Master's Degree in Economics of Globalisation and European Integration

A COMPARISON OF THE UNCONVENTIONAL MONETARY POLICIES OF THE ECB AND THE FED

Master dissertation

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Acknowledgments

Declaration of authorship

I, Matěj Bohůnek, hereby declare that the thesis "A Comparison of the Unconventional Monetary Policies of the ECB and the FED" was written by myself and that all presented results are my own, unless stated otherwise. The literature sources are listed in the References section.

Prague, September 30th, 2015

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Signature

Abstract

The monetary policy of the Fed and the ECB has greatly change as a result of the global crisis. The goal of the thesis is to analyse the evolution of unconventional monetary instruments in the USA and the EU after the outbreak of the global crisis and nowadays with the help of pivotal economic models; namely, the IS-LM-BP model and the quantity theory of money. In addition, the paper should assess the impacts of adopted instruments and programs and draw conclusions about their success. The theoretical part explains the IS-LM-BP framework and the quantity theory of money and describes the unconventional monetary tools that the central banks can use when the interest rates reach the zero lower bound. The practical part analyses EU and US economy with the explained models. Furthermore, the implemented instruments of the Fed and the ECB are described and compared. The thesis should be concluded with the claim that the transmission mechanism was restored with the help of the non-standard measures, however, the desirable price level stabilization has not been reached.

Keywords: ECB, FED, unconventional monetary policy, IS-LM-BP, quantity theory of money

List of abbreviations

ABSPP	Asset-backed Security Purchase Program
CBPP	Covered Bond Purchase Programme
CE	Credit Easing
ECB	European Central Bank
ECS	Enhanced Credit Support
EFSM	European Financial Stabilisation Mechanism
ESM	European Stability Mechanism
EU	European Union
FED	Federal Reserve System
FOMC	Federal Open Market Comittee
FRFA	Fixed Rate Full Allotment
GDP	Gross Domestic Product
GSE	Government-sponsored Enterprise
LTRO	Long-term Refinancing Operations
LSAP	Large-scale Asset Purchase
MBS	Mortgage-backed Securities
MEP	Maturity Extension Programme
MRO	Main Refinancing Operations
OMT	Outright Monetary Transactions
PSPP	Public Sector Purchase Programme
QE	Quantitative Easing
SMP	Securities Market Programme
TLTRO	Targeted Long-term Refinancing Operations
US	United States of America
USA	United States of America
ZLB	Zero Lower Bound

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Introduction

Central banks are the main monetary authorities. They are the creators of monetary policy using a wide range of instruments usually to affect the interest rates, which influence the economic variables through various transmission channels. In this way, central banks try to achieve desirable goal. After a closer look at the nature of monetary policy in the developed world, significant progress in the past decade is apparent.

As a reason of this turnaround in the current conducting of monetary policy is considered to be irresponsible behaviour of the subjects in the money markets and excessive innovation, which induced the emergence of a wide range of financial instruments. In particular, the securitization process, which as a consequence led to the formation of bubbles in asset markets and the expansion of moral hazard. These trends have resulted in a financial crisis that is often compared Great Depression of the 30s of the 20th century.

It follows that the central bank faced in recent years a deep economic recession that went hand in hand with increasing pressure to undesirable inflation development. Since conventional monetary instruments appeared in the context of the global crisis as insufficient, the central bank gradually started to take steps that can be described as unconventional.

The exception in this sense are neither the ECB nor the Fed, which have been using the non-standard tools continuously since October 2008, and May 2008 respectively. As the form of monetary policy keeps to evolve, I consider this issue to be highly topical and complex. In connection with relative speed of formation of further and further measures is evident the lack of literature that would be devoted to this issue in its entirety. The aforementioned facts are the reason why the topic of my thesis is unconventional monetary policy of the ECB and the Fed.

Besides drawing general conclusions about the success of non-standard monetary policy instruments is the main goal of the thesis to evaluate the current unconventional policies of central banks and their inclusion in the economic context. The thesis tries to explain the global crisis; and especially; the subsequent unconventional measures with the cardinal economic theories; namely, the IS-LM-BP model and the quantity theory of money. The hypothesis that unconventional measures have led to a calming down of the

situation after the crisis, and that the application of these tools is essential in terms of achieving stable development of inflation is tested in this paper.

The thesis is divided into two main parts; namely, the theoretical and the practical one. The former set the basic ground for further analysis of unconventional monetary policy. The latter investigates the measures taken in praxis. The IS-LM-BP framework and the quantity theory of money are described in the theoretical part, since they will be used in the practical part to examine the monetary policy measures made during global crisis. Furthermore, a simple overview of the instruments at the central banks' disposal in a situation when the interest rates reach the zero lower bound is introduced.

The practical part deals with the implementation of unconventional monetary instruments in selected countries. This section covers, firstly, the post-crisis actions of the Fed; secondly, the characteristics of unconventional instruments adopted by the ECB, both followed by analysing the macroeconomic effects; and finally, the comparison of the approaches of the US Federal Reserve and European Central Bank.

1 Theoretical part

1.1 The IS-LM-BP model

The IS-LM framework was first developed by John Hicks in his paper, 'Mr. Keynes and the "Classics": a suggested interpretation', published in Econometrica in April 1937. The analysis was later extended by James Fleming and Robert Mundell who added the BP curve. The model naturally consists of three curves; the IS curve represents "investment" and "saving" and shows the development on the market for goods and services. The LM curve symbolizes "liquidity" and "money" and shows what is happening with the supply and demand for money. The BP curve stands for "balance of payments" and represents the equilibrium in the foreign exchange market. The model explains the interaction between goods, money and foreign exchange markets and presents the economy in short run. In addition the model enables to analyse the impacts of monetary and fiscal policy and changes primarily in the interest rate and real output of economy. The IS-LM-BP model will be further used in the practical part to analyse the effects of unconventional monetary policy.

1.1.1 The IS curve

The main concern of this part is to derive the equilibrium condition in the market for goods and service for two unknown variables; namely, the level of income and interest rate. Soukup et al. (2010) defines the IS schedule as:

$$Y = \alpha \times (\bar{A} + v \times R) - \alpha \times b \times i$$

Where Y is the real output; α is an expenditure multiplier for the open economy; $\bar{A}$ stands for planned autonomous expenditure, which are independent of the level of income, interest rate and real exchange rate. v represents sensitivity of net exports to the real exchange rate; R stands for the real exchange rate; b is the sensitivity of autonomous consumption to interest rate; and i is the interest rate[1].

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[1] More precisely the real interest rate determines the investment decisions, however, to simplify, the role of expected inflation is ignored here, as it will be examined later in the text.

As can be seen in Graph 1 the IS curve is downward sloping from left to right in the interest rate-income level space. This is because the lower interest rate implies bigger autonomous expenditure; namely autonomous consumption and investments that are affected by the interest rate. Therefore, the growth in aggregate expenditure leads to higher real output of the economy. The investment drop implies a decrease in output, which further decreases consumption and investment, through the multiplier effect. The IS curve can be defined as a set of combinations of the interest rate and the level of income for which is the market for goods and services in equilibrium.

Graph 1: The IS curve
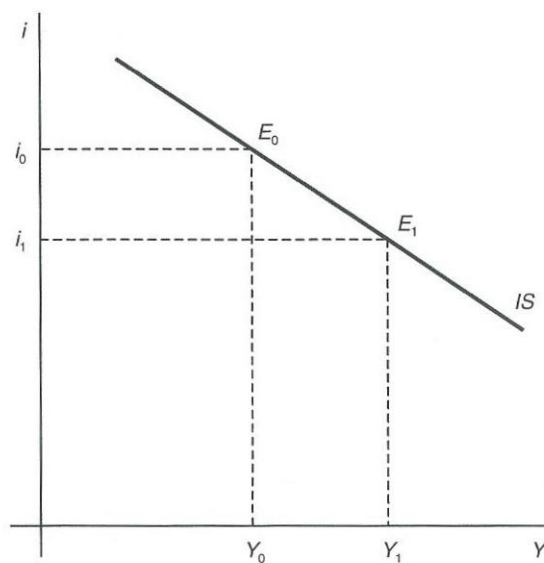
Source: Soukup et. al (2010)

To finish the analysis of the IS curve the factors which can shift the curve should be mentioned. For a given interest rate an increase in the level of income leads to the movement of the IS curve to the right. An increase in autonomous expenditure[2], growth in the sensitivity of net exports to the real exchange rate and increase in the real exchange rate will cause above stated shift. On the contrary, the reverse movement in above mentioned variables will imply the lower level of income for a given interest rate and therefore the shift of the IS curve to the left. In addition, the change in the sensitivity of the autonomous expenditure to the interest rate will rotate the IS schedule around the intersection with the horizontal axe. The variation of the open economy multiplier will

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[2] Growth in autonomous consumption, transfers, autonomous investments, government spending and autonomous net exports; or decrease in autonomous taxes

twirl the IS curve around the point of intersection with the vertical axe, further the variation of the multiplier changes the equilibrium income when the sensitivity of the autonomous expenditure to the interest rate equals to zero.
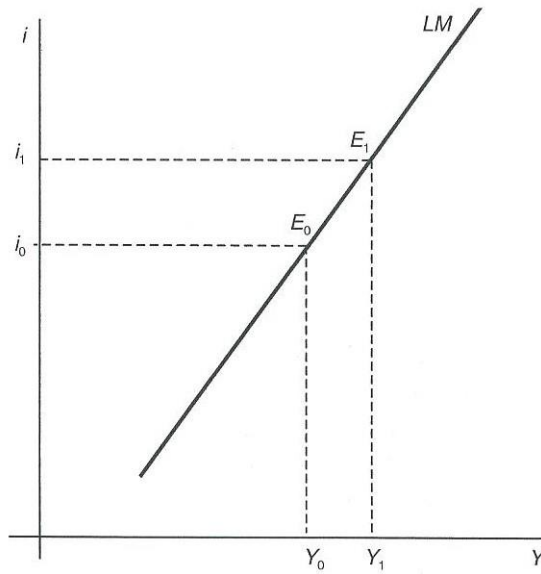
1.1.2 The LM curve

Villaverde (2016) states that the LM schedule shows various combinations of the level of income and rate of interest for which the money market is in equilibrium, that means the money demand equals the money supply. Soukup et al. (2010) uses the Keynes theory of money demand to derive the LM curve. The Keynesian approach adds another market into the analysis; namely, the bond market, and considers two types of money demand. The first one is called transactions demand and is dependant only on the real output, the second one is named speculative demand and is dependent on the interest rate.

$$i = -\frac{M}{h} + \frac{k}{h} \times Y$$

With this equation the LM curve can be described. M is the money supply; h represents the sensitivity of the money demand to the interest rate; k stands for the sensitivity of money demand to the real output, i and Y are again the interest rate and the real output respectively.

As can be seen in Graph 2 the LM curve is upward sloping from left to right in the interest rate-income level space. As a result of a growth in the level of income the interest rate increases as well, that is because the rise in income leads to higher transactions demand for money; however, the money supply remains unchanged, therefore the interest rate grows to the point where the money demand and money supply find themselves in equilibrium again.

Source: Soukup et. al (2010)

The only factor that is causing the shift of the LM curve is the change in money supply, since the price level is fixed in short-run. Growth in the nominal money supply cause an increase in the real money supply, thus for a given level of income the interest rate must fall to set the equilibrium in the money market. With the same logic, a decrease in the nominal money supply leads to an increase in the interest rate. Nevertheless, there are two additional components that might rotate the LM schedule. The higher sensitivity of the money demand to the real income the higher the slope of the curve. On the other hand, the lower sensitivity of money demand to the interest rate implies a higher slope of the LM curve.

Expectations

Before introducing the BP curve the expectations should be added to the model to make it more realistic and lay the foundations for the analysis of unconventional monetary policy. As mentioned above spending decisions depend on the real interest rate. According to Izák (2009), the central banks change the nominal interest rate in an effort to shape the real rate; however, the real interest rate might not go the way the banks supposed to. The real interest rate measured in terms of goods does not depend only on the nominal interest rate, but also on the expected inflation. The relationship is as follows:

$$(1 + r_t) = (1 + i_t) \frac{P_t}{P_{t+1}^e}$$

Where P_t is the price level today and P_{t+1}^e is the expected price level in the next time horizon for example next year. The formula for expected inflation

$$\pi_{t+1}^e = \frac{(P_{t+1}^e - P_t)}{P_t}$$

should be substituted to the equation 2.5 and after an elementary operation the precise equation for the real interest rate is:

$$(1 + r_t) = \frac{1 + i_t}{1 + \pi_{t+1}^e}$$

Further approximation can be made for small numbers of expected inflation (less than 30% per year).

$$r_t \approx i_t - \pi_{t+1}^e$$

This equation set very important relationship that is the nominal interest rate minus the expected inflation is approximately equal to the real interest rate. Above derived formula for the real interest rate has implications for the IS-LM model. As it was said the real rate has an effect on investment decisions, therefore it slightly changes the IS relation.

$$Y = C(Y - T) + I(Y, r) + G$$

The LM relation remains unaffected, since the demand for money depends on the nominal interest rate. Izák (2009) explains that the nominal interest rate is directly determined by the central banks whereas the real interest rate induce spending and output, thus the effects of monetary policy rely on the process of transformation of changes in the nominal rate into the real terms. The short-run effect of monetary policy was solved in the previous question, the medium-run response will be examined here. At first, the natural level of income Y_n should be introduced. It is a level of output which is stable over time if the output growth is ignored. The existence of natural level of output implies further the natural real interest rate r_n. Blanchard and Johnson (2013) state that it is the rate to which the real interest rate returns in medium-term and it is independent of the rate of money growth. Since there is an equality between the rate of money growth and the rate of inflation in medium run the real interest rate formula can be rewritten as

$$i = r_n - g_M$$

According to Mankiw (2016), consequently, a 1 percent increase in the rate of inflation in turn causes a 1 percent increase in the nominal interest rate. This relation is called Fisher hypothesis. The process of monetary expansion from the short-run to the medium-run is following. After the monetary expansion the nominal interest rate decreases, low interest rate induces higher demand and higher output; however, higher output is accompanied by inflation, which in turn signifies a fall in the real money stock and a rise in the nominal interest rates. The real interest rate after a decrease in the short run goes back to the natural value.

Expectations do not have an impact only on the real interest in the IS-LM model, they shape the IS curve even through investment and consumption decisions. Firstly, individual's consumption is affected by human wealth, such as the present value of expected after-tax income; and by non-human wealth, such as housing and financial wealth. The human wealth is determined by the future after-tax labour income and future real interest rates, the non-human wealth in influenced by future real dividends and future real and nominal interest rates. The major channel which determines the investment decisions is the present value of after tax profits, it can be affected by change in future after tax profits or in future real interest rates (Blanchard and Johnson, 2013).

To further analyse the IS-LM framework the aggregate private spending should be introduced.

$$A = C + I$$

The aggregate private spending is a sum of consumption and investment. When the expectations are taken into account, the aggregate spending is determined by current and expected income, current and expected taxes, current and expected real interest rate.
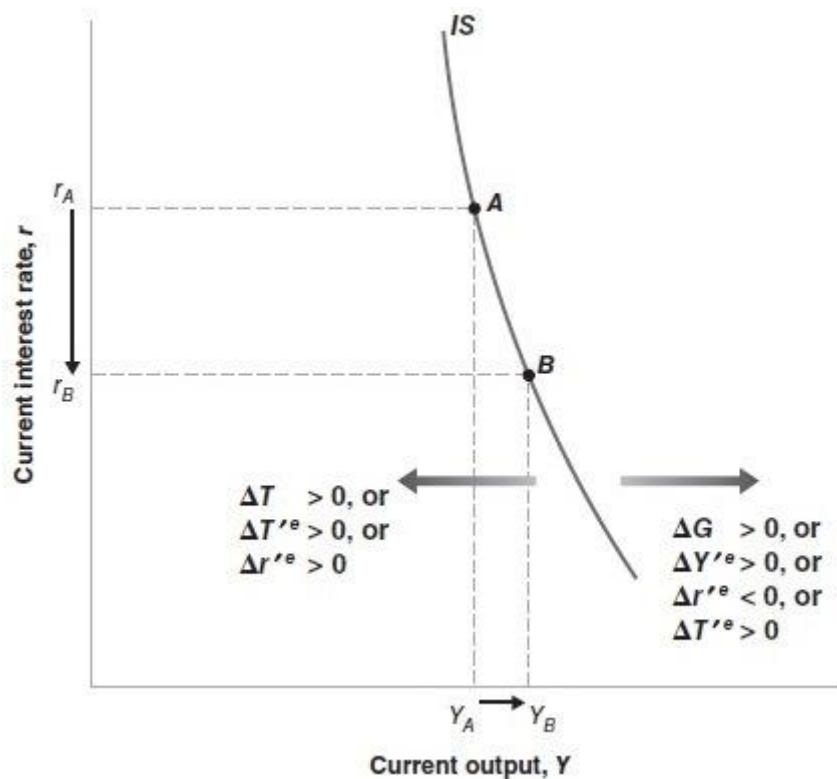
$$A\ (Y, Y^e, T, T^e, r, r^e)$$

$$(+, +, -, -, -, -)$$

Therefore, the IS relation can be edited as:

$$Y = A(Y, Y^e, T, T^e, r, r^e) + G$$

As can be seen in the Graph 3 the IS curve is steeper, and therefore only small increase in output is caused by big drop in interest rate.

Graph 3: The IS curve with expectations

Source: Blanchard and Johnson (2013)

That is, because a decrease in real interest rate does not boost spending so much, since spending, and especially investment, depends on the expected real interest rate, which remains constant. In addition, the rise in income does not generate further multiplier effect, since the future expected income stays unchanged. The factors shifting the IS curve are following. The move of the IS schedule to the right is provoked by the increase in government spending, rise in expectations about future income and decrease in expectations concerning the future real interest rate. On the other hand, an increase in current taxes, or rise in expected real interest rate will move the IS curve to the left. The impact of an increase in expected future taxes seems to be ambiguous. It may lead the consumers to reduce current spending, however, it might also induce them to buy the goods now, when there is a threat of higher future taxes (Blanchard and Johnson, 2013)

The LM relation remains all the time unchanged and will hold the same even after implementing expectations about future. The money demand depends on current income and on current short-term interest rate, therefore expectations have no effect.

It should be obvious from previous analysis, that expectations play a major role. The monetary expansion strongly depends on consumers' future forecasts. Adjusting the nominal interest rate through a monetary expansion and keeping the expectations unchanged will bring just small increase in output, since the IS curve will not shift. However, if the monetary expansion is accompanied by change in expectations about future values of income and real interest rate it might move the IS curve to the right and the impact will be immense.

1.1.3 The BP curve

So far the internal balance of economy was solved, now the external balance represented by the BP curve will be examined. For simplicity only two components of balance of payments will be considered, namely net exports (NX) and net capital flows (NFC). The former represents the current account and depends on the real output, the latter comprises of capital and financial account and is affected by the interest rate. Soukup et al. (2010) defines the BP curve as follows.

$$i_D = \frac{\rho \times i_F - NX_a - \upsilon \times R - NFC_a}{\rho} + \frac{m}{\rho} \times Y$$

Where i_D and i_F is the domestic and foreign real interest rate, respectively; ρ represents the sensitivity of the net capital flows to the interest rate differential; and m is marginal propensity to imports.

Villaverde (2016) states that the BP curve is upward sloping as the higher output leads to deterioration in the current account that requires the lower interest rate reduce capital outflow or induce higher capital inflow. The BP curve can be defined as a set of combinations of the interest rate and the level of income for which is the balance of payments in equilibrium.
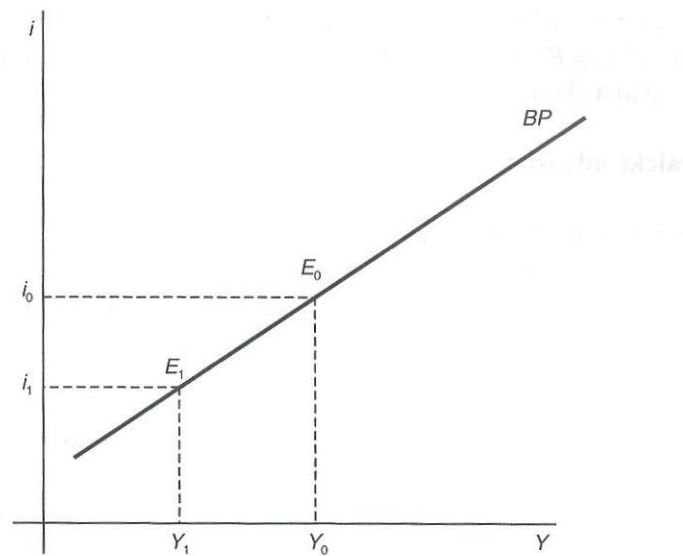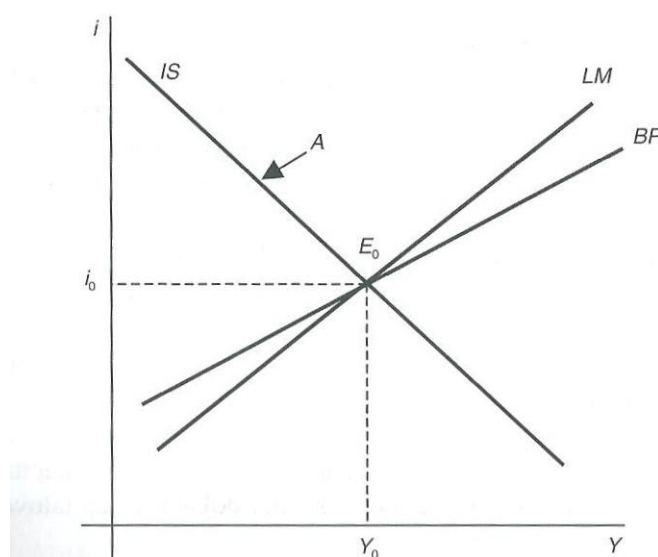
Source: Soukup et. al (2010)

The analysis of the BP schedule should be finished again with the factors that shift or rotate the curve. The shift to the right may be caused by decrease in the foreign interest rate; increase in autonomous net exports; growth in the sensitivity of net exports to the real exchange rate; real depreciation or devaluation; and finally, increase in the autonomous net capital flows. The reverse changes of the factors would cause the opposite shift. In addition, there is the sensitivity of the net capital flows to the interest rate differential which induces a rotation of the BP curve. Two extreme cases should be mentioned here, firstly, when the sensitivity is close to zero, the capital flows do not react to changes in interest rates and the BP curve is vertical. On the other hand, the sensitivity approaching to infinity implies a horizontal BP schedule. The change in the interest rate is immediately followed by inflows or outflows of capital until the foreign and domestic interest rate are equalized again.

1.1.4 The IS-LM-BP equilibrium

The Graph 5 shows the internal and external balance. All the three curves must pass through the equilibrium point E_0 with the real output Y_0 and the interest rate i_0.

Graph 5: The IS-LM-BP equilibrium

Source: Soukup et. al (2010)

Now suppose that the economy is situated at point A and only the goods market find itself in equilibrium. At point A the money supply overweighs the money demand and the balance of payments is in surplus; nevertheless, the automatic mechanisms bring the economy back to internal and external equilibrium. The supply of money over the demand creates a pressure on interest rate to decrease, it leads to outflow of net capital and therefore restating the balance of payments equilibrium. Increase of the real output through the growth in aggregate demand is another effect caused by the decrease in interest rate. The rise in the real output has two implications; firstly, it induces higher transactions demand for money, and therefore equals the money demand with money supply and sets the money market in equilibrium. Secondly, it sets in the equilibrium the balance of payments as it generates higher induced imports and decrease in net capital flows.

The central bank as a creator of monetary policy has many instruments at its disposal, which will be described in more details later. Now, it will be briefly described what happens when central banks decides on monetary expansion through basic open market operations. In short, an open market operation means, according to Soukup et al. (2010), that central bank sells or buys financial assets such as bonds mostly to or from commercial banks. Monetary expansion involves a growth of nominal money supply and so the purchase of securities and bonds. Reversely, monetary restriction means a decrease in

nominal money supply through the sale of bonds and securities. In case of analysing the monetary policy of the ECB and the FED, it should be supposed that the capital mobility in the European Union and the United States of America is imperfect, however the capital flows barriers are not significant, and therefore the BP curve will be flatter that the LM schedule. In addition the exchange rate is flexible. Consider the economy at point E_0 with the interest rate i_0 and the real output at level Y_0. One of the above mentioned central banks move to monetary expansion to stimulate the economy. The monetary expansion cause a decrease in interest rate and an increase in the real income (a shift from LM_0 to LM_1); both these changes imply balance of payments deficit. The deficit stirs up a depreciation of the domestic currency (a shift from BP_0 to BP_1) and when the Marshall-Lerner condition is being fulfilled[3] a growth in the net exports (a shift from IS_0 to IS_1). The new equilibrium is at point E_1 with lower interest rate i_1 and higher real output Y_1

Graph 6: The monetary expansion
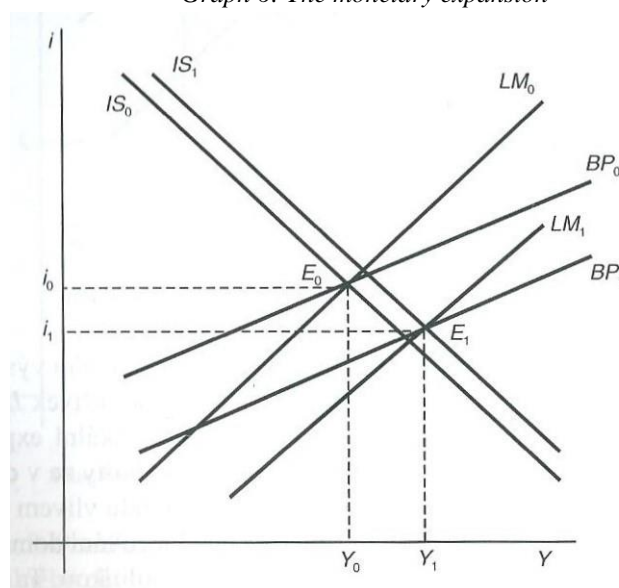
Source: Soukup et. al (2010)

Liquidity trap

The expectations play even greater role, when the economy is caught in liquidity trap. To explain the mechanism of liquidity trap, the IS-LM framework will be used. Blanchard and Johnson (2013) describe the liquidity trap as a situation when people are willing to hold more money at the same interest rate. Such situation comes when the interest rate

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[3] Marshall-Lerner condition says that the devaluation or depreciation will improve the current account only if the sum of the foreign elasticity of demand for exports and the home country elasticity of demand for imports is greater than unity.

hits the zero bound and conventional monetary policy such as open market operations loses its power.

Graph 7: The liquidity trap
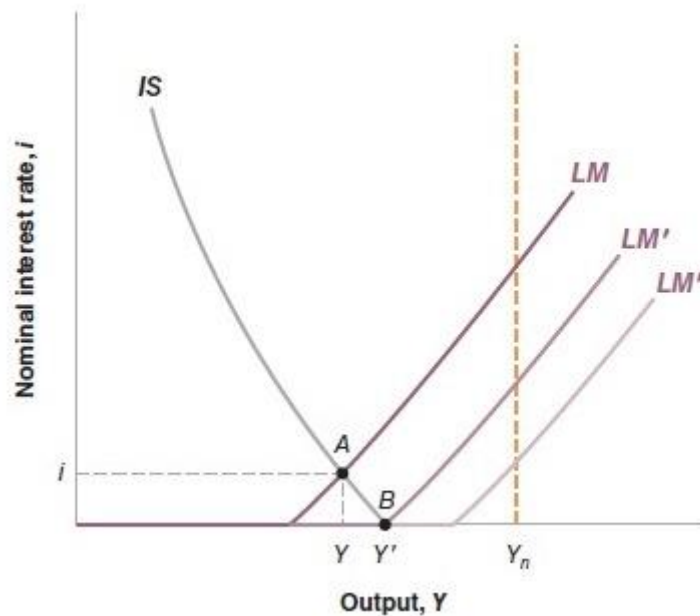
Source: Blanchard and Johnson (2013)

The mechanism is simple, the economy finds itself in depression at initial equilibrium A where the output is below the natural level of output Y_n. The central bank decides to expand the money supply to induce investment and spending, however without any shift in expectations, therefore the IS curve remains the same and the equilibrium moves to the point B with zero interest rate. The central bank desperately chasing an increase in output may try the monetary expansion again; nevertheless, the effect will be zero and the equilibrium stays in point B where the economy is caught in the liquidity trap. The central bank should in this situation implement unconventional measures. These measures will be in detail explored below (Blanchard and Johnson, 2013).

1.2 Quantity Theory of money

The second theory important for the analysis of unconventional monetary policy is the Quantity Theory of Money, through which the possibilities of influencing the economy with monetary instruments and the effect of money on the real economy will be examined. According to Soukup et al. (2010), there exist two approaches to the quantity theory, namely Fisher's and Cambridge quantity theory of money. Fisher's version is based on the quantity equation, which is:

$$M \times V_T = P \times T$$

The equation is an identity which means that the equality holds permanently and if one of the variables changes, one or more of the others must also change. This identity implies that each transaction has its own seller and buyer. M represents the money supply, V_T stands for the transactions velocity of money. The left side shows the value of purchases made over some period of time. On the other hand, the right side shows the value of sales made over the same period of time, where an average price of the transaction is P and T represents the amount of all transactions.

If the relationship between the volume of transaction and the real output is stable, the equation can be rewritten as:

$$M \times V_Y = P \times Y$$

Where V_Y represent the income velocity of money and T is substituted by the real income Y.

The Cambridge version of quantity theory should be considered as a theory of money demand. It introduces a coefficient k, which depends on institutional factors such as technology of payments.

$$\left(\frac{M}{P}\right)^d = k \times Y$$

The quantity of real money balances demanded is proportional to real income is expressed by this relationship. If the coefficient k and in the Fisher's version V_Y as well as the real product can be viewed as stable at least in short term, the price level is determined by the

money supply. According to Mankiw (2016), the quantity theory of money says that the rate of inflation is under absolute control of central bank, which regulates the money supply. The price level will be stable, if the central bank keeps the money supply stable. The price level will rise, if the central bank increases the money supply. The changes in money supply do not have any power to affect the real variables and their only consequence is the change in price level. It is called a neutrality of money.

1.3 Monetary policy and crisis

With the arrival of the financial crisis that escalated in fall 2008, it could be spoken about new era in conducting monetary policy characterized by innovative and unconventional approaches. As stated above, the monetary authorities usually use the open market operations to reach their goals. Nevertheless, when the conventional measures do not lead to fulfilling desirable objectives, the central bank should come up with the unconventional measures. According to Smaghi (2009), there are two moments when the unconventional policies should be introduced. Firstly, after a powerful economic shock, when the interest rate hits the zero lower bound, the central bank needs to give an extra stimulus. It could be done through guiding medium to long-term interest rate expectations; or through changing the composition of the central bank's balance sheet; or through expanding it. In the second case, it is the broken transmission mechanism that requires the use of non-conventional monetary policy, despite the fact that the interest rate may not be close to zero. A lack of confidence in the market caused by a drastic decrease in liquidity will imply that an additional reduction in the interest rate will not be so effective, since the transmission mechanism is badly damaged. The application of non-conventional monetary tools helps the central banks to further ease the financial market conditions in order to boost the aggregate demand. The list of the most frequently mentioned unconventional measures includes *quantitative easing, credit easing, forward guidance, negative interest rate and foreign exchange interventions.*

1.3.1 Quantitative easing

Quantitative easing - QE is a way of conducting monetary policy in a situation where the central bank is no longer able to reduce the policy rate, as it has fallen near to zero. The essence of quantitative easing are asset purchases from commercial banks by the central bank, which implies a creation of relatively high supply of free reserves in commercial banks' accounts. The purpose of these policies is to strengthen the balance sheet and the market liquidity of the banking system and to minimize the risk of a rise in interest rates due to lack of liquidity (CNB, 2013-1014). Quantitative easing results in an expansion of the central bank balance sheet; especially, an expansion of the monetary base. Furthermore, the composition of the asset side of the balance sheet does not change. It means that a bank holds the same categories of assets as in normal times, however, the

amount is amplified (Lenza, Pill, Reichlin, 2010). There are several channels through which the quantitative easing works. Firstly, the purchase of government bonds leads to an increase in price of these assets and may cause a welfare effect and encourage the consumption. Secondly, higher price of government bonds induces a decrease in interest rate and therefore borrowing costs which induces higher consumption and investments. Furthermore, quantitative easing creates pressure on depreciation of domestic currency supporting the exports and domestic consumption as well. Finally, the act of purchasing bonds can demonstrate the power of central bank and increase its trustworthiness which is one of the key to successful implementation of unconventional measures. The overall impact of quantitative easing should be eventually reflected in higher inflation and output.

1.3.2 Credit easing

Credit easing – CE can be described as a special case of quantitative easing. The difference is according to Lenza, Pill and Reichlin (2010) that the composition of the central bank balance sheet is transformed such that unconventional assets are introduced at the expense of conventional assets, however, the overall size of the balance sheet remains unchanged. The main idea of credit easing is to pour liquidity into those market segments where it is absent. I may be done by purchases of commercial paper, corporate bonds and asset-backed securities (Smaghi, 2009). The central bank is moving from purchase of government bond to acquisition of private assets. The biggest advantage of credit easing is the possibility to deliver the necessary liquidity to the disrupted markets, whereas during quantitative easing it the liquidity spread across the board. In addition, since the size of the balance sheet is untouched, the central bank avoid "printing money", which is negatively perceived by public. The possible threat is the risk related to private assets. Private assets are usually riskier than government bonds, thus the central bank needs to carefully evaluate and select the potential purchase. A quick withdrawal from this policy seems to be a bit precarious, as the high-risk assets is much harder to sell if needed. The central bank has to be cautious about the market competition, since the credit easing might favour problematic subjects and bigger firms.

1.3.3 Forward guidance

The aim of forward guidance is to secure that market expectations about future monetary policy are coherent with the policy intentions of the central bank (Coeuré, 2013). With

the announcements about future policy makes the central bank clear how it will solve potential problems, and thus anchors market expectations of economic agents. According to Williams (2011), the commitment of the central bank to follow two rules is crucial for this policy to have the desired effects: keeping the short-term policy rate lower than it otherwise would in the future, and allowing inflation to rise higher than it otherwise would. Two obstacles may arise when delivering the monetary policy message. Firstly, there might be a problem of misunderstanding the information or different future expectations of the economy. The essential issue for the effectiveness of forward guidance policy is the expectations channel, and therefore. Monetary policy cannot simply be successful if the public misunderstand the intentions of the announced policy. The second concern is related to credibility of the central bank and time consistency of its decisions, as these two issues come hand in hand. The temptation of short-term benefits arising from discretionary decision may force the central bank to deviate from previous commitment. These actions must inevitably in the long term result in a reduction of monetary authority credibility, and thus its ability to effectively influence the economy. Indeed, if economic agents do not respond to the incentives of central banks, these authorities become impotent to enforce its monetary policy.

1.3.4 Negative interest rate

It is usually assumed by the public that the interest rates cannot become negative, since it is always possible to keep the money in cash. However, even the money holding is not costless, because of inflation. As demonstrated above the real interest rate is difference between nominal interest rate and expected inflation.

$$r_t \approx i_t - \pi_{t+1}^e$$

Therefore, it is not hard to imagine that the real interest is below zero. It is sufficient that inflation is higher than explicitly expressed nominal interest rate. A decline in the nominal rate might lower the real rate, and therefore allow inflation expectations to rise and encourage aggregate demand; nevertheless, if both nominal and real interest rates are shifted down, a widening gap leads to deflation pressure. Thus, the central bank lowering deposit rate can effectively decrease the interbank and other interest rates in order to cut the commercial banks' reserves and motivate them to take greater risks and facilitating portfolio rebalancing (Jobst and Lin 2016). An important assumption for this policy to be

effective is to charge the possession of money in the reserve accounts of commercial banks, so that commercial banks have nowhere to escape, in order to avoid "taxation".

1.3.5 Foreign exchange interventions

The foreign exchange interventions are usually approached by the central banks, which represent more open economy, since the speed of reaction of the markets and the actual efficiency is much higher. Svensson (2000) calls the managed devaluation of domestic currency together with announcing a rise in the price level "the foolproof way" of escaping from a liquidity trap in an open economy. Foreign exchange interventions should ensure that through the prices of imported goods and services that is through the exchange rate transmission channel of monetary policy the domestic price level will be increased. The interventions commitment should be rather long-term. In the first stage the impact of this policy may be quickly visible as increase in the price level, since a weaker currency pushes importers to raise prices. In an open economy the significant shift to domestic production is not often possible, so consumers have to accept higher prices. The exports are after the devaluation cheaper abroad; however, it takes some time to exporters to adjust to new conditions. After this period of time the exporters increase productions and raise the output of the whole economy. Nevertheless, as Smaghi (2009) claims this policy may not work in today's context. Such measurement would cause a beggar-thy-neighbour situation, where one country gains at the expense of other countries. The countries might be even worse off if they were to depreciate their currencies at the same time in order to push inflation up.

2 Empirical part

As mentioned above, the unconventional monetary policy came as a response to the global crisis. The beginnings of the global crisis go back to 2007 when a number of problems associated with risky behaviour in the financial markets was brought to light. Given the interactions between a lots of markets, the financial crisis triggered shortly after an economic crisis and the developed nations have begun to deal with the general economic stagnation, which; however, escalated immensely. The signs of problems with the sustainability of government debt started to appear and that was retroactively threatening to the outset of the economic growth. The final shape of crisis is the result of strong financial imbalances globally; irresponsible behaviour of governments considering the debt levels; and excessively expansionary monetary policies which contributed to the formation of price bubbles in asset markets. These problems have been amplified by the fact that governments were often trying to mitigate the situation on financial markets and the economic recession by pumping additional funds into their economies (Janáčková 2010).

Figure 1 shows the rate of growth of GDP in the EU (15) and USA. Positive economic growth in previous years was halted in 2008, when the annual GDP growth in the US was negative. EU economy had been growing that year by 0.8%, but a year later, when the impact of the financial crisis was fully reflected, the European economy dipped considerably - GDP growth compared to the previous period slowed to -4.4%. Due to the measures taken, which have been in order to support economic activity, the situation in 2010 has improved significantly and in the US remained stable. This does not apply to the EU, where the financial crisis has spilled over into the debt crisis, which has slowed down the pace of growth again.

Figure 1: The annual GDP growth (%), 2000-2015
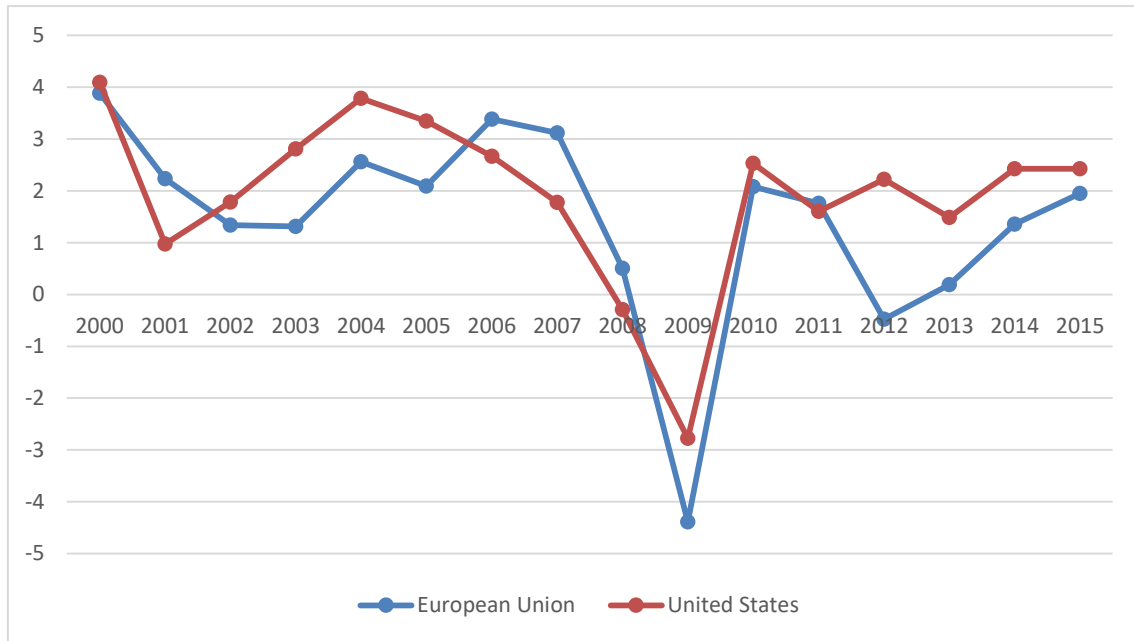
Source: World Development Indicators data, own editing

The first step that the central banks took after the outbreak of this crisis, was reducing main interest rates, see Figure 2. The Fed began to reduce interest rates in autumn 2007 (by 0.5 percentage points to 4.75%), shortly after the problems in the mortgage market had begun to arise. By the contrast, until 2008 the ECB was continuing gradually increasing MRO rate, with which it had begun in late 2005. The reason for the preservation of monetary policy restriction was the fact that the mortgage crisis moving from the US to Europe was not expected. The ECB eased the strict conditions after the collapse of Lehman Brothers, and since then its main interest rate gradually decreases. In this sense, it is important to emphasize that while the Federal Funds Rate was moving since December 2008 in the range of 0 - 0.25%, where is the traditional monetary policy de facto powerless, the ECB had much more leeway - even during 2011 it kept the MRO rate in the range of 1 - 1.5% and 0.5% threshold was reached not until spring 2013.

Figure 2: Main interest rates of the Fed and the ECB (%)

ECB (The interest rate on the main refinancing operations)														
2006		2007		2008				2009		2011			2015	2016
Oct 11th	Dec 13th	Mar 14th	June 13th	July 9th	Oct 15th	Nov 12th	Dec 10th	Mar 11th	May 13th	Apr 13th	July 13th	Nov 9th	Dec 9th	Mar 16th
3,25	3,5	3,75	4	4,25	3,75	3,25	2,5	1,5	1	1,25	1,5	1,25	0,05	0

FED (Federal Funds Rate)														
2006				2007			2008							2015
Jan 31st	Mar 28th	May 10th	June 29th	Sep 18th	Oct 31st	Dec 11th	Jan 22nd	Jan 30th	Mar 18th	Apr 30th	Oct 8th	Oct 29th	Dec 16th	Dec 17th
4,5	4,75	5	5,25	4,75	4,5	4,25	3,5	3	2,25	2	1,5	1	0-0,25	0,25-0,50

Source: ECB and Fed data, own editing

According to Zamrazilova (2014), the central banks got into a situation when they cannot reduce interest rates and classical (conventional) monetary policy has no more room for easing monetary conditions; the interest rate has reached the Zero Lower Bound (ZLB). Therefore, the attention has started to turn to unconventional monetary policy. Besides the ZLB restraint the use of unconventional monetary policy instruments is attributed to the limited functionality of the financial system as well, which is closely linked to the general decline in confidence in financial markets and the transmission mechanism malfunctions. The willingness of commercial banks to provide loans is likely to be disturbed due to tensions in financial markets, the central bank may react to this situation afterwards by supplying liquidity, either by transformation of existing monetary policy instruments, or creation of new measures. Another solution may be to purchase securities in the secondary market, which is used to achieve a lower level of long-term interest rates.
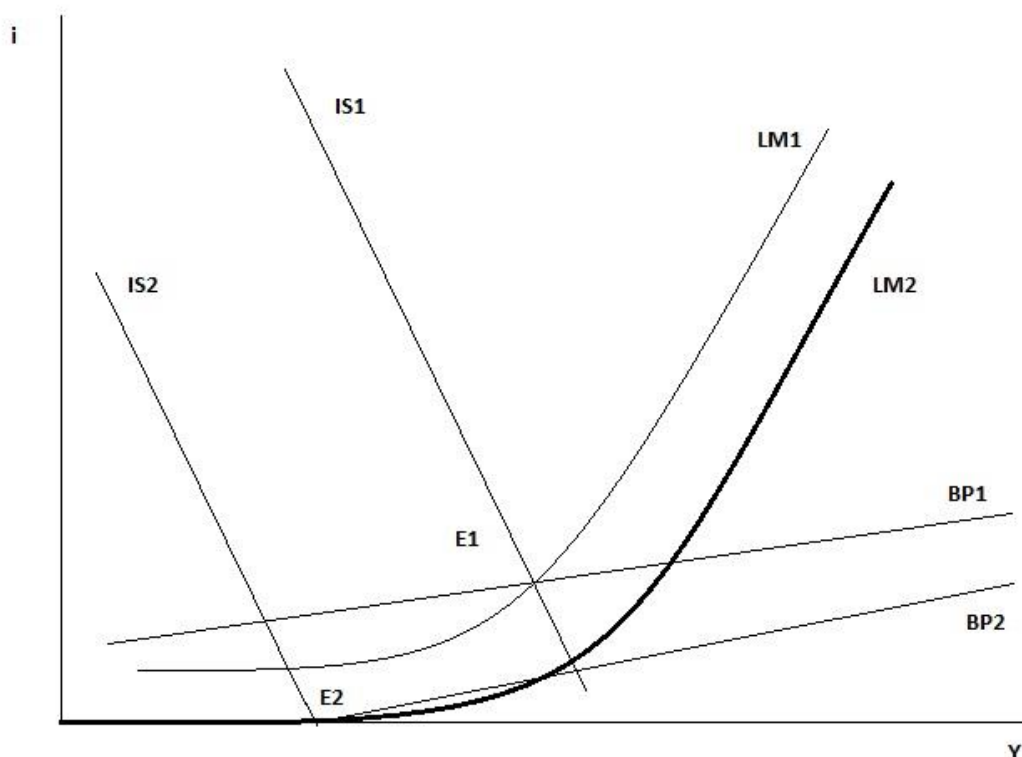
2.1 The Fed

The obligations of central banks in the United States carries the Federal Reserve System. The Fed, unlike most of the developed central banks, is publicly reported to track multiple targets of monetary policy. The primary objective remains, of course, the price stability, however, in 1978 full employment was added as a second objective (The Full Employment and Balanced Growth Act, 1978).[4] The Fed unconventional policy measures consists of primarily two instruments; namely, quantitate easing and forward guidance.

It should be now illustrated with the above explained models where was the US economy right after the outbreak of the crisis and what measures the Fed took to help the economy to recover. The pre-crisis situation can be represented by the point E1 in the Graph 8. Decrease in housing prices, increasing foreclosures, financial instability, and higher volatility together had an impact on consumer confidence and caused a decline. The households started to defer the consumption, since they were highly uncertain about the future development of the economy. Principally, expenditure on durable goods such as cars and household appliances were stalled. As a result, a sharp adverse shift of the IS curve was induced by all these events (from IS1 to IS2). Production, income, and employment declined. The unemployment rate rose from 4.7 percent in October 2007 to 10.0 percent in October 2009 (Mankiw, 2015). As saw in the Figure 2, the Fed responded to the crisis by cutting the Federal Funds rate in order to boost the credit lending (from LM1 to LM2). The interest rate, however, hit the zero lower bound in December, the conventional measures were depleted and the economy was caught in liquidity trap[5], which is highlighted in the Graph 8. From the point E2 to the left, along the LM2 curve, people are indifferent between holding money or assets, and therefore, further monetary expansion would not cause any increase in level of income and the economy would remain at point E2. The BP1 curve has moved to BP2 position, since the decrease in net exports was balanced by increase in net capital flows. Furthermore the sensitivity of the net capital flows to the interest rate differential was lower after the outbreak of crisis, since investors were uncertain about the future, therefore, the BP2 curve is steeper.

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[4] In February 2014 was Ben Bernanke replaced as governor of the Federal Reserve System after two terms by Janet Yellen. She became the first woman ever to lead the top monetary authority in the United States.

[5] Described in more details in chapter 1.1.4

Graph 8: US economy after outbreak of crisis

Source: own editing

The US economy found itself in the equilibrium E2. As the additional shift of LM curve does not have any impact on the output, the Fed needed to shift the IS curve to the right to increase the income. As seen in the chapter 1.1.2 this could be done through rise in expectations about future income and decrease in expectations concerning the future real interest rate. The future real interest rate equals the nominal interest rate minus the expected inflation. As Blanchard and Johnson (2013) state, when caught in the liquidity trap, higher expected inflation might be good, since it implies the lower current and future expected real interest rates. Thus, if the large increase in the money supply leads people to expect more inflation in the future, this will also increase spending today. Therefore the Fed implement the quantitative easing and forward guidance to affect the long-term interest rates which reflect the expected level of short-term rates plus a risk premium to compensate for uncertainty (Bank of Canada, 2011).

Quantitative easing

The primary objective of QE is typically the breaking of a liquidity trap while trying to prevent deflation, which may arise due to the credit freeze; and stabilizing long-term interest rates at low levels, which should stimulate economic growth.

The Fed introduced four measures focusing on purchases of government, agency and mortgage-backed debt securities (MBS). The dominant type of QE was called Large Scale Asset Purchase (LSAP), from 2008 onwards were announced three rounds of QE in total amount approaching 4,000 bn. USD.

All the main monetary policy the Fed's programs, which were aimed at purchases of government, agency and mortgage-backed debt securities are summarized in Figure 3.

Figure 3: Bond purchase programs in the US

| Duration	Name	Purchase	Value
12/5/2008 – 3/31/2010	QE1	MBS	$1250 bn.
		Treasury securities	$300 bn.
		Agency debt securities	$172 bn.
11/12/2010 – 6/30/2011	QE2	Treasury securities	$600 bn.
10/3/2011 – 12/30/2012	MEP	Treasury securities	$667 bn.
9/14/2012 – 10/31/2014	QE2	MBS	$823 bn.
		Treasury securities	$790 bn.

Source: Fisher (2015), own editing

The main objective of QE 1 was to support housing markets and foster improved conditions in financial markets, more generally by reducing the cost and increasing the availability of credit for the purchase of houses (The Fed, 2008). In total, the amount transactions included the LSAP 1 exceeded 1,700 billion. USD; GSE debt and MBS accounted for more than 80 percent of the assets purchased (Fawley a Neeley, 2013). Compared with other programs, this was the "most expensive" and at the same time the only one, when the agency bonds were bought.

The purpose of the second wave of QE was the promotion of a stronger pace of economic recovery and helping to ensure that inflation, over time, was at levels consistent with its mandate (The Fed, 2010). During LSAP 2 the Fed made purchases of Treasury securities in amount of USD 600 billion. However, Fawley a Neeley (2013) argue that this move by the Fed was expected by financial markets, and therefore the anticipation resulted in

only small change after the announcement had been made, as the asset prices had already adjusted to these expectations.

The next measure the Fed took was in response to renewed fears of recession in the United States. The US monetary authority announced a third round of long-term Treasury purchases in September 2011, officially termed the Maturity Extension Program and Reinvestment Policy (MEP). The program was called nicknamed "Operation Twist[6]" since the Fed sold $400 billion in short-term assets while purchasing $400 billion in long-term assets, and the intention was to reduce long-term interest rates relative to short-term interest rates (Fawley a Neeley, 2013). It was not, unlike the most of non-conventional measures, financed by newly issued money, the monetary base was not increased and therefore it cannot be called quantitative easing.

Figure 4: Unconventional programs of the FED and interest rates (%), 2005-2015
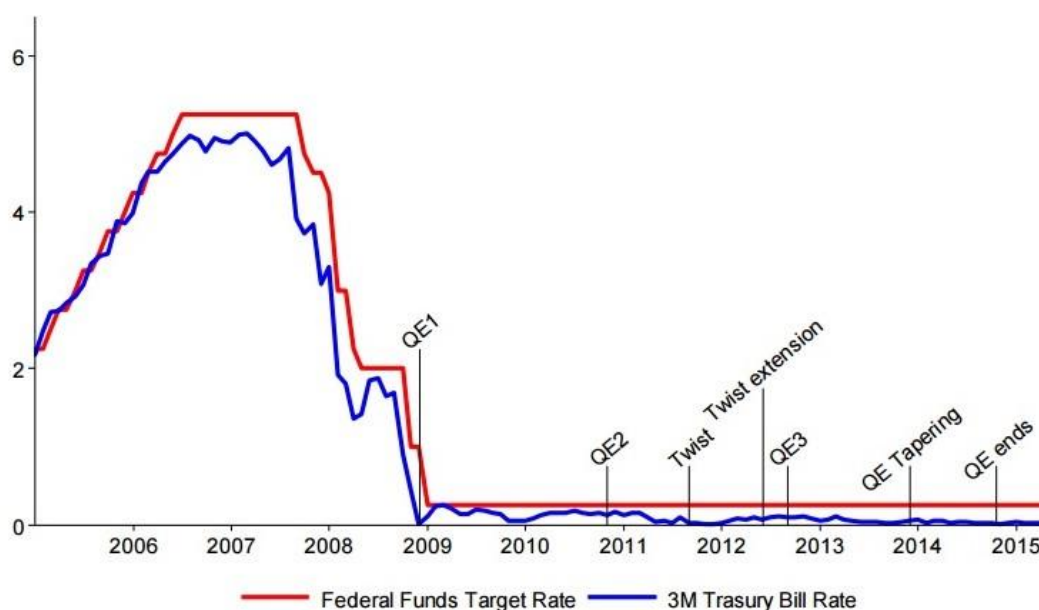
Source: Komárek (2015)

The third round of quantitative easing was, in contrary to the first two, an open-ended program, in which the FOMC said the purchases would continue at a certain pace until a particular objective was achieved. The objective was to improve significantly the labour

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[6] In 1961, in order to prevent the outflow of gold from the United States the US government suggested as a solution a program known as the "Operation Twist", which was supposed to reduce long-term interest rate, while maintaining the short-term unchanged. This program included the sale of short-term Treasury bills and vice versa buying long-term government bonds.

markets (Bullard, 2015). The total volume of the purchased bonds was not announced, however, there was a monthly limit reaching 45 bn. USD, accompanied by purchases of mortgage-backed securities in the monthly value of 40 bn. USD. The Fed announced in December 2013 that it would begin to taper[7] its purchases in January of 2014. QE3 officially ended in October 2014. Chronological overview of non-standard measures adopted until early 2015 together with the development of key interest rates are depicted in Figure 4.

Forward guidance

The second type of unconventional measures, which Fed started to use at the end of 2008, was the forward guidance policy. It was aimed, just as the QE, at weakening the disinflationary pressures and fostering economic growth after the federal funds rate reached the zero lower bound. The statements of the FOMC have evolved considerable over the years and it could be defined as forecasting of policy rather than committing to exact measures. The launch of QE1 was accompanied by claim that the main interest rate will remain low "for some time" which was later substituted by "for extended period". The first change in language of statements came in 2011, when the Fed issued a calendar-based guidance by communicating that economic conditions would warrant policy rates at their lower bound for at least two years. Since December 2012, the Federal Reserve has been pursuing threshold-based forward guidance, the clarification that the extraordinary policy accommodation would be maintained until the unemployment and inflation rates reach desirable levels (Filardo and Hofmann, 2014).

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[7]To reduce the amount purchased monthly.

Figure 5: FOMC statements and market reactions

Market Reactions to Major Changes in FOMC Forward Guidance

Date of statement	Forward guidance	Market expectations of future rates
December 16, 2008	"The Committee anticipates that weak economic conditions are likely to warrant exceptionally low levels of the federal funds rate for some time."	Decreased
March 18, 2009	"Economic conditions are likely to warrant exceptionally low levels of the federal funds rate for an extended period."	Decreased
August 9, 2011	"Economic conditions[…]are likely to warrant exceptionally low levels of the federal funds rate at least through mid-2013."	Decreased
January 25, 2012	"Economic conditions[…]are likely to warrant exceptionally low levels for the federal funds rate at least through late 2014."	Decreased
September 13, 2012	"Exceptionally low levels for the federal funds rate are likely to be warranted at least through mid-2015."	Decreased
December 12, 2012	"This exceptionally low range for the federal funds rate will be appropriate at least as long as the unemployment rate remains above 6-1/2 percent, inflation between one and two years ahead is projected to be no more than a half percentage point above the Committee's 2 percent longer-run goal, and longer-term inflation expectations continue to be well anchored." Policy is expected to remain "highly accommodative" for a "considerable time" after the end of the asset purchase program.	Mixed
October 29, 2014	QE III Asset Purchase Program ends. Even after employment and inflation are near target, "economic conditions may, for some time, warrant" lower than average levels of the federal funds rate.	Increased
December 17, 2014	Clock starts on "considerable time" from October meeting.	Increased

Notes: The table shows how the price of federal funds futures contracts, which settle four to 12 months ahead, and Eurodollar futures contracts, which settle 13-31 months ahead, changed from the day before various FOMC announcements to the day after.

Source: Smith and Becker (2015)

2.1.1 Macroeconomic effects

This part should begin with analysis of the key macroeconomic time series, which the central bank is primarily the responsibility for. Figure 5 shows the medium-term inflation in the US in 2000 - 2015. The long-term price stability objective of the Federal Reserve System is a 2% annual inflation rate. The financial and economic crisis brought about a significant reduction in the price level at the end of 2008, forcing the US monetary authority to proceed mainly to individual rounds of quantitative easing together with forward guidance policy. Inflation was very turbulent and could be described as stable only in the period 2012 - 2014, when the inflation rate was around desirable level of 2%.

The price decline was most significant in the autumn of 2009, when quarterly inflation reached a critical value of -1.6%.

Figure 6: The quarterly CPI growth in US (%), Q1 2000 – Q4 2015
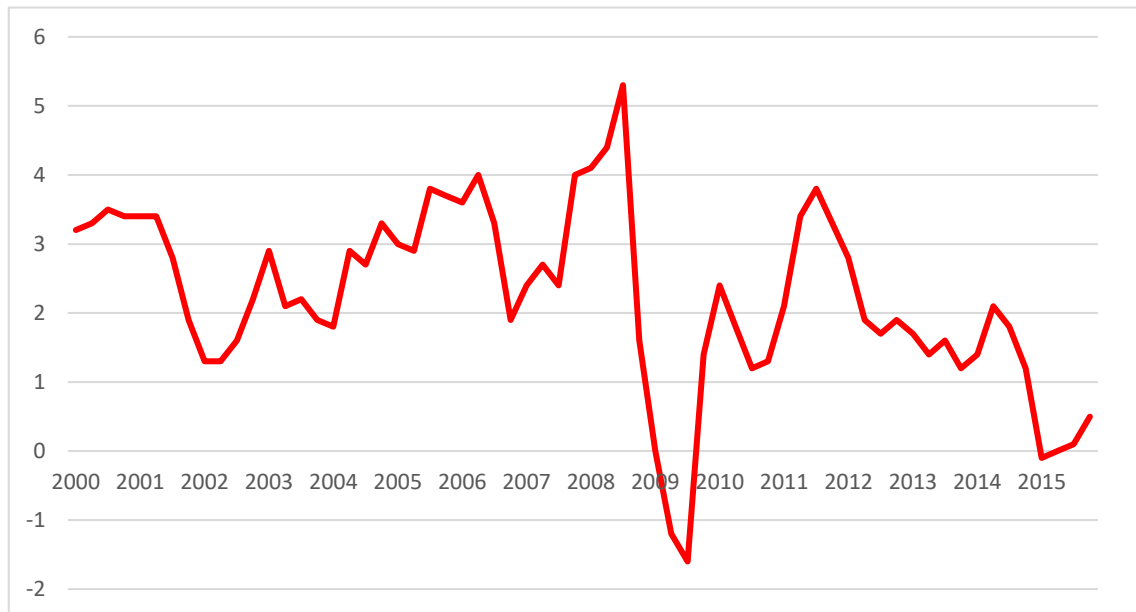
Source: OECD data, own editing

Since the Fed has a dual mandate, it has to maintain not only the price stability, but also the maximum rate of employment. The unemployment rocketed since the end of 2007 and this trend peaked in the fourth quarter of 2009 at the maximum nearly 10%. Nevertheless, in recent years it decreases gradually; in the last quarter of 2015 reached the unemployment 5%.

Figure 7: Unemployment rate in US, % of labour force, Q1 2000 – Q4 2015

Source: OECD data, own editing

The overall impact of unconventional monetary policy actions is not clear - the condition of the economy is affected by many other factors such as the value of the dollar, international trade etc. Rosengren (2015) states that an objective assessment of the impacts of unconventional monetary measures will be possible only after the Fed turns back to full use standard tools. At the same time, when comparing individual rounds of QE, he concludes that the programs, which did not impose the maximum total volume of purchases, but determined their pace, and those of which objects were assets with wider spreads (typically MBS) were the most effective. This definition fit the most the third round of quantitative easing. Baumeister and Benati (2010) estimate that without interventions by the Fed there would be a huge downswing up to 10% in GDP in the first quarter of 2009. The estimate is based on a simulation of the shock into long-term interest rates assuming that the spreads between long and short-term rates would fail to be cut. A comprehensive evaluation is attempted by Engen, Laubach and Reitschneider (2015), who in their study concluded that in comparison with the theoretical situation where the Fed would not take the non-standard monetary actions, the implementation of QE and forward guidance contributed to a decline in the unemployment rate more than 1 percentage point, and to an increase in inflation about 0.5 percentage point. Overall, they evaluate the measures as beneficial.
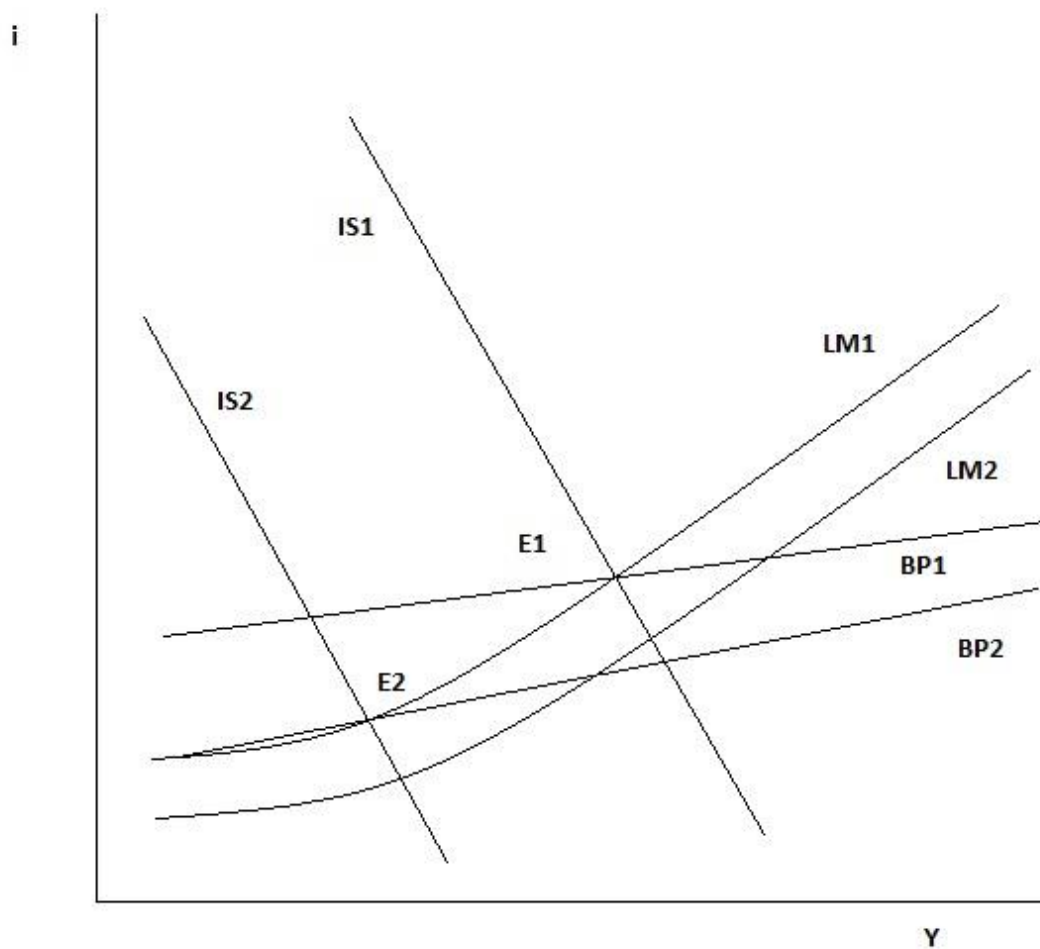
2.2 The ECB

The European Central Bank (ECB) administers the monetary policy of the European Union countries that have adopted the euro as their official currency. It is a relatively new central bank, which was established by the Maastricht Treaty in 1993. Officially, however, the ECB began to carry out its duties after the introduction of the euro in 1999. The main objective of the monetary policy of the ECB is to maintain price stability, when fulfilling the primary objective a secondary objective is to foster economic growth and employment.

The European Central Bank was in recent years significantly influenced by two events that need attention. First, the ECB had to deal with the global financial crisis in the years 2007 - 2009. The second phase of the crisis, particularly specific for the euro area, was associated with the debt problems of member countries.

The Eurozone have experienced the same primal shock in a sense of a sharp adverse shift of the IS curve. It could be situated in equilibrium E1 before the crisis. After the breakdown of Lehman Brothers the wave of caution has risen, accompanied by a significant drop in the volume of loans granted on the interbank market, which was in fact threatening the existence of banks that were dependent on debt financing. This development had a negative effect on European banking institutions involved in operations on the US mortgage market. It lead to decline in investment and consumption and therefore shift to IS2. However, the situation was different from the US, since the interest rate have not reached the zero lower bound and the liquidity was trapped in the banking system; nevertheless, precautionary measures shifted the LM schedule to the LM2 position. The ECB tried to restore the confidence in the money market and the credit channel; however, it was circumspect about lowering the key interest rate. Concerning the BP curve, some countries, such as Greece, were in deficit of balance of payment and external imbalance. However, most of the Eurozone countries found itself in internal as well as external balance. That is the reason why the BP curve shifts to BP2 and goes through the equilibrium E2. Again, the sensitivity of the net capital flows to the interest rate differential was lower after the outbreak of crisis, therefore, the BP2 curve is steeper.

Graph 9: Eurozone economy after outbreak of crisis

Source: Own editing

Financial crisis

As in the US, problems related to the financial crisis involved the European monetary authority - the ECB to seeking solutions. Initial reactions of the ECB to the growing uncertainty across the interbank market was in the summer of 2007 an unlimited overnight provision of liquidity to the banking system in the amount of 95 bn. EUR, followed by an extension of the maturity of refinancing operations for six months. This quick response helped to temporarily restore the confidence in the money market (Cour-Thimann and Winkler, 2013), but the turning point came after the bankruptcy of Lehman Brothers, when the uncertainty on the financial markets once again escalated.

Together with reducing the interest rate on the main refinancing operations implemented the ECB in October 2008 a programme called Enhanced Credit Support. Trichet (2010) stated that non-standard measures were necessary to ensure the efficient transmission of monetary policy measures into wider economy, despite the dysfunctionality of certain

financial markets. Within the framework of ECS introduced the ECB among other measures a program FRFA (Fixed Rate Full Allotment) guaranteeing unlimited liquidity against collateral and expanded the list of assets eligible as collateral. Change to the full allotment regime was applied to all refinancing operations. In May 2009 the ECB as a response to the continuing mistrust - freezing of the interbank market - temporarily extended the maturity of long term refinancing operations (LTRO) for one year, which played in combination with the program FRFA vital role in keeping interest rates on the money market at low levels. The ECB launched as well a covered bond purchase program (CBPP) in the amount of 60 bn. Euros. The size of the program represented around 2.5% of the total outstanding amount of covered bonds. Covered bond purchases should facilitate opportunities and reduce the cost of long-term bank financing, since the issuance of covered bonds is the primary source of funding for euro area banks. The program was announced for the period July 2009 to June 2010, with the ECB measures declared as a credit (not quantitative) easing in order to reduce the demand for long-term refinancing operations (Zamrazilova, 2014). It should be noted that the ECS measures cannot be considered as quantitative easing, since the increase in reserves of commercial banks was only a by-product, not a primary objective of the ECB's efforts to ensure sufficient liquidity. Another argument is that while the QE is mostly used in a situation of interest rates approaching zero - that is the moment when standard monetary policy is lose its power. The ECS program was operated as a complement to conventional instruments, as the MRO interest rate was set at 3.75% at the time the actions were taken.

Figure 8: Credit to the non-financial sector (bn. EUR, %), 2007-2010

Source: BIS data, own editing

These measures have helped to restore the credit channel, which should encourage the investment and consumption decisions and therefore shift the IS curve to the right. The development of the volume of loans to private non-financial sector in the Eurozone is demonstrated in Figure 8. The situation was most critical in the third quarter of 2009 when the growth rate of loans compared to the previous quarter was negative (-0.5%). The situation began to improve afterwards at a moderate pace and the danger of a credit crunch has been avoided.

Debt crisis

In this phase of the global crisis the approaches of the Federal Reserve and the European Central Bank differed significantly. While the Fed was focused mainly on the support of insufficiently growing economy and reducing the high unemployment rate, the ECB had to deal with the spreading panic about a possible Greek insolvency. As a response to the Greek crisis announced the Securities Market Programme (SMP). The aim of the measure was to ensure the functioning of the bond market and restore the transmission mechanism of monetary policy. Within the SMP started the ECB buying government bonds of Eurozone countries[8], however these purchases were made on the secondary market and sterilized, which means that once again it cannot be classified as a quantitative easing

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[8] Bonds of Ireland, Greece, Spain, Italy and Portugal; the biggest share had the Italian debt securities (ECB, 2013).

(Fawley a Neeley, 2013). The ECB even decided to raise interest rates from 1.00% to 1.25% in April 2011 and to 1.5% in July 2011, which shifted the LM curve to the left. It might be seen as hasty step, since the rate of return on government bonds started to rise again and economic growth slowed down few month later. Taking into account the further unfavourable developments on the bond markets of peripheral Eurozone countries, the ECB reactivated SMP in July 2011. The purchase amount of sovereign bonds of stressed countries reached a peak of 220 billion euros in February 2012. In addition, the SMP was complemented by second round of Covered Bond Purchase Programme (CBPP2), reaching a high of 16 billion euros. However, in September 2012 the ECB announced most likely the most significant measure, a new program of purchases on secondary markets in government bonds, called Outright Monetary Transactions (OMT). It has been designed for the bonds of Eurozone countries using programs EFSM and ESM, as long as those countries meet the requirements. This also meant the end of a previous program, the SMP. OMT program has not yet been activated (Carrasco, Rodríguez, 2014).

Figure 9: Unconventional programs of the ECB and interest rates (%), 2005-2015
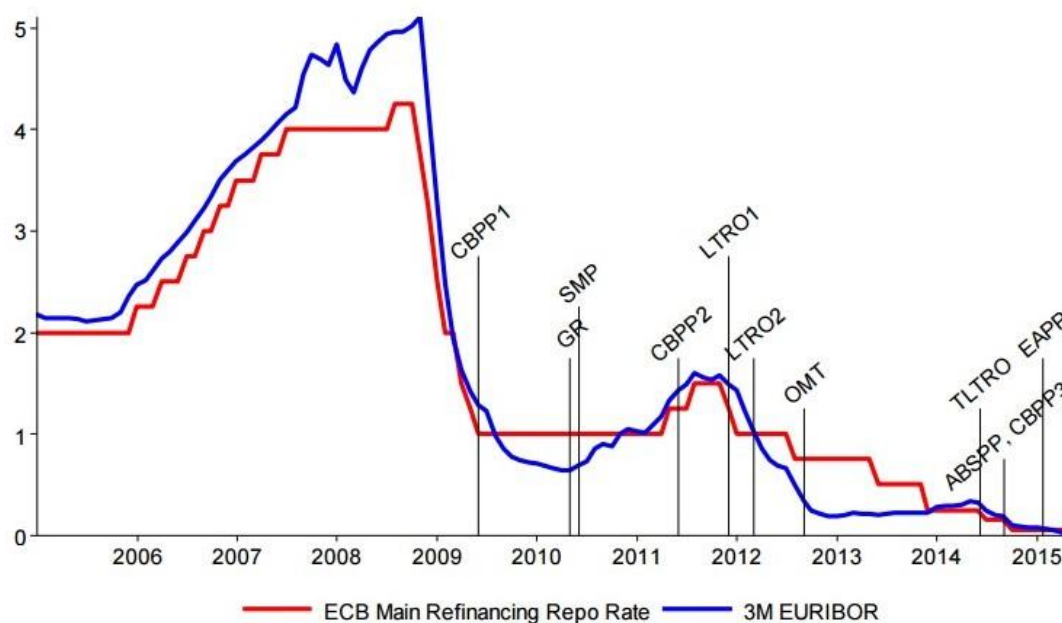
Source: Komárek (2015)

The next action taken was an employment of verbal interventions in the form of forward guidance in order to influence the expectations about future and therefore shift the IS schedule to the right. It started in the summer of 2013, stating its intention to keep interest rates at prevailing or lower levels "for an extended period of time". This represented a

break with the long-standing practice of not commenting on policy rates beyond the following policy meeting (Filardo and Hofmann, 2014). In compliance with efforts to achieve price stability a program Targeted Longer-Term Refinancing Operations (TLTRO) was announced in June 2014 to facilitate the provision of bank loans to the private non-financial sector (excluding financing the purchase of real estate). It was an effort to support the process of monetary policy transmission (ECB, 2014).

According to Duarte and Modenesi (2016), implemented the ECB in September 2014 new instruments in order to improve the transmission of monetary stimulus to the credit market and the real economy and to avoid a deflationary spiral. The MRO interest rates was reduced to 0.05% as seen in Figure 2, and the deposit rate was also reduced to an even more negative level (-0.20%, from -0.10 in June 2014), in an attempt to avoid that banks kept parking liquidity on ECB's current account. The Eurozone monetary authority installed in autumn 2014 two programs; namely, round three of the Covered Bond Purchase Program (CBPP3) and Asset Backed Security Purchase Program (ABSPP), which are both expected to last until at least March 2017. The aim of the ABSPP is to encourage bank lending through the purchases of all sorts of securities backed by other assets. Furthermore, the ECB started a QE program in March 2015, called Public Sector Purchase Program - PSPP. It should consist of unsterilized purchases of bonds issued by governments, national agencies and EU's supranational bodies (Dědek, 2015).

The second series of targeted long-term refinancing operations (TLTRO 2) was announced in March 2016. Banks participating TLTRO2 can borrow an amount of money equal up to 30% of the loans they have provided to firms and consumers. This means that banks lending more to real economy, can borrow more resources at a lower interest rate than the ECB usually offers. TLTRO2 consists of series of four operations which will be conducted once a quarter between June 2016 and March 2017 (ECB, 2016).

2.2.1 Macroeconomic effects

The primary objective of the ECB is to maintain price stability at 2%, or just below it. Taking into account the monthly figures in the period from August 2006 to July 2016 in Figure 10 and the yearly numbers in the period from 2006 to 2015 in Figure 11, it cannot be considered as meeting the inflation target set by the ECB. The high rates of price growth in the period from autumn 2007 to autumn 2008 were a consequence of a high

level of economic activity. In the second half of 2007, the oil and food prices and food increased; however, it was not immediately followed by the corresponding wage development. The ECB responded to these trends by gradually raising its key rates.

Figure 10: The monthly CPI growth in Eurozone (%), June 2006 – June 2016
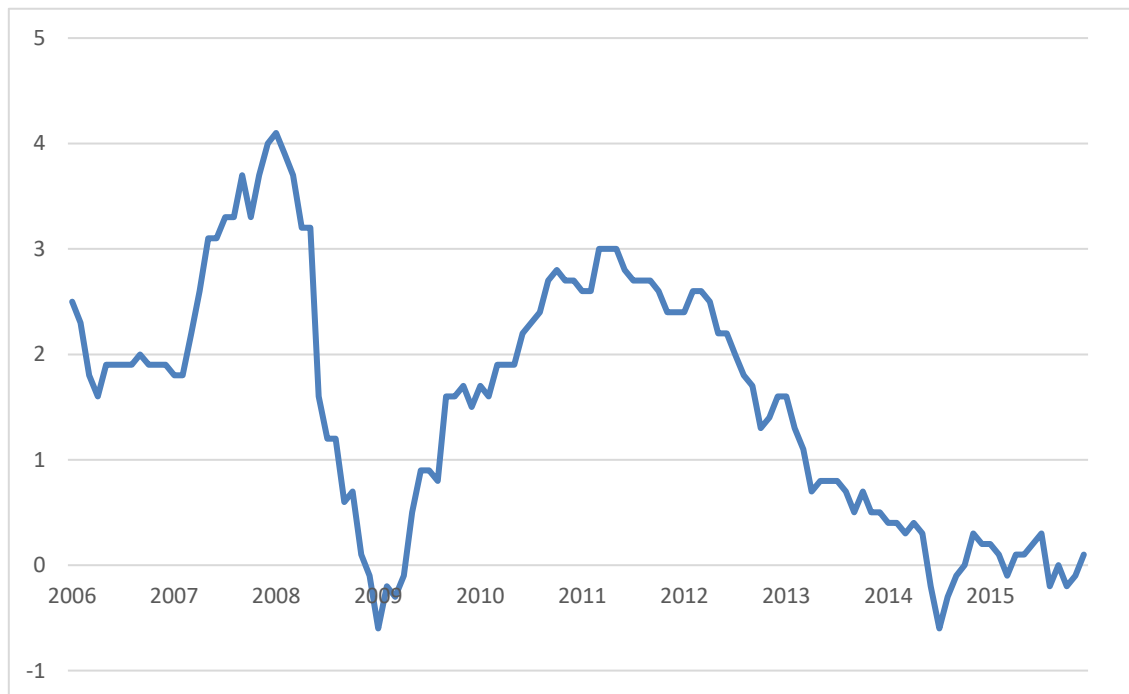
Source: OECD data, own editing

Significant turnover occurred in the period after the collapse of Lehman Brothers, when the inflation rate fell from 3.2% in October 2008 to 2.2% in November, and then to 1.6% in December, which went hand in hand with the slowdown of the economic performance of the region. The lowest numbers were recorded in July 2009, when prices "grew" negatively by -0.6%. This negative price development was again reflected in the rate of economic performance, which reached historic low at the end of the first half of 2009 - real GDP growth was around -5.6%. An interesting point of this period is the fact that inflation in the US has fluctuated compared to the Euro area much more. In my opinion to the rapid decline in inflation in the US in 2009 contributed greatly the fact that American subjects are in comparison with the EU more dependent on resources coming from financial markets than from the banking system, which activity was affected by a high degree of uncertainty.

Figure 11: The yearly CPI growth in Eurozone (%), 2006 – 2015

Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Inflation rate (%)	2,2	2,2	3,3	0,3	1,6	2,7	2,5	1,3	0,4	0,0

*Source: OECD Economic Outlook: Statistics and Projections, own editing*

The inflation rate started to achieve positive values in the autumn of 2009 when the financial tensions gradually disappeared and the credit channel of transmission mechanism began to work again. The rise of the price level continued up to the end of 2011. The fall 2012 was followed by a period of moderate price decline and particularly slow economic growth. The ECB continued to gradually reduce its key interest rates, but in this sense, it was running out of options, as inflation was resistant to these steps and the price level was steadily decreasing since mid-2013. The ECB implemented a package of comprehensive programs at the end of 2014 aimed at economic recovery and restoring growth in prices, however the values are balancing on the edge between inflation and deflation through the whole year 2015 and beginning of 2016.

2.3 A Comparison of policies of the Fed and the ECB

Monetary policy of the Fed and ECB has undergone a dramatic development in recent years. Although the crisis in the US and Europe was similarly caused by problems in the financial markets, and especially the bankruptcy of Lehman Brothers in 2008, this development cannot be described as identical - a difference was not only the timing of implemented monetary measures (resulting mainly from the fact that the transmission of the crisis from the US to Europe was not expected), but in most cases also their nature, since the Fed was strongly focused on QE.

The initial difference was the management of major interest rates; the Fed started gradually decline the Federal Funds Rate as early as autumn 2007, while the ECB steadily increased its MRO interest rate until October 2008. In addition, a significant anomaly was the outbreak of the debt crisis in the Eurozone, which further implied the stagnation of European economies at a time the US economy started slowly to recover. Taking into account that the standard instruments monetary policy were not sufficient, both monetary authorities introduced so called unconventional instruments. As a consequence of these measures was increase in the balance sheets of both central banks, nevertheless, they differed in structure (see Figure 12). Whilst the Fed was initially under the QE programs focused on buying the MBS, the purchase of government bonds accelerated around 2011, the primary growth in the balance sheet of the ECB was caused by MRO and eased conditions of LTRO programme (besides the increase in the ECB's balance sheet was also generated by programs CBPP and SMP).

*Figure 12: Balance sheet composition: the FED and the ECB*
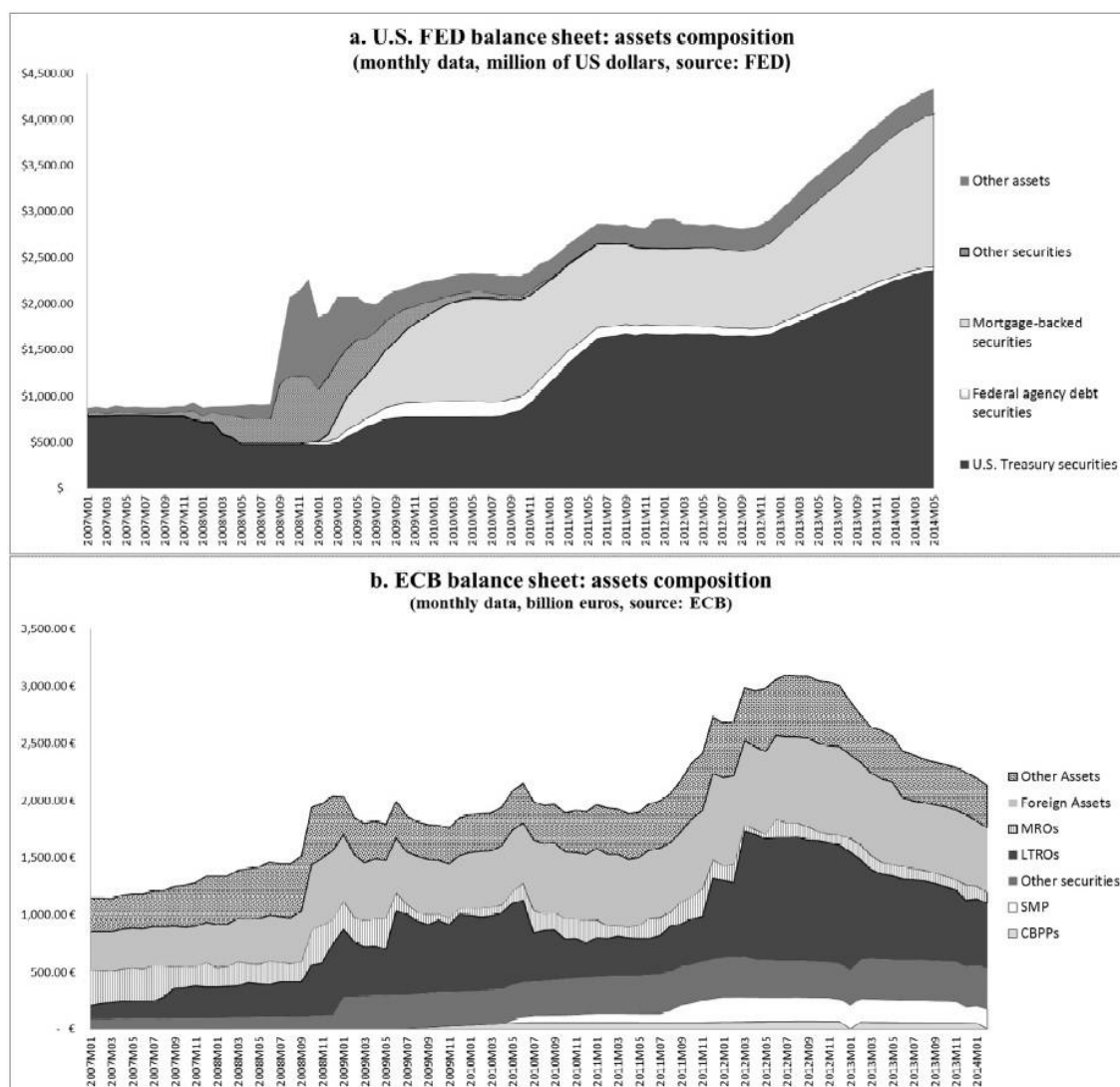
Source: Carrasco, Rodríguez (2014)

Regarding the differences in the balance sheets it is important to stress that most of the assets purchased by the ECB is collateralised (approximately 90%) and the remaining 10% is in form of the SMP and CBPP. In the US case, the situation is reversed. Despite this contrast, the balance sheets of the two central banks almost tripled in the period from the beginning of the crisis until the end of 2012. This trend was interrupted during 2013, when the ECB's balance sheet started shrinking again, as a result of redeeming the previous loans.

The character of the measures taken varied as well because of the difference in the financial structure of the US and the Eurozone. While in the euro area banks are considered to be the main channel of the transmission mechanism (70% of external

finance non-financial companies comes from banks, in contrast with only 30% coming from financial markets), which suggests why the monetary policy of the ECB has been focused in recent years on encouraging the banking system to lend the money, in the US, the situation is entirely opposite again (Cour-Thimann and Winkler, 2013).

Figure 13: Funding of non-financial corporations in the euro area and the United States
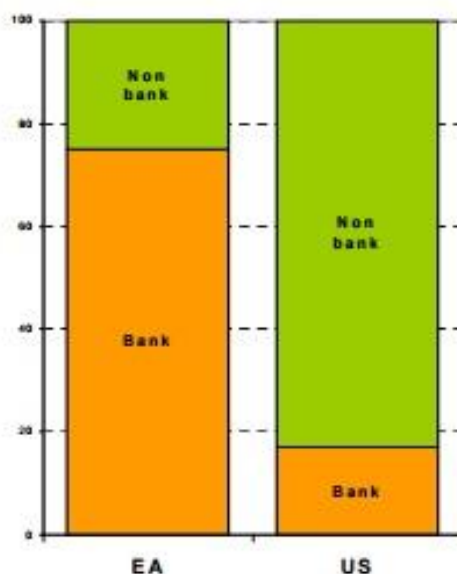
Source: Cour-Thimann and Winkler (2013)

**The quantity theory of money applied**

The quantity theory of money suggests that the price level will rise, if the central bank increases the money supply. However, it was not the case during the global crisis, the central banks were rising the money supply, but the prices did not went up. The problem might be caused by collapse of velocity of money. The equation from the chapter 1.2 can be rewritten as:

$$V = \frac{P \times Y}{M}$$

This relationship shows the velocity of money as a nominal output divided by money supply. If the money supply grows far more rapidly than nominal output, the velocity of money will decline. Nevertheless, while this should be reflected in inflation, it could also signify a declining output relative to the money supply. When economic activity is high, the velocity of money is high, it reflects the fact that money is changing hands in transactions and banking activity. Reversely, low level of economic activity implies that

the pace at which money circulates through the system slows down. It might be the reason, why the central banks are failing in fighting the inflation.

Figure 14: Velocity of M1 Money Stock
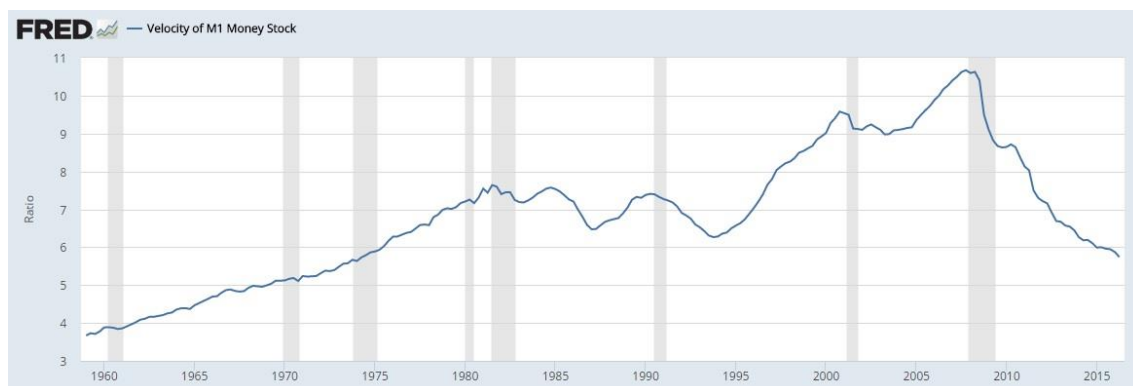
Source: Federal Reserve Bank of St. Louis (2016)

Figure 14 shows the velocity of M1 money stock; Figure 15 shows the velocity of M money stock both calculated as the ratio of quarterly nominal GDP. M1 is the narrowest component and contains the currency in circulation.[9] Less short-term consumption transactions might be indicated by a decrease in velocity of M1. M1 is included in the broader M2 component in addition to saving deposits, certificates of deposit, and money market deposits for individuals (Federal Reserve Bank of St. Louis, 2016).

Figure 15: Velocity of M2 Money Stock

Source: Federal Reserve Bank of St. Louis (2016)

The velocity of M1 usually declines during a recession, however, it has been falling even last five years and reaching its 40 year low. The same could be said about the velocity of M2, it has continued to slow down in the post-recession era and has now dropped to the

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[9] notes and coins, traveller's checks, demand deposits, and checkable deposits

lowest level recorded. It signals that the money remains trapped in the financial system and the central banks need to find a way to solve this issue.

IS-LM-BP today

To illustrate today's situation in the Eurozone the Graph 8 could be used, as the ECB hit the zero lower bound quite recently. The ECB is caught in the liquidity trap and implemented quantitative easing in 2015 in order to affect the long-term interest rates which reflect the expected level of short-term rates. As stated above a higher expected inflation might be good, since it implies the lower current and future expected real interest rates. Thus, if the large increase in the money supply leads people to expect more inflation in the future, it will also increase spending today (Blanchard and Johnson, 2013). It seems based on the IS-LM-BP analysis that the ECB with its monetary policy is now facing the same situation as the Fed at the beginning of crisis.

Graph 10: The US economy today
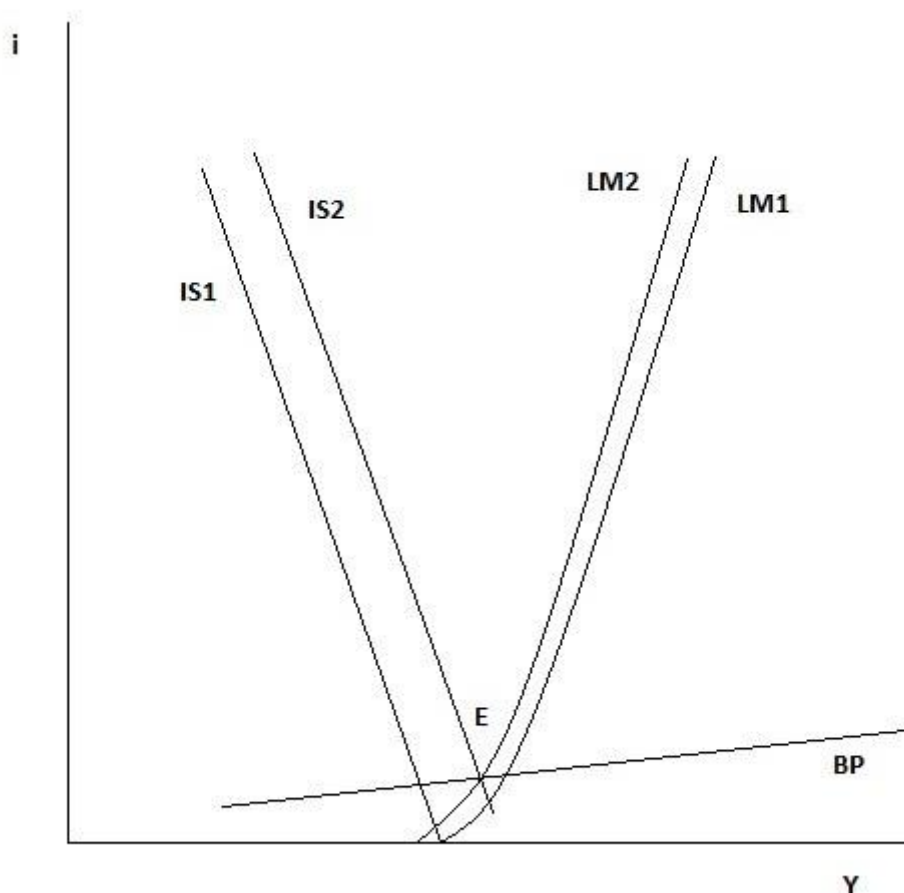
Source: Own editing

On the other hand, the US economy is depicted in Graph 10. The Fed have ended the quantitative easing programs, anchored the expectations about future and even raised the

key interest rate in 2015, which suggest a small shift of the LM curve to the left (to LM2) caused by this contractionary policy. The US economy has been slowly escaping the liquidity trap and the IS curve is moving to the right (to IS2). Therefore, the restrictive monetary policy does not cause a decrease in level of output and the US economy finds itself in the equilibrium E.

Conclusion

The thesis focuses on the unconventional monetary policy of the ECB and the Fed. The period of conducting non-standard measures is framed by the year 2008 at the one end; however, the opposite end remains open. The reason is that the Eurozone keeps coming up with new programs and instruments (the latest measures was announced in 2015). After a closer look at the character of the various unconventional instruments it is obvious that these measures differ in its content and purpose. After a detailed study of the chosen topic of the thesis I was confirmed in the original assumption that an unconventional approach to the execution of monetary policy remains an issue. Moreover, in this context, I would like to express my opinion that it is still not the end of the era of unconventional steps taken by the central banks.

The main reason of the turn in conducting of monetary policy was the depth of the economic problems, to which the economically advanced regions were exposed in recent years. These issues were caused by the turmoil in the financial markets, which was induced by risky behaviour among involved subjects (particularly in relation to the provision of subprime mortgages and their subsequent securitization). The attractiveness of the housing market in US pushed the growing prices to unrealistic heights; nevertheless, this trend was not sustainable and, in the summer of 2007, the real estate market bubble burst. The interconnectedness of mortgage and financial market subsequently caused the collapse of the latter one, which was followed by selling various assets in panic that led to drop in their prices and also to increase in interest rates. These events have directly affected the US banking system; the major breakthrough came in October 2008 when the investment bank Lehman Brothers bankrupted. In connection with the volume of transactions, which the non-US banks conducted with Lehman Brothers before its fall, the financial crisis quickly spilled over the US borders.

The primary task of the central bank at this stage of the crisis was to restore activity in the financial markets, since the high interest rates on this market negatively affected the level of interest rates in further lending of the banking system to the private sector, which not only threatened the functioning of the transmission mechanism, but also counteracted the restoration of economic growth, as investment and consumption decreased and unemployment rose.

In this context, the first step was a radical reduction of key interest rates by majority of central banks; however, the ECB decided to do this with considerable delay compared to other major central banks, since it was assumed that the Eurozone will not be affected by financial crisis. The standard monetary tools proved to be insufficient relative to the extent of the crisis, therefore it was necessary to come up with new instruments and monetary policy of the ECB and the Fed was no exception in this respect.

As indicated, the ECB's unconventional approach differed from the Fed's approach mainly in the volume of QE, which was dominant in the case of the Fed while the ECB was careful to ensure that its operations were sterilized. Fed was, unlike the ECB, focused on buying mortgage-backed assets as the financial markets are considered to be the main source of lending for the US economy. In the case of the euro area the major role plays the banks. A coincident feature of both monetary authorities was inflating the balance sheet and the application of forward guidance.

The unconventional policies were also examined with the famous economic models; namely, the IS-LM-BP model and the quantity theory of money. Concerning the quantity theory of money, the assumption of constant velocity of money is not valid. The rise in the money base caused by QE programs would imply an increase in price level, which was not true. Therefore, the velocity of money collapsed and the money put in the economy is not able to affect the inflation.

The IS-LM-BP illustrated the situation of US and Eurozone economy at the beginning of the crisis and at present. Both economies experienced adverse shock and the IS curve moved to the left. While the Fed after the outbreak of the crisis lowered the key interest rate near to zero and was caught in the liquidity trap, the ECB still had space for further monetary expansion. Both monetary authorities therefore had to influence the expectations about future level of inflation and future interest rates to boost the investment and consumption and shift the IS curve back to the right. Nowadays, the situation is reversed, as the US economy is successfully leaving the liquidity trap and encouraging the consumption investment decisions. On the other hand, the Eurozone is stuck in the trap even with negative deposit facility rate.

After the overall assessment of unconventional monetary policy, I conclude that the newly adopted measures led to the fulfilment of objectives, to which they were primarily

designed. The hypothesis about the necessity of non-standard measures to maintain a stable price level could not be confirmed, as inflation has been for most of the period deviated from the prescribed band. The inflation rate is thus more sensitive to standard monetary policy.

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