichenbaumEvans%20QJE%2095.PDF

[107]When talking about „responses", I mean the responses of output, inflation, domestic interest rate and Exchange rate.

[108] Also, in Hungary are the responses to shock to F2 and to MCI almost the same, but still the responses to shock to F1 and to 3- month Euribor are practically the same.

[109]Slightly different is in case of the UK, where the dynamics of the reaction of interest rate to F2 (unconventional monetary policy).

in euro area[110]. The answer is yes in case of Czech Republic, Hungary, Denmark and Poland. As for Sweden, the Impulse Responses to shocks to MCI are more similar to those to F1. In case of the UK, there is no clear similarity among all the Impulse Responses and the reaction of domestic interest rate is quite different, going sharply up in response to shock to MCI, but not showing significant deviation from zero in response to shock to 3-month Euribor.

Also, I would expect the reactions to shock to F1 to be more dynamic then those to F2 in this time period but I did not find apparent evidence for that. However, the variables react more supposedly (drop in the output, muted response of inflation with a deflationary tendency, rising interest rate) to shock to F1 than to F2 until September 2008. In Czech Republic, Denmark, Sweden domestic interest rates respond to shocks to F1 and F2 in exactly the opposite way – going up in response to shock to F1, but down in response to F2. The same is also for the UK, but in this country the inflation stay above zero for more than two years (instead of having descending trend).

Looking at the second time period (after September 2008), there is a similarity between the Impulse Responses to shock to F2 and MCI. Output falls, inflation mainly falls (Czech Republic, Hungary, Denmark) or the response is insignificant (Sweden). Interest rate rises just in case of Denmark and the UK. On top of that, in UK inflation again goes up immediately and turns negative only after one year.[111] In Sweden, output falls more quickly in response to shock to F2 and in Hungary the fall in output is even persistent. Also, the Impulse Responses of interest rate are more persistent in the period before September 2008 in Czech Republic, Denmark, Sweden and United Kingdom. In addition to that, during "unconventional times" (the second period) macroeconomic variables in Czech Republic, Hungary and Sweden react in a quite different manner to shock to F2 than to 3-month Euribor.

The final table is the comparison of Impulse Responses to shock to the shadow rate (MCI) by Claeys et al.[112]with the shadow by Wu and Xia[113]. The Responses are generally same,

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[110]Babecká Kucharčuková, O., Claeys, P., Vašíček, B.: Spillover of the ECB's Monetary Policy Outside the Euro Area: How Different is Conventional from Unconventional Policy? [online]. CNB Working Paper Series15/2014. ©Czech National Bank, December 2014, [2015-08-20]. Pp 20.
http://invenio.nusl.cz/record/180948/files/nusl-180948_1.pdf
[111]However, in the UK, price puzzle is present in Impulse Responses to all shocks in this time period.
[112]Babecká Kucharčuková, O., Claeys, P., Vašíček, B.: Spillover of the ECB's Monetary Policy Outside the Euro Area: How Different is Conventional from Unconventional Policy? Note No. 110, Pp. 9-10.
[113]Wu, C. J., Xia D. F.: Measuring the Macroeconomic Impact of Monetary Policy at the Zero Lower Bound [online]. CQER Working Paper 14-02, June 2014, [2015-09-30]. Federal Reserve Bank of Atlanta. Pp. 4-15.
http://faculty.chicagobooth.edu/jing.wu/research/pdf/wx.pdf

one can find just gentle differences in the reaction of interest rates and inflation which is not surprising taking into account different structure of these two shadow rates.[114]

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[114]As mentioned in section 3.1., while the MCI contains information regarding interest rates, monetary aggregates, ECB balance sheet and Exchange rate, the shadow rate by Wu and Xia (2014) contains also variables measuring price level, real economic activity and employment.

Conclusion

On the verge of a crisis-break out, markets tend to be flooded by asset price bubbles and debt-financed spending booms. Once the bubble bursts, borrowers are forced to recover their balance sheet via reduced spending or default. This leads to <u>balance sheet recession</u>, typically followed by sluggish recoveries and permanent output losses which force the authorities to intensively think about solutions. Past five years were characterized by QE programs, put into effect by major advanced economies. The ECB and the FED both implemented series of unconventional policy actions, but these policies differed in nature, purpose, timing and allocated amount of money. While the FED launched large-scale asset purchases, the ECB focused on collateralized lending which correspond to its more bank-concentrated financial system.

My aim in this dissertation was to provide reader with a theoretical background concerning the unconventional monetary policies implemented by the FED and the ECB after 2008, look at their global spillovers and then analyse how the UMP of ECB were transmitted to the six particular countries outside euro area.

Empirical evidence suggests that unconventional monetary policies implemented by the FED and the ECB have had economically significant effects in the US and the Eurozone but their impact on foreign economies may not always be beneficial. The FED's UMP lowered foreign long-term interest rates which induced portfolio-rebalancing toward more risky assets as investors were seeking higher yields. Also, emerging market economies were adversely affected by the pro-cyclical effects of quantitative easing policies. On the other hand, these policies also lowered term premium and eased financial conditions. Unconventional policies adopted by the ECB increased equity prices, lowered credit risk and market fragmentation in bond markets and often lead to exchange rate movements.

Recent literature suggests that using so called shadow rates instead of policy rates can give a better picture of the effects of unconventional policies as this rate is not constrained by the zero lower bound and is able to record the real interest rate more reliably.

In my empirical part, the benchmark model comes from Claeys et al.[115]. The block-restricted VAR model enables to track the changes in macroeconomic variables in response to shock to

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[115]Babecká Kucharčuková, O., Claeys, P., Vašíček, B.: Spillover of the ECB's Monetary Policy Outside the Euro Area: How Different is Conventional from Unconventional Policy? [online]. CNB Working Paper Series15/2014. ©Czech National Bank, December 2014, [2015-08-20]. Pp 20. http://invenio.nusl.cz/record/180948/files/nusl-180948_1.pdf

not only 3-month Euribor but also to the Monetary Condition Index, conventional and unconventional policies.

My results confirm that euro area monetary policy does have an impact on non-euro area countries, although the response of macroeconomic variables in analysed countries are heterogeneous and also differ in the period before and after September 2008. Further, my results prove that non-euro area countries are affected more by conventional monetary policies until September 2008, but the euro-area monetary policy spills over via unconventional policies after September 2008. Overall, the ECB's policies affect economic activity outside euro area, but does not have significant effect on inflation. Furthermore, the exchange rate just initially drops in response to monetary tightening, but this reaction usually does not last for more than four months. Using the shadow rate by Wu and Xia[116] instead of the MCI does not essentially change the picture.

The spillover effects of ECB's UMP are still of further research. For example, my model does not account for changes in market's expectation, nominal rigidities and various endogenous factors that influence the trade, portfolio-rebalancing and exchange rate channels of transmission and thus can lead to different results.

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Appendix

Table A: Overview of the stationary/non stationary variables[117]

	CPICZ	CPIDK	CPIEZ	CPIHU	CPIPL	CPISE	CPIUK	IPCZ	IPEZ	IPDK	IPHU	IPPL	IPSE
STAT.	X***			X***	X***	X*		X**	X*	X***	X**	X***	X***
NONSTAT.		X***	X***				X***						

Table B: Comparison of Impulse responses with/without HP filter for ipez, ipdk, cpiez, cpidkin Denmark; 3 lags, 67% Efron Percentile for 48 periods

With HP filter
a) shock to 3M Euribor   *b) shock to MCI*   *c) shock to F1*   *d) shock to F2*

---
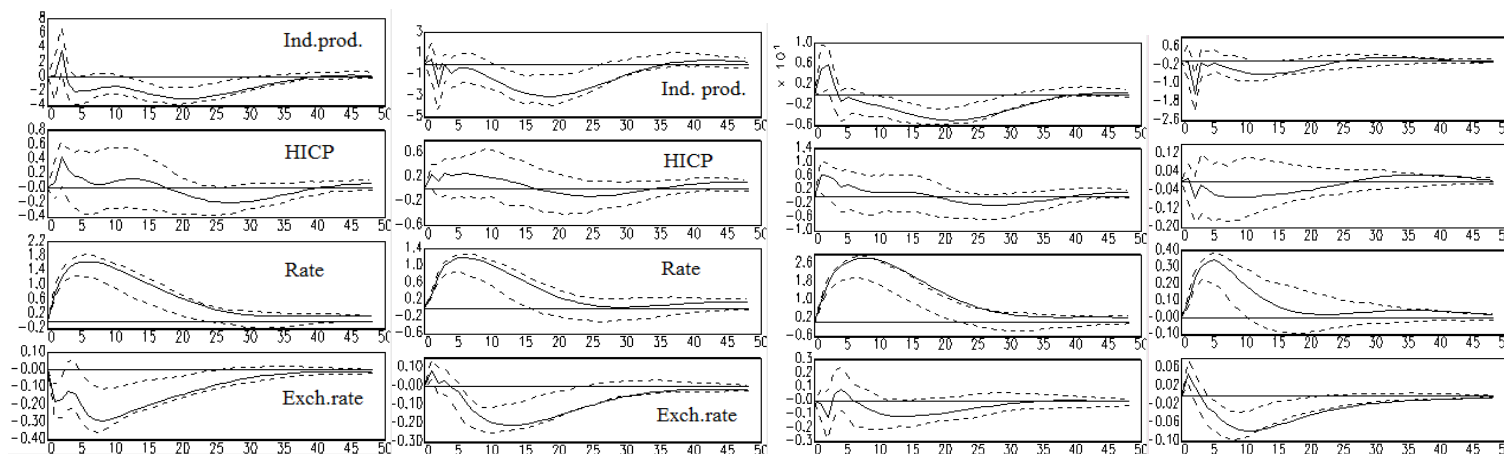
[117]Results are obtained by ADF test; *,**, *** significance at 10, 5, 1 percent levels; STAT. = stationary, NONSTAT. = non stationary.

Without HP filter
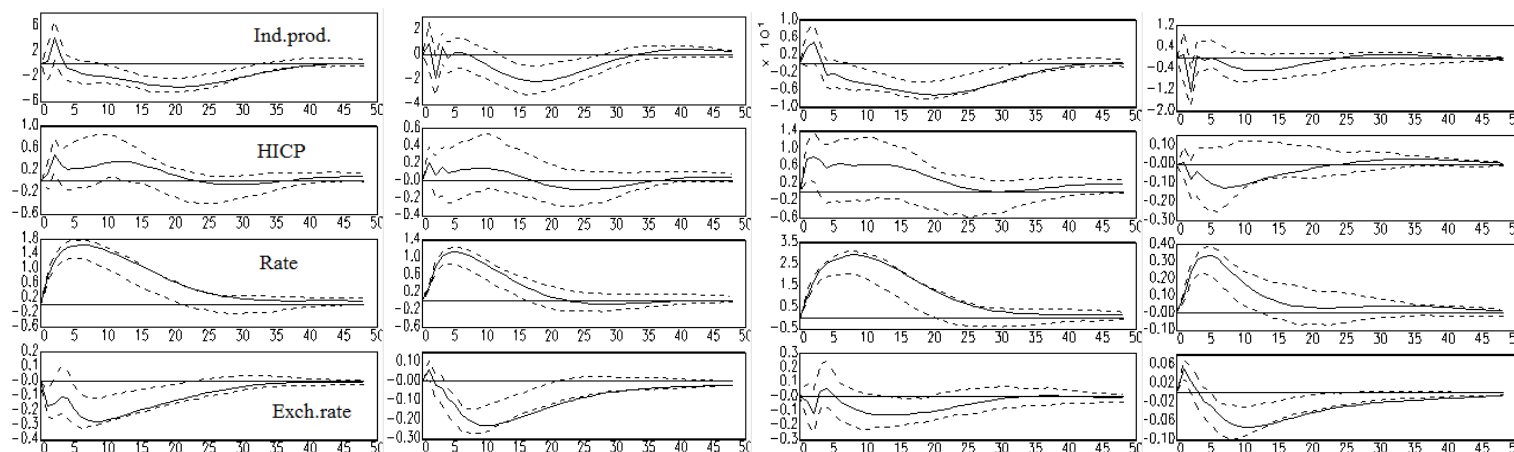
Table C: Comparison of Forecast/Orthogonal Impulse Responses in Czech Republic;
3 lags, HP filter (lambda 120600) for ipez, ipcz, cpiez, cpicz, 67% Efron Percentile for 48 periods

Orthogonal Impulse Responses

a) shock to 3M Euribor   *b) shock to MCI*   *c) shock to F1*   *d) shock to F2*
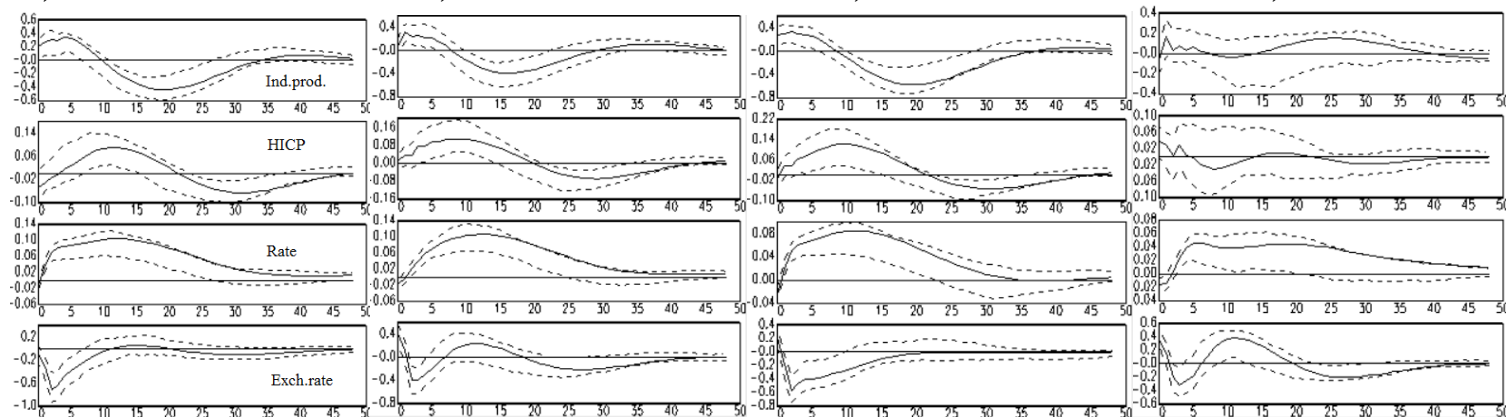
Forecast Impulse Responses

a) shock to 3M Euribor   b) shock to MCI   c) shock to F1   d) shock to F2
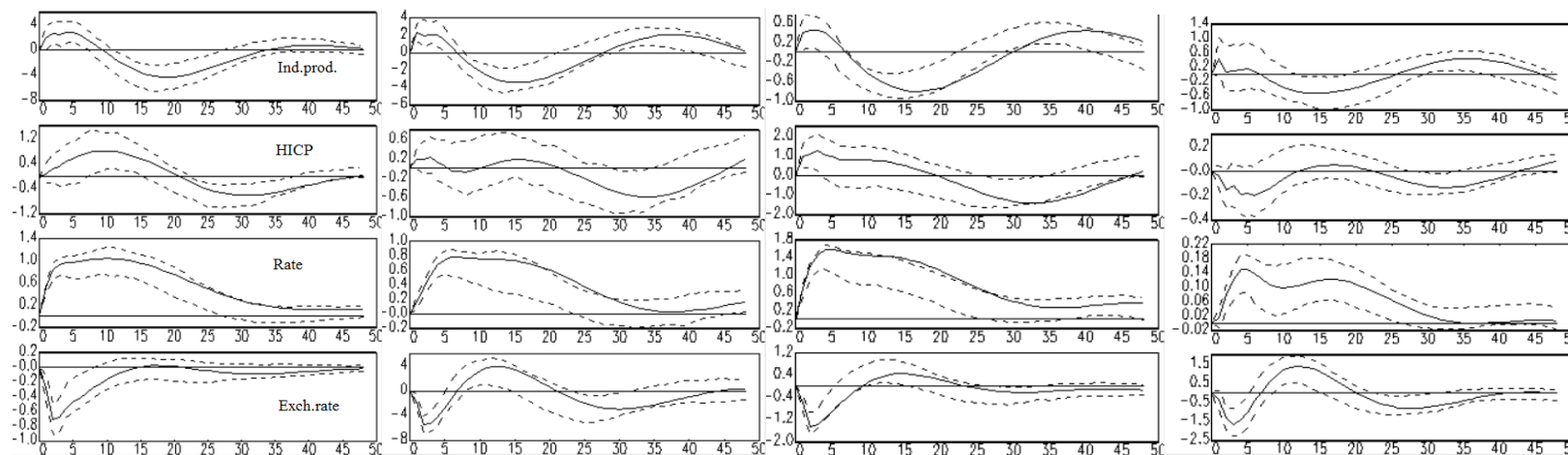
Following tables always display Impulse Responses coming from VAR models using 3 lags (except for Hungary and Poland), HP filter (with lambda 129600) just for the industrial production index, inflation (instead of HICP), first differences of logarithmic exchange rate and 90% Efron percentile for 36 periods; shift dummy for 09/2008 is used when analyzing the whole sample (not for Impulse Responses before and after 09/2008).

Table D:CZECH REPUBLIC
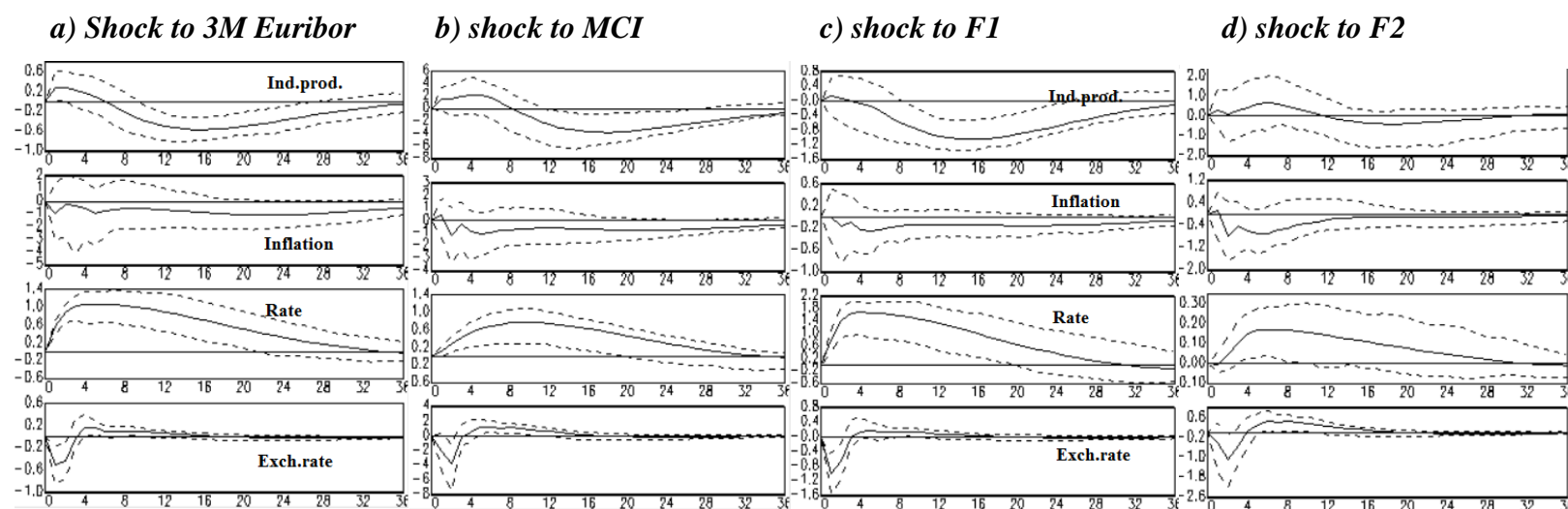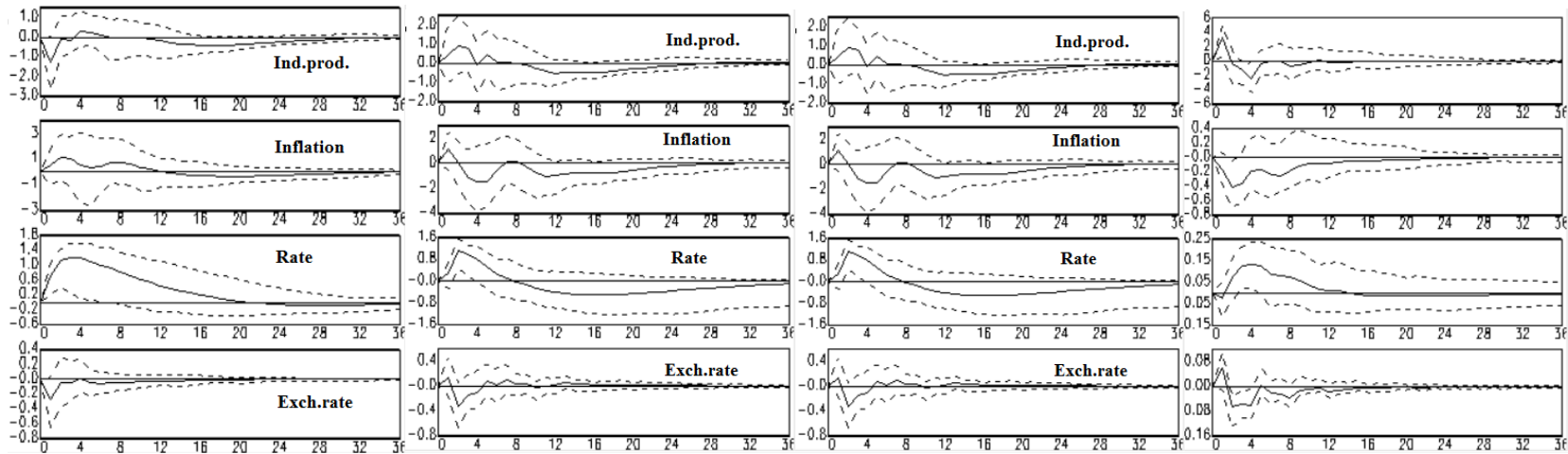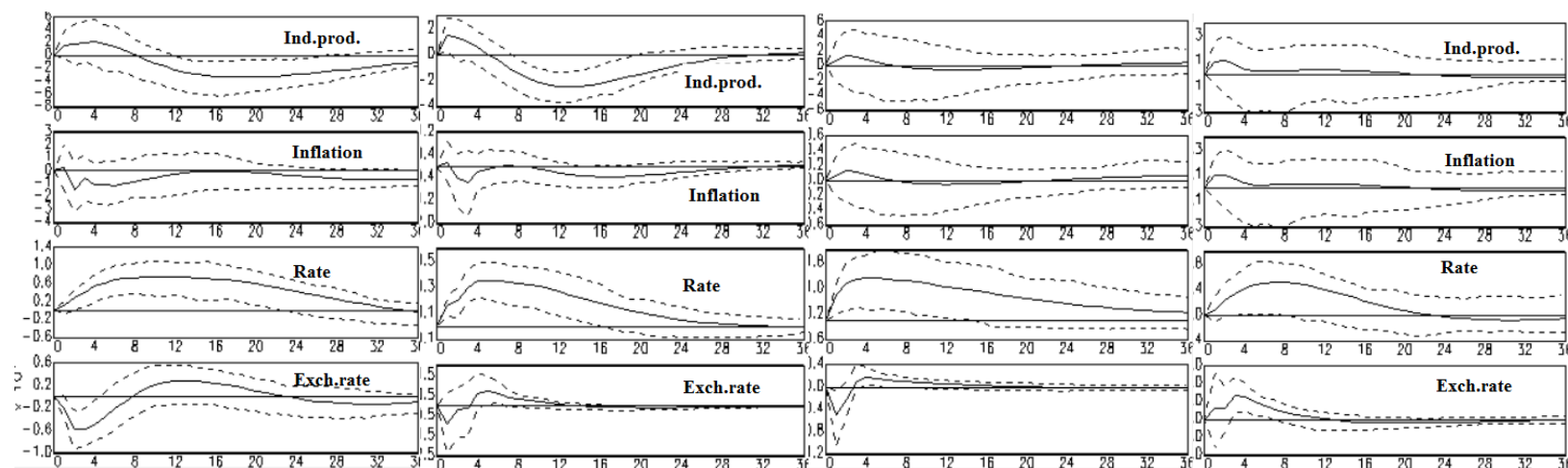
a) Shock to 3M Euribor   *b) shock to MCI*   *c) shock to F1*   *d) shock to F2*
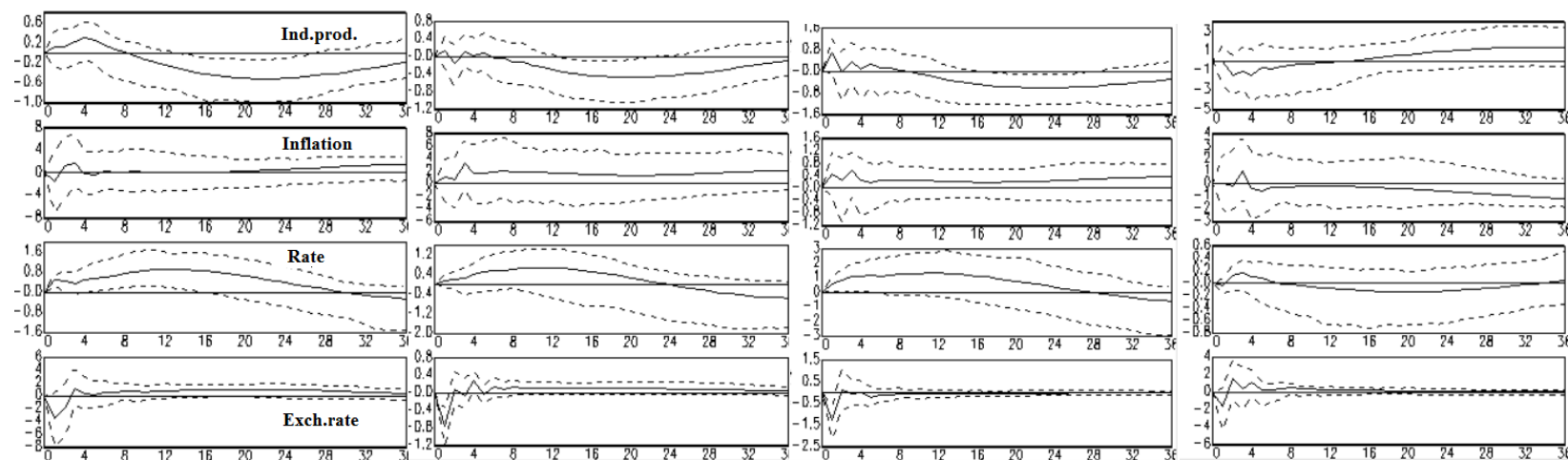
UNTILL 09/2008

AFTER 09/2008

a) shock to 3M Euribor   *b) shock to MCI*   *c) shock to F1*   *d) shock to F2*
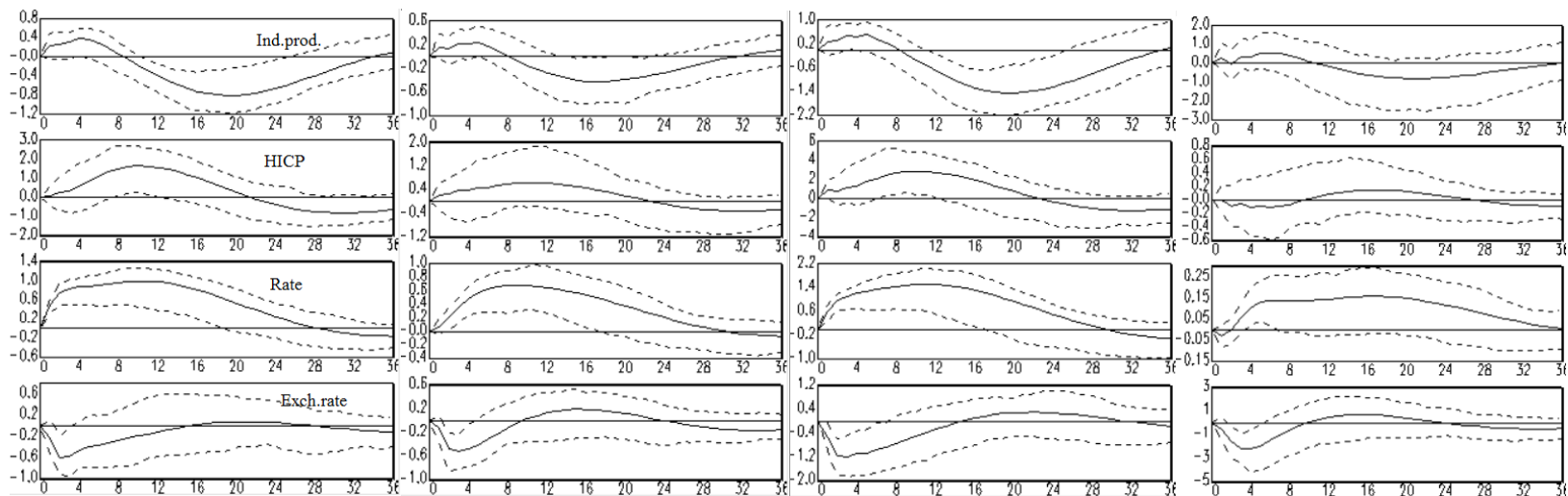
Table E: HUNGARY (only 2 lags)
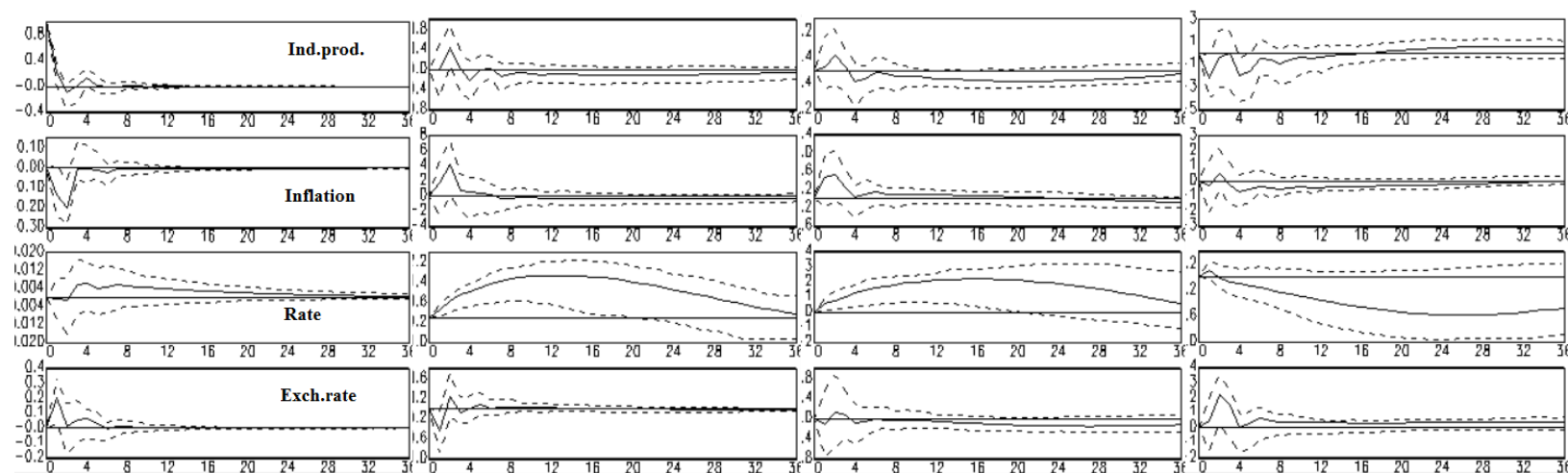
a) shock to 3M Euribor   *b) shock to MCI*   *c) shock to F1*   *d) shock to F2*
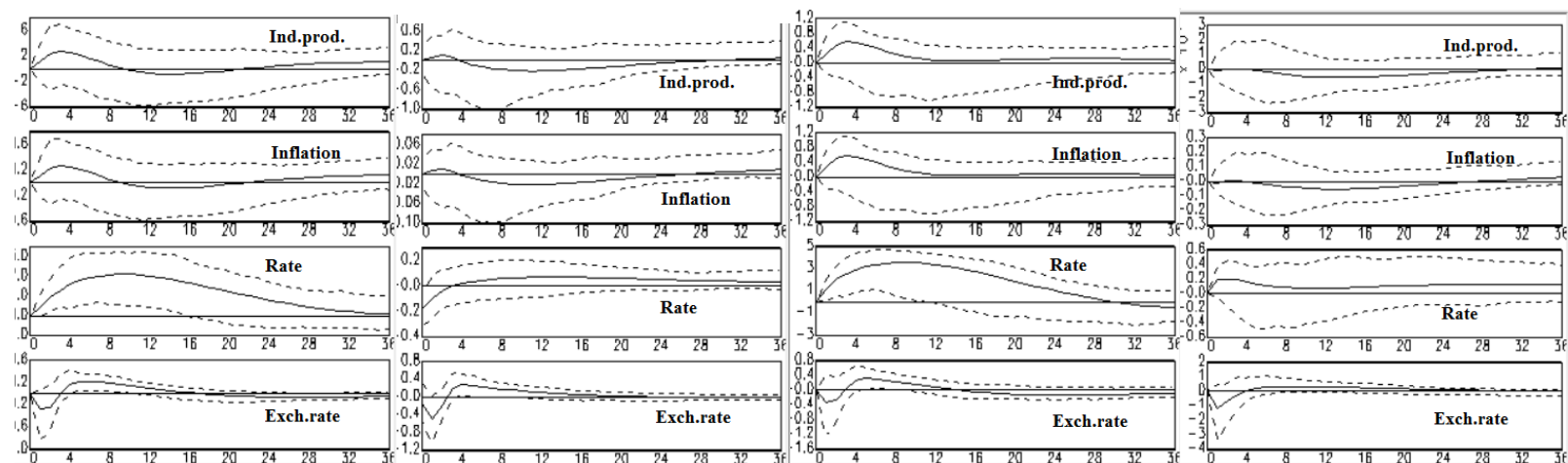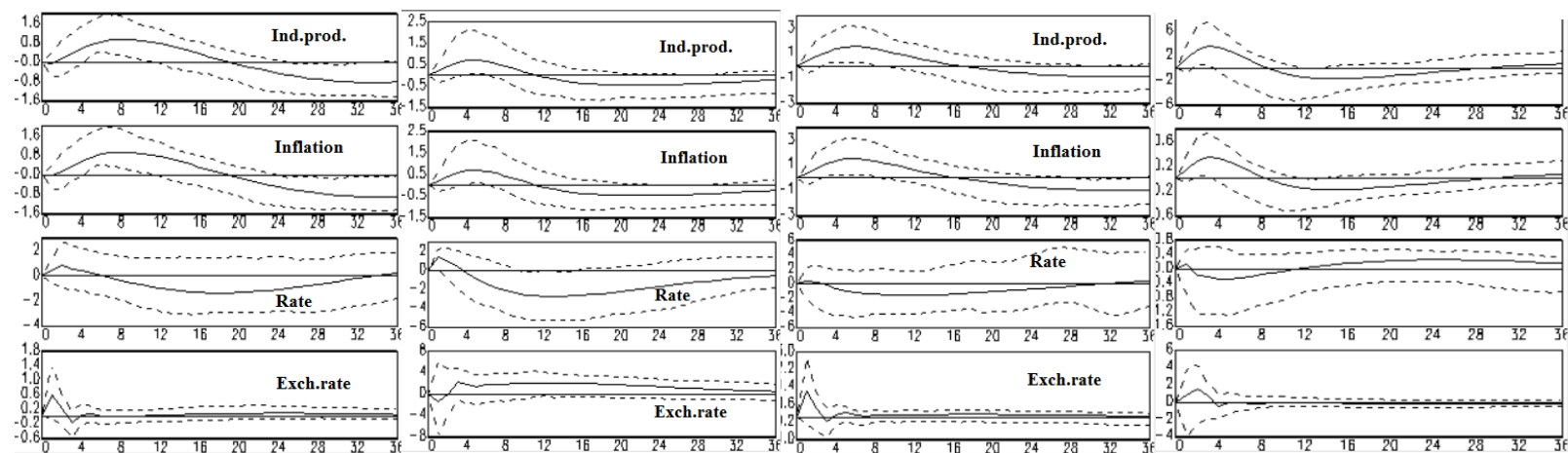
UNTILL 09/2008

AFTER 09/2008

a) shock to 3M Euribor   **b) shock to MCI**   **c) shock to F1**   **d) shock to F2**
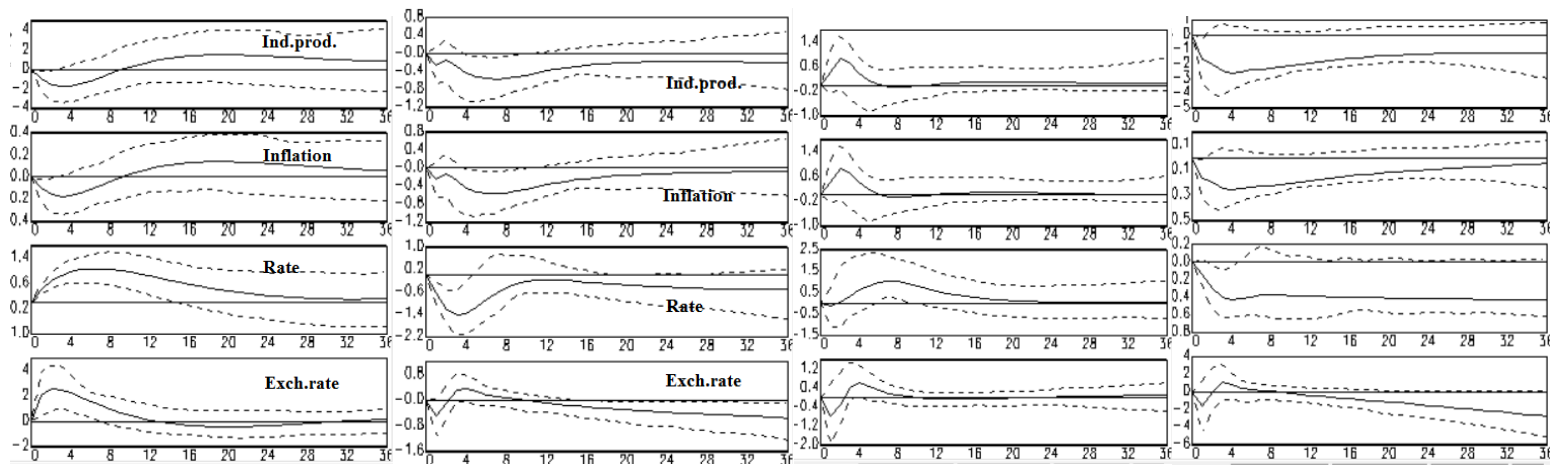
Table F: **POLAND (only 2 lags)**

a) shock to 3M Euribor   *b) shock to MCI*   *c) shock to F1*   *d) shock to F2*
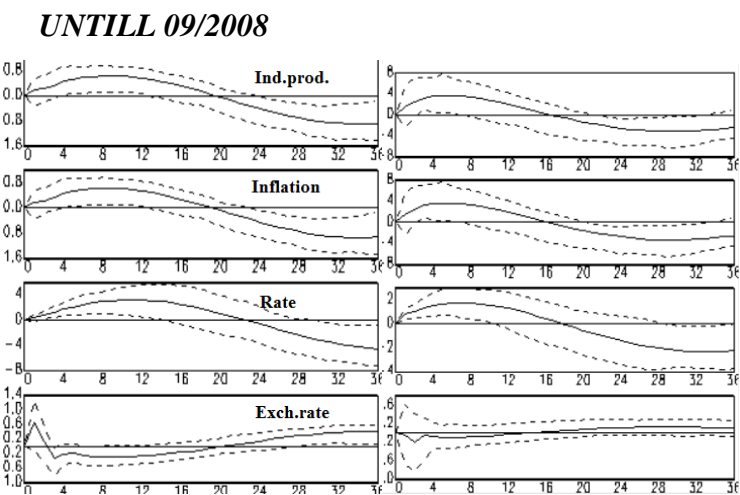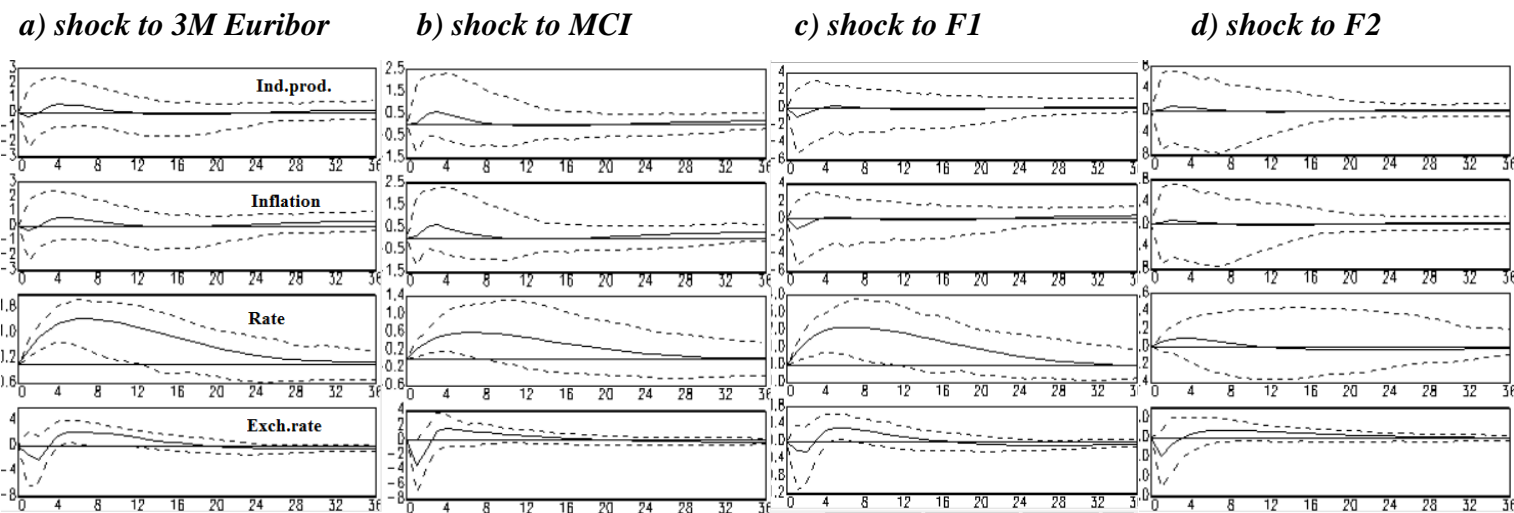
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a) shock to 3M Euribor   *b) shock to MCI*   *c) shock to F1*   *d) shock to F2*
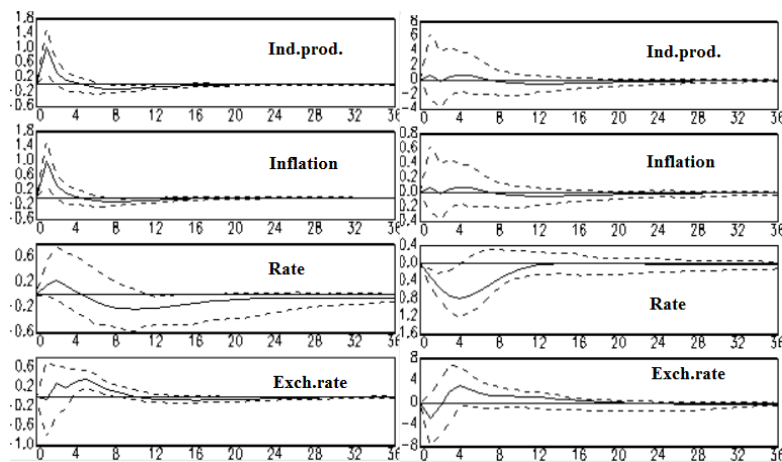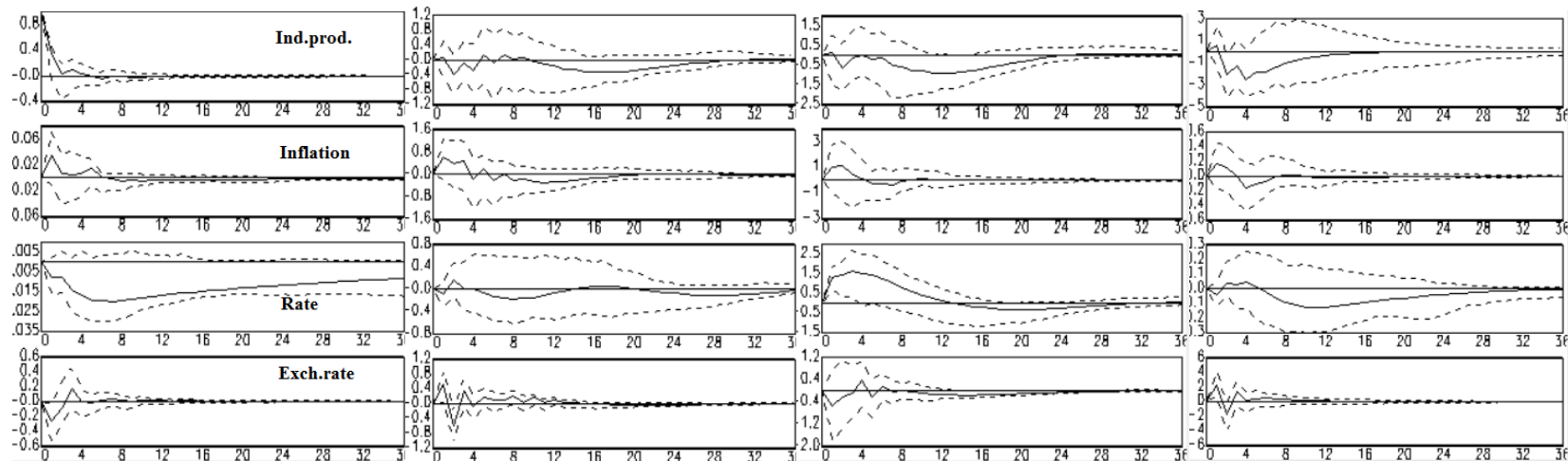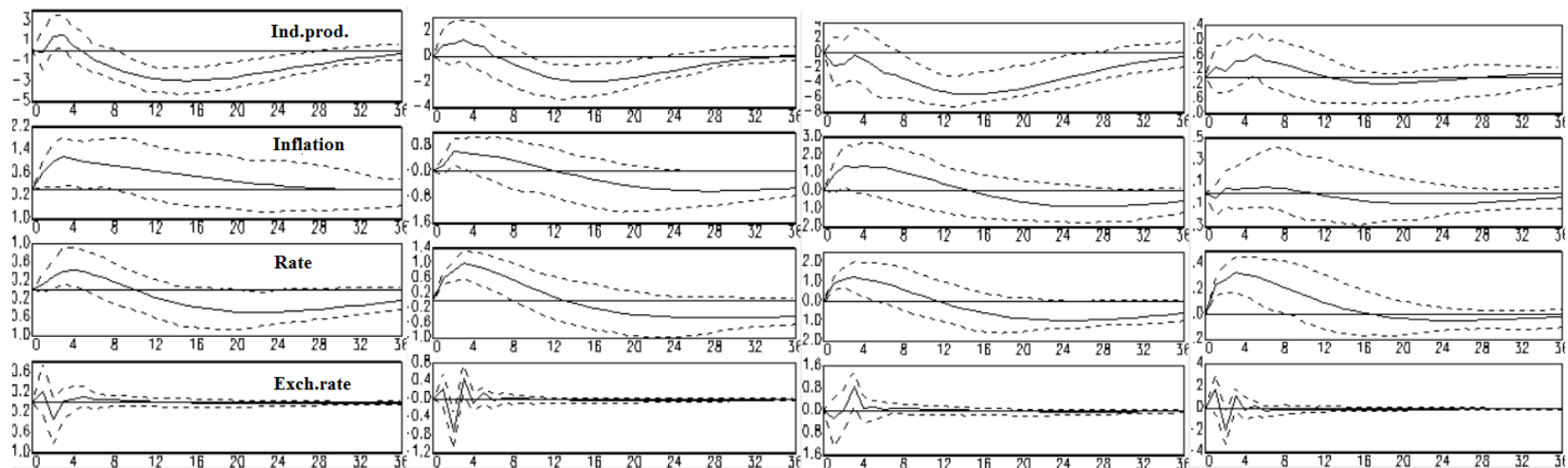

Table G: DENMARK
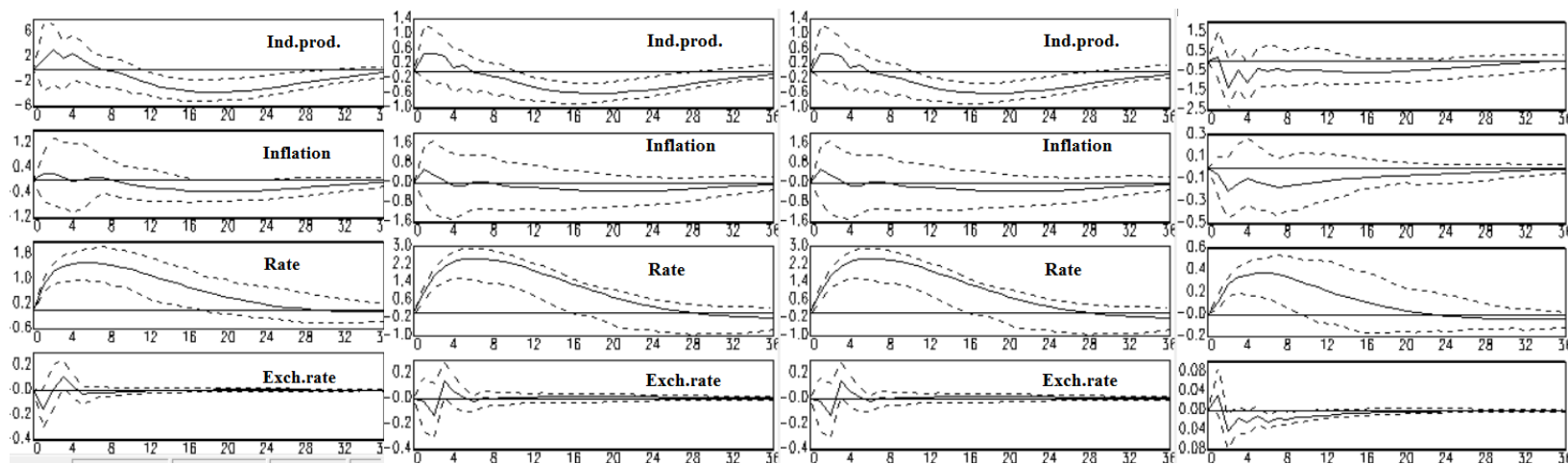
UNTILL 09/2008

a) shock to 3M Euribor   b) shock to MCI   c) shock to F1   d) shock to F2
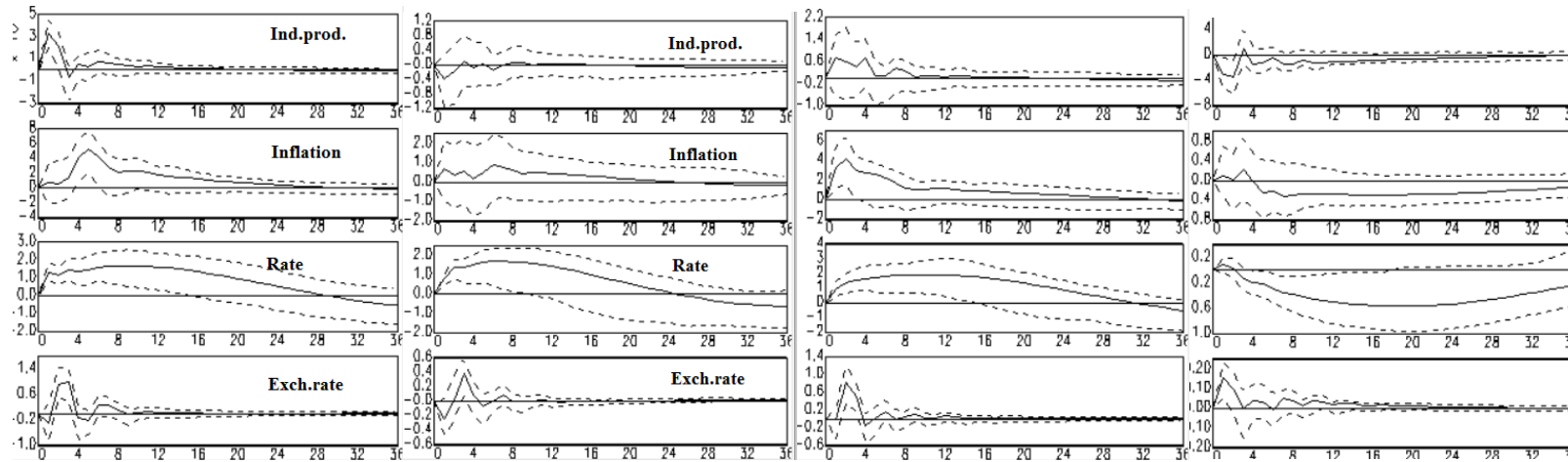
AFTER 09/2008

Table H: SWEDEN

a) shock to 3M Euribor   *b) shock to MCI*   *c) shock to F1*   *d) shock to F2*

UNTILL 09/2008

AFTER 09/2008

a) shock to 3M Euribor *b) shock to MCI* *c) shock to F1* *d) shock to F2*
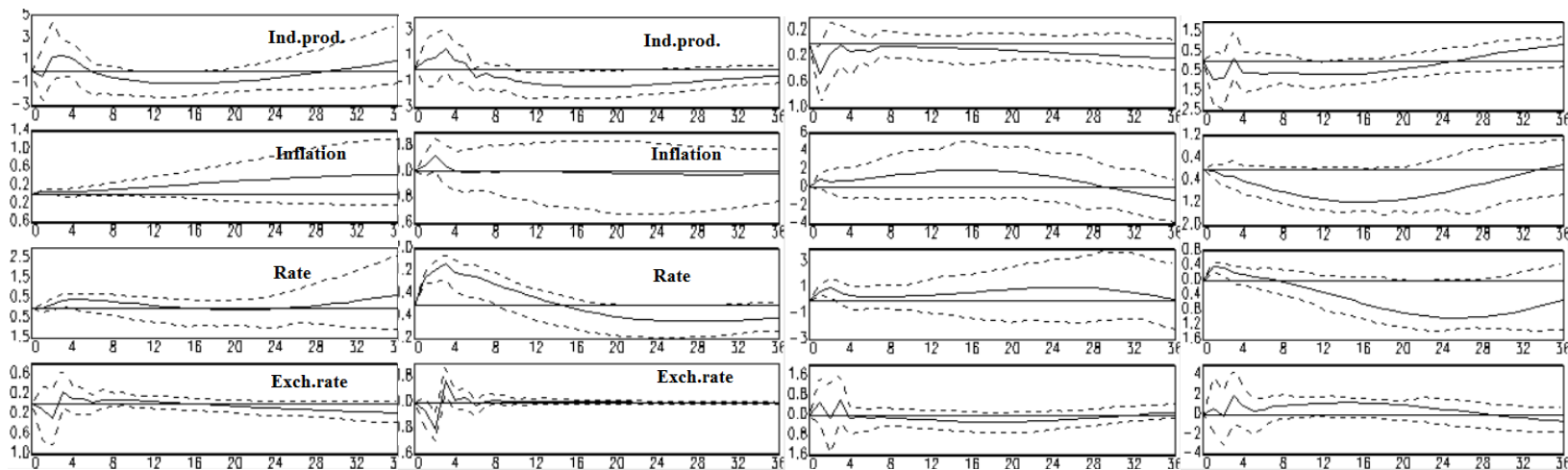

Table I: UNITED KINGDOM

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a) shock to 3M Euribor **b) shock to MCI** **c) shock to F1** **d) shock to F2**

AFTER 09/2008

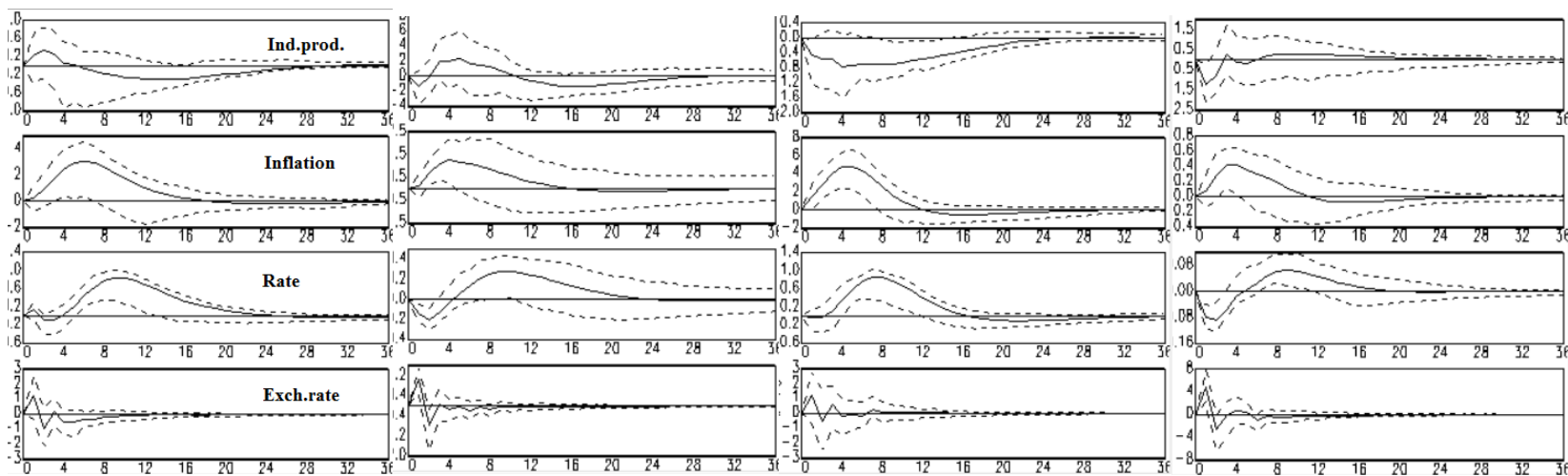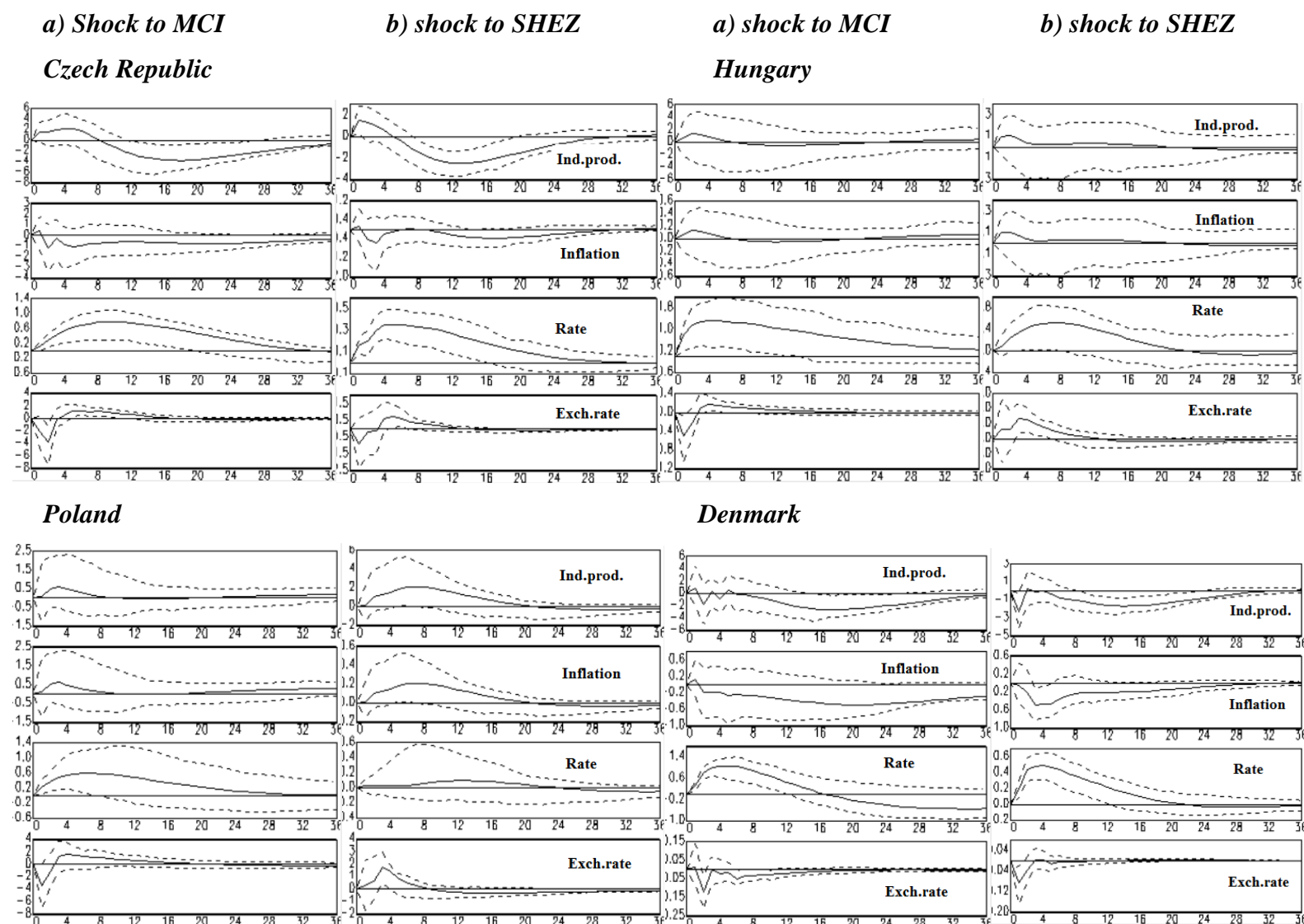**Table J: Comparison of Impulse Responses to shock to MCI and SHEZ**

a) Shock to MCI   *b) shock to SHEZ*   *a) shock to MCI*   *b) shock to SHEZ*

Czech Republic   *Hungary*

Poland   *Denmark*

XIV

a) Shock to MCI　　　　*b) shock to SHEZ*　　　　*a) shock to MCI*　　　　*b) shock to SHEZ*

Sweden　　　　　　　　　　　　　　　　　　　　*United Kingdom*