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ECB's quantitative easing – how it affects the economy

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Abstract

To address the prolonged low inflation in the Eurozone and to overcome the zero lower bound, the ECB introduced its quantitative easing programme, the Expanded Asset Purchase Programme (APP) early 2015. In this thesis, I examine the mechanisms how such a large-scale asset purchase programme affects the economy, especially sovereign yields and inflation. I also analyse whether the purchases under the APP have influenced the euro area economy as the theory suggests using empirical research about the impact. I also bring forward, what caused the shift in ECB's monetary policy from interest policy to balance sheet policy. The thesis is a literature review in which I use the theoretical framework of Krishnamurthy and Vissing-Jorgensen (2011) and work of Joyce et al. (2012) to analyse the transmission channels of quantitative easing. The effects of quantitative easing come through the expansion of the central bank's balance sheet and the maturity of an asset plays a key role in the transmission. Quantitative easing has both ex ante and ex post effects: Through purchases, the central bank sends a signal that it will keep short-term interests low as well as it creates scarcity of bonds in the markets, which pushes up their prices. I show that the APP has dampened yield curves of euro countries and led to rising inflation and subtle GDP growth.

Keywords Quantitative easing, monetary policy, ECB, expanded asset purchase programme, bond yields, inflation, sovereign bonds

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1 Introduction

After the financial crisis and the sovereign debt crisis, the Eurozone has ended up in a tricky situation of zero lower bound and close-to-zero inflation. The ECB has tried to push money into the economy by setting the policy rates to zero – with no success. According to standard macroeconomic theory, it should stimulate inflation and narrow the negative output gap. The central bank has adopted many unconventional measures, e.g. long-term refinancing operations and the securities market programme. Nevertheless, there has still been the risk of deflation. Are we close to the situation of Japan in the early 2000's where monetary policy loses its grip?

The measures to tackle the prolonged low inflation were the quantitative easing programme, the name of which is the Expanded Asset Purchase Programme, starting early 2015, that has sparked a lot of controversy in the public discussion. The term quantitative easing refers to unconventional monetary policy of creating more liquidity to the economy through asset purchases by a central bank. Many have argued that the ECB is overstepping its mandate that was defined in the Lisbon Treaty as maintaining the price stability. The ECB has been accused of carrying on monetary financing which is prohibited from the central bank. The highest court of Germany has even referred a lawsuit against the ECB for the expanded asset purchase programme (Financial Times, 15 August 2017).

Soon after the start of the financial crisis, the Federal Reserve and Bank of England launched their quantitative easing (QE) programmes, late 2008 and in March 2009 respectively. However, the situation of the ECB is somewhat different from those central banks since the recession of the euro area intensified due to the sovereign debt crisis in 2010.

Expanding the ECB's balance sheet so heavily, the programme has a profound effect on the Eurozone economy. The purpose of this study is to understand why the ECB decided to introduce its QE programme and how such large-scale asset purchases affect the economy, especially sovereign yields and inflation. The thesis is a literature review and I will address the QE programme of the ECB from a theoretical perspective. There have been numerous papers about quantitative easing in the recent years, many of which are ECB working papers. I use the theoretical framework of Krishnamurthy and Vissing-Jorgensen (2011) and the article of Joyce et al. (2012) to analyse the transmission mechanism of QE, more precisely the channels through which the purchases affect the economy.

Additionally, the aim of this thesis is to examine, using previous literature, whether the purchases have affected the Eurozone economy as the theory suggests. Since the ECB launched the programme only 2.5

years ago, there is a little evidence regarding their impact on the economy. I will go through a few working papers on ex-ante effects of the announcement and implementation (e.g. De Santis, 2016; Andrade et al., 2016) as well as later research regarding the impact on sovereign yields and economy longer-term (Valiante, 2017; Gambetti and Musso, 2017).

First, I will consider the background of the QE: What caused the shift of the ECB monetary policy from interest setting to balance sheet policy (chapter 2). I will go through the financial crisis and the sovereign debt crisis as well as the ECB's measures regarding them. Next, I will give an overview of the expanded asset purchase programme (APP) and its quantity (chapter 3). Then, I will focus on the theory of quantitative easing and analyse the channels through which the purchases affect economy (chapter 4). Finally, I will present empirical findings about the impact on yields and broadly, inflation and GDP growth (chapter 5).

2 The two crises that lead to recession and ECB's measures

Before the global financial crisis, the ECB's monetary policy rested on setting the interest rate (Joyce et al., 2012). The central bank operated mainly with the following instruments: open market operations, standing facilities and minimum reserve requirements (ECB). However, in the recent years, it has become clear, that the transmission of the interest-setting policy is at risk since the interests have been lowered to the zero lower bound and there have been no signs of increasing inflation. Therefore, we need to go through the crises to understand the reasons behind the shift in the ECB's monetary policy from interest setting to balance sheet policy.

According to Cour-Thimann and Winkler (2013), there are three distinguishable phases in the recession in Europe:

1. The financial crisis which started September 2008, triggered by the collapse of Lehman Brothers
2. The sovereign debt crisis which started May 2010, triggered by the Greek crisis
3. The re-intensification of the sovereign debt crisis and the problems of the European banking sector which started mid-2011

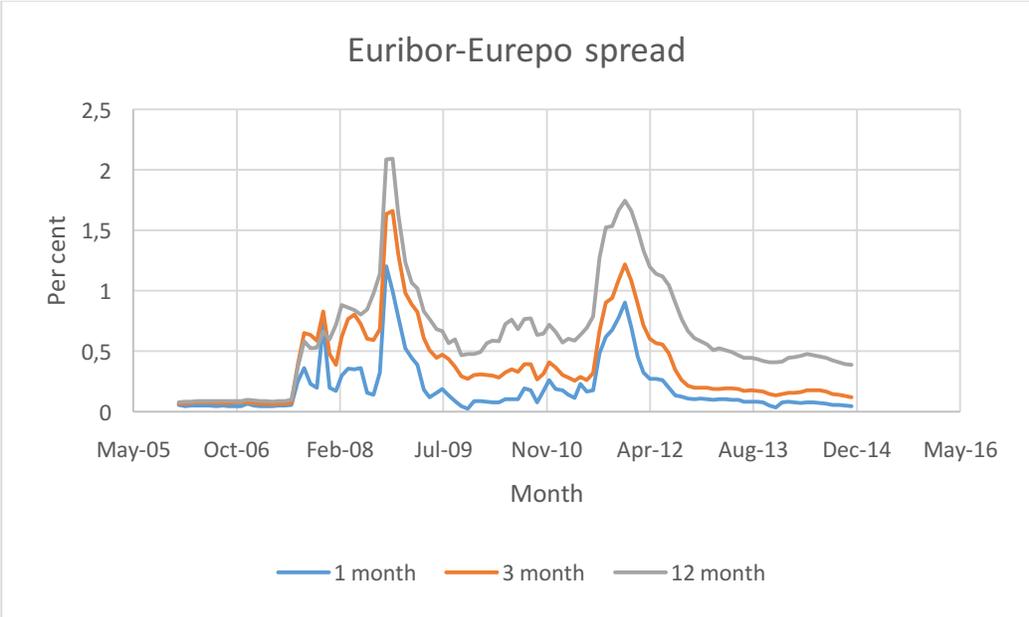
In this chapter, I will shed light on these crises as well as the zero lower bound the ECB has faced as the result of the crises. I will discuss the ECB's many measures it has taken to address the liquidity

challenges of banks and to ease their funding, and to repair the transmission channels of its monetary policy. I will also bring forth what made the ECB finally decide to implement quantitative easing.

2.1 The global financial crisis

The packaged subprime mortgage loans turned out to be riskier than thought when the US housing bubble burst in 2007. When the investment bank Lehman Brothers filed for bankruptcy September 15th, 2008, the global financial crisis erupted leading to doubts about financial condition of banks in the interbank market. The doubts about possible risks in other banks claims caused the rise in the money market interests and drove spreads to abnormally high levels (Trichet, 2010). ECB's interest rates and money market rates were impaired (ECB, 2009).

The spread between Eurepo and Euribor rates indicates the mistrust in one another in the interbank market. The banks and financial institutions were unsure whether the counterpart has assets in risk of default in their balance sheets. Hence, they were demanding collaterals when providing each other liquidity. In the graph 1, we can see the difference between Eurepo and Euribor rates, which started to spread late 2007.



Graph 1: Spread between Euribor and Eurepo. Data source: Bank of Finland

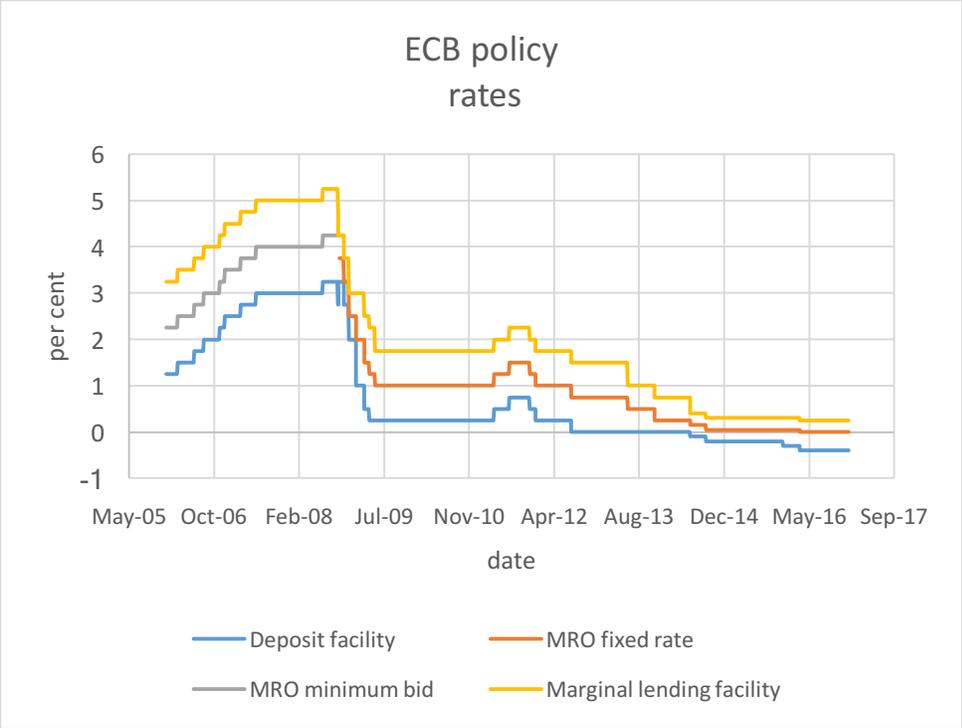
The transmission of the interest policy and ECB's ability to steer the money market were in risk. The banks started to create a liquidity buffer by collecting more reserves. The banks also tightened their lending conditions and tried to shed the risks in their balance sheets. (Cour-Thimann and Winkler, 2013) According to Trichet (2010), many financial markets plunged. The credibility of ECB would be impaired if it could not steer the money market through interest rate decisions.

2.1.1 ECB's measures against the mistrust in the markets

As we can see in the graph 2, the ECB lowered its main policy rates in the meeting of October 15th 2008, to support banks acquiring liquidity. The deposit facility rate is the overnight interest paid for commercial banks' central bank reserves exceeding the minimum reserves. With the marginal lending facility rate, the ECB offers overnight credit for commercial banks. With the main refinancing operations (MRO) rate, the commercial banks can acquire liquidity for a week against a collateral. Before the crisis, the MROs were conducted through auctions. Yet, starting 15 October 2008, the ECB decided to carry out the MROs through a fixed rate (ECB).

Since the transmission of interest rate policy was in risk, ECB adopted unconventional measures, known as enhanced credit support, to support bank liquidity. (Cour-Thimann and Winkler, 2013) ECB responded by providing banks with unlimited liquidity at a fixed rate against a collateral and extended the list of assets adequate as a collateral until 2010 (Trichet, 2010; Cheun, von Köppen-Mertels and Weller, 2009) ECB also extended the maturity of long-term refinancing options temporarily up to 12 months, the operation known as LTRO. Another measure to provide liquidity were currency swap agreements. (Cour-Thimann and Winkler, 2013)

Moreover, to enhance liquidity of banks, ECB started a covered bond purchase programme (CBPP). The central bank allocated funds to purchase covered bonds between June 2009 and June 2010 with a total amount of €60 billion and in the second operation between November 2011 and October 2012 with the amount of €40 billion. The covered bonds, long-term debt securities, collateralised against a set of other loans, are a major source of liquidity for European banks. The market for them nearly collapsed during the intensification of financial crisis. (Cour-Thimann and Winkler, 2013; Trichet, 2010)



Graph 2: The ECB policy rates. Data source: ECB

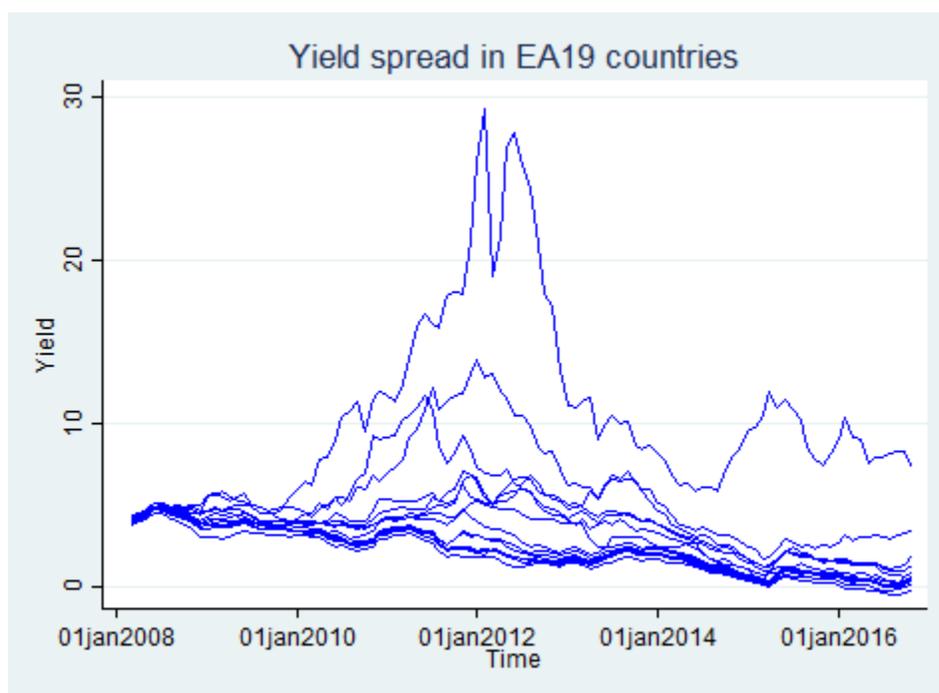
2.2 The sovereign debt crisis and its impact on banks

The sovereign debt crisis started early 2010 when the markets started to doubt whether Greek government bonds were in risk of default. The markets suspected that the possible default would have an impact on the sovereign bonds of Portugal, Ireland, Italy and Spain as well. In May 2010, the secondary markets for these government bonds deteriorated: There were less buy orders and the prices of these bonds fell, resulting in a peak in their yields. The sovereign debt crisis deepened in summer 2010 when the secondary markets for government bonds of Italy and Spain, in addition to the Greek sovereign bonds, were in risk to become dysfunctional. (Cour-Thimann and Winkler, 2013) As we see in the graph 3, the yields of many euro area countries started to rise, the year 2012 being the most serious.

What is more, the sovereign debt crisis started to develop into a banking crisis and the banking system of the euro area came under strain. Banks experienced decreased valuation of their balance sheets due to the falling sovereign bond prices. They suspected risks in each other balance sheets and feared the borrower's possible lack of liquidity. The markets were unsure about the viability of many banks across

Europe. (Cour-Thimann and Winkler, 2013) The concerns about the risks in banks' balance sheets can be as well seen in the Euribor-Eurepo spread which started to peak mid-June 2011 (graph 1).

The funding of banks deteriorated, and banks' liquidity was in risk. The falling bond prices result in weakened balance sheets of banks, which means struggles for interbank lending and therefore lending to the public. First, losses on banks government bond holdings mean that they have assets less worth to use as collaterals in the interbank operations. Sovereign bonds are usually in high liquidity and banks use them in repo purchases. (Cour-Thimann and Winkler, 2013). What is more, according to Mink and de Haan (2013), falling bond prices means that the counterparts require more collaterals from the borrower in the interbank market. Moreover, the issuance of covered bonds, a primary source of funding for European banks, was under strain and uncovered issuance ceased, which lead to more problems in the interbank market resulting in struggles to acquire liquidity. (Cour-Thimann and Winkler, 2013) According to Cour-Thimann and Winkler (2013), large changes of the government bond prices drive up the financing costs of the private sector since banks are less willing to invest in riskier claims when they experience deteriorated funding and lack of liquidity.



Graph 3: The 10-year government bond yield spread between euro countries. Data source: OECD

2.2.1 ECB's monetary policy measures

The ECB responded to the liquidity troubles and the weakening balance sheet problems of banks with following actions. To support long-term liquidity of banks and to help banks meet the risen requirements of the Core Tier (raised from eight to nine per cent), the ECB took additional measures: It implemented two more LTROs with an extended maturity of three years. In addition, it reduced the reserve ratio from 2 % to 1 % so the banks did not need to collect more liquidity buffer. The ECB also expanded the list of adequate collaterals further (the list of eligible Asset Backed Securities). (ECB Press Release, 8 December 2011)

2.2.2 ECB starts to purchase sovereign bonds in secondary markets

In response to the struggling secondary bond markets, ECB launched the Securities Market Programme (SMP), the goal of which was to lower the yields of the peripheral euro area sovereign bonds and to revive the transmission mechanism of monetary policy. (Gibson, Hall and Tavlás, 2015) The SMP purchases took place between May 2010 and September 2012 (ECB Monthly Bulletin, 2016).

According to Eser and Schwaab (2016), the aim of the SMP was different from the purchase programmes of the Federal Reserve (FED) and Bank of England (BOE) and that is why it was not regarded as quantitative easing by the ECB. Instead of making the monetary policy stance more accommodative at the zero lower bound, the goal of the ECB was to revive the monetary policy transmission mechanism and repair its perceived malfunction (Eser and Schwaab, 2016). The main concern in the Eurozone was indeed the impaired sovereign bond markets and their effects on the banking system.

The SMP purchases took place in the secondary government bond markets that were impaired. The ECB sterilised the purchases so that they would not affect the monetary policy stance. The ECB's goal was not to increase the liquidity in the euro area, which happened by selling other bonds and money market instruments so the purchases did not increase the money supply (Belke, 2010). Thus, the ECB kept the money base – the ability of commercial banks to create money so to say – on the same level regarding the purchases. According to Eser and Shwaab (2016), the working method of SMP purchases is to send a signal that the euro area regards the yields of peripheral bonds too high and that it is willing to take non-conventional measures.

Gibson, Hall and Tavlás (2015) examined the impact of the SMP and found the programme to be effective: The spreads of sovereign bonds cut back due to the SMP. Esel and Schwaab (2016) also found out that there was a negative impact on the yields of Greek, Spanish, Irish, Italian and Portuguese government bonds. As we can see in the graph of government bond yield spread, the yields started to decrease during the 2012. However, the Greek bond yield (the upper line), did not converge to the other EA19 yields.

To calm the markets, the president of the ECB, Mario Draghi held the famous speech on 26 July 2012 emphasising: “Within our mandate, the ECB is ready to do whatever it takes to preserve the euro”, referring to sovereign purchases. The Securities Markets Programme was terminated, following the announcement of the ECB’s Outright Monetary Transactions programme on 2 August 2012. The aim of the OMT was to purchase bonds in secondary sovereign bond markets to support the transmission of the ECB’s monetary policy. Again, the liquidity created in the programme was fully sterilised. (ECB press release, 6 September 2012)

2.3 Zero lower bound makes conventional monetary policy ineffective

The ECB’s main goal is to keep the inflation on the target level – just below 2 per cent. The central bank aims to its goal by carrying through open market operations, providing overnight facilities and requiring minimum reserves from the commercial banks. The main channel of the ECB’s monetary policy is the interest-setting decisions that the market interest will follow. However, since the financial crisis, the ECB’s decisions have not been transmitted into the markets as usual.

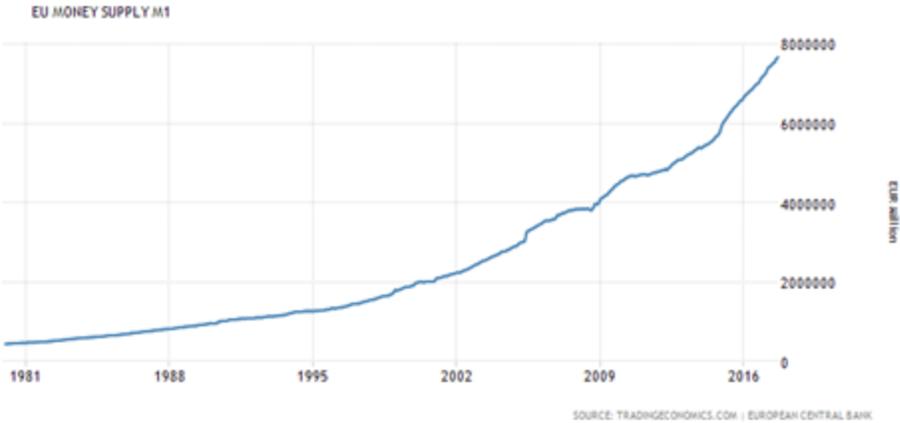
The graph 2 shows that the interests are now historically low. The zero lower bound means that central banks are unable to set the interest rates below zero – otherwise the public will hold cash (Gerlach and Lewis, 2014). Krugman (1998) explains that expanding the monetary base is ineffective since the public considers bonds and base money as perfect substitutes. However, as we see in the graph 2, the ECB has set the deposit facility rate below zero in 2013.

Despite this interest policy in the recent years, the inflation of the euro area has fallen to a level that makes the markets fear deflation and there is the risk of a liquidity trap – the situation in which the monetary policy stance becomes ineffective (graph 4). The graph 5 shows that the money supply M1 - that comprises cash, coins and checking accounts - has kept increasing but the inflation trend between

2012 and 2016 has been negative (graph 4). The most critical period were the years of 2014 and 2015 when the inflation of the euro area was below one per cent and even negative.



Graph 4: Inflation in the euro area (HICP), Graph source: ECB Statistical Data Warehouse



Graph 5: M1 (money supply of cash and checking accounts) Graph source: Trading Economics

At the zero lower bound, there is a risk that the real interest rises. The Fisher equation implies that the nominal interest rate is the sum of real rate and expected inflation if the zero lower bound exists (see e.g. Dimand and Betancourt, 2012). If the nominal interest rate were zero, the constant real rate would be the opposite number of expected inflation. During the time of negative inflation expectations at the zero lower bound, the constant real rate is positive. Hence, setting the nominal rate to zero will be

ineffective regarding the investment decisions, for example. If the interest rate policy of ECB does not work anymore, the central bank needs to think about other measures to stimulate inflation.

3 The expanded asset purchase programme

3.1 ECB joins other central banks by implementing QE

In the ECB Economic Bulletin 1/2015, the central bank argued that the previous unconventional measures have not resulted “in a sufficient quantity of liquidity”. The Governing Council of the ECB has judged that the measures the ECB has taken have been insufficient to tackle prolonged inflation and the risk of deflation. This implies that the ECB should consider more powerful actions in order to fulfil its inflation target. (ECB Economic Bulletin, 2015)

As a result, at its meeting on the 22nd of January, the Governing Council of the ECB decided to launch an expanded asset purchase programme (APP), to tackle the prolonged inflation and the risk of deflation in the euro area. In this quantitative easing programme, the ECB will purchase “euro-denominated investment-grade securities issued by euro area governments, agencies and European institutions in the secondary market”. The APP encompasses the existing purchase programmes, the covered bond purchase programme (CBPP) and the outright monetary transactions (OMT). (ECB Economic Bulletin, 2015) This programme corresponds the quantitative easing (henceforth QE) performed by Bank of England and the large-scale asset purchases of the Federal Reserve.

The APP consists of:

- The public sector purchase programme (PSPP) which encompasses euro-denominated sovereign bonds with a residual maturity between 2 and 30 years
- The corporate sector purchase programme (CSPP) started from April 2016
- The asset backed securities programme (ABSPP)
- The third covered bond purchase programme (CBPP).

The asset-backed securities purchase programme was introduced in November 2014 and comprises simple asset-backed securities – bonds backed by financial assets such as mortgage loans – on the primary and secondary markets. The third covered purchase programme was launched a month earlier,

in October 2014, and comprises covered bond purchases on the primary and secondary markets as well. (Bank of Finland)

The total sum allocated for these purchases was €60 billion monthly and this includes the covered bond purchases as well as the asset backed securities purchases. The purchases should take place until October 2016 or later if the inflation will not reach its target. (ECB Economic Bulletin, 2015)

So far, the programme has been extended several times regarding the period, the range of asset purchased and the amount of assets purchased. In December 2015, the period was prolonged until the end of March 2017 – at least – (Gambetti and Musso, 2017) and the ECB stated that it would reinvest the principal payments when the purchased assets mature (Andrade et al., 2016). What is more, in March 2016, the monthly purchases were expanded to €80 billion between April 2016 and March 2017 and the corporate bond purchase programme (CBPP), was introduced. In December 2016, the ECB Governance Council decided to proceed the purchase programme at least until December 2017. (Bank of Finland)

3.2 The extent of the APP

The balance sheet of ECB has been expanding since 2014 (ECB Balance Sheet). The main component of expansion on the liability side of the balance sheet have been the liabilities to euro area credit institutions related to monetary policy operations denominated in euro, particularly the growth of the items L2.1 and L2.2 (ECB Balance Sheet, appendix 2), which is a natural effect since the purchases are financed with reserves. The base money comprises the items 1, 2.1 and 2.2. The items 2.1 and 2.2 represent the current accounts (minimum reserves) and the deposit facility (excess reserves), respectively. (ECB) As we see in the graph 6, the base money has been increasing sharply since 2015 and adds up to €3000 billion in October 2017. This means more possibilities for commercial banks to create money through lending.



Graph 6: Base money (estimated), millions of €, Graph source: ECB Statistical Data Warehouse.

In the public sector purchase programme (PSPP), the central banks of the euro area have bought sovereign bonds, of which the cumulative monthly net purchases are €1,834,307 million (book value) as at 31 October 2017. The most purchased sovereign bond is the German government bond, the total net amount of which is €437,095 million. The French and Italian government bonds follow, with net amounts of €356,106 and €309,691 million respectively. (ECB) The PSPP programme excludes Greek government bonds since ECB has already them in its balance sheet and will wait until they mature (Valiante, 2016).

4 How quantitative easing affects the economy – theory

“The aim of quantitative easing is to inject money into the economy in order to revive nominal spending”, Benford et al. (2009) explain. In quantitative easing, a central bank purchases assets in order to expand its balance sheet. At the same time, the central bank creates additional liquidity in the economy, which should boost inflation.

The goal of bond purchases is to reduce “the interest spread between short and long maturities” (Priftis and Vogel, 2016). By implementing quantitative easing, the ECB tries to lower the yields of Eurozone bonds. The yield curve represents the relation between the demanded interest and the maturity or the

duration of a bond. A rising yield curve indicates rising expectations about interest rates in the future. Thus, flattening the yield curve means lowering expectations about future bond yields.

In this chapter, I will analyse the theory behind quantitative easing. To begin with, I will discuss the effectiveness of a balance sheet policy and the role of the maturity of an asset. Next, I will bring out the transmission channels, presented by Krishnamurthy and Vissing-Jorgensen (2011) and Joyce et al. (2012), through which quantitative easing affects the economy. I will present the signalling channel, duration risk channel, portfolio rebalancing channel and liquidity channel. Lastly, I will analyse the effect of lower yields on nominal spending.

4.1 Expanding the balance sheet

Joyce et al. (2012) explain that the focus of monetary policy became the balance sheet of a central bank rather than “setting a price – the policy rate”. The term quantitative easing stands for expanding the balance sheet of a central bank. The purchased assets are usually government bonds and assets issued by the private sector such as corporate bonds. By purchasing those assets, the central bank acquires more claims and creates more reserves for banks. (Joyce et al., 2012)

By purchasing assets from the private and public sector, the central bank creates money in the economy. The purchases are financed by adding additional reserves in the commercial banks’ reserves. When the central bank purchases a bond, the asset side of its balance sheet expands. At the same time, the liabilities increase: The money is added to the agent’s bank account; hence, the reserves of a commercial bank increase.

The expanded monetary base means more opportunities for the banks to create money. More reserves should make them more willing to increase their borrowing, since they are more able to cope with more payment activity by their customers. (Benford et al., 2009) This derives from the liquidity regulation of Basel III, the liquidity coverage ratio (LCR) to be more precise. Under the LCR, a bank needs to have high-quality liquid assets over 100 % of its net cash requirements over 30 days. Level 1 assets are considered coins and bank notes, central bank reserves and sovereign debt securities issued in the bank’s home country, to name a few. (Basel III)

Andrade et al. (2016) bring forward that the macroeconomic impacts are stronger when the central bank purchases riskier assets as it changes the composition of banks’ balance sheets. According to them,

the banks replace the riskier assets with liquid reserves, which makes it possible to increase riskier lending. As we see in the graph 6, the base money has increased sharply after 2015.

Gern et al. (2015) argue: “Via arbitrage processes the returns on similar assets are also affected.” The purchases affect not only the yields of asset purchased, e.g. the Portuguese 10-year government bond, but they also push up other assets’ prices as well. Agents that sold one type of assets to the central bank will likely switch the assets to other types of assets, which will increase their prices. (Benford et al., 2009) If the agent prefers a certain maturity or riskiness of an asset (preferred habitat theory), the price of that type of asset increases.

According to Borio and Disyatat (2010), the purchases of government bonds are especially effective, since they “set the floor for private yields”. In the following, I will discuss the ways that the balance sheet expansion affects yields: by sending a signal about future interests, reducing demanded risk premia for assets and decreasing the amount of certain types of assets in circulation.

4.2 The role of the maturity of an asset

The maturity of an asset plays a key role in the transmission of quantitative easing. This derives from the assumption that the expected returns of short-term and long-term assets need to be equal so that investors keep them both (Clouse et al., 2003). If the long-term expected return is much higher, the increased demand will push the price up resulting in lower long-term yield. What is more, if the markets expect that the short-term interests will rise in the future, the long-term interest is likely to rise. Otherwise, it would be more profitable for agents to wait for the next period and purchase the short-dated bond then, which is the opportunity cost. Additionally, there is an inverse relation between the expected interests and bond prices. If the future interest is expected to rise, the price of bonds in the market will drop and the yield will adjust to the same level as the expected interest. Otherwise, there would be no demand for the second market bonds.

4.3 The transmission channels

4.3.1 Signalling channel

According to signalling channel theory, by purchasing assets, the central bank affects market expectations of future risk-free interest rates (Altavilla, Carboni and Motto, 2015). Gern et al. (2015) explain that the central bank sends a signal that it will keep short-term rates low for a longer period by purchasing longer-maturity bonds (ex-ante effect). The announcement will enhance the central bank's credibility "because an earlier exit from this strategy would trigger losses for the central bank" (Gern et al., 2015). If the central bank buys long-term bonds and does not keep the short-term interest rates low, it will experience losses since the price of the bonds will fall when the markets expect higher interests and the central bank will end up having less worth of bonds in its balance sheet. Swanson and Williams (2014) bring out standard macroeconomic theory of Woodford and Clarida stating that all the expected future short rates influence the asset prices, not only the prevailing rate.

According to Valiante (2016), the signalling channel affects in two phases: it creates the forward guidance effect and the announcement effect. First, the central bank gives the markets signals of its future policy and the markets can take this into account. A case in point is Mr. Draghi's famous remark "Within our mandate, the ECB is ready to do whatever it takes to preserve the euro." This is called forward guidance. However, the announce effect happens when the central bank announces its measures and the markets will be certain that the measures will be implemented. (Valiante, 2016)

The signalling has also a positive effect to the central bank's credibility. The ECB has had credibility problems since it has been unable to stimulate the inflation despite many conventional – and unconventional – measures. According to Krishnamurthy and Vissing-Jorgensen (2011) quantitative easing is a credible commitment that it will keep the interest rates low since the markets believe the central bank has weighed the opportunity costs of raising the interests afterwards.

4.3.2 Duration risk channel

Krishnamurthy and Vissing-Jorgensen (2011) also bring out the duration risk channel (ex-ante impact). The central bank can reduce the duration risk of bonds, thus dampen the yield curve, by purchasing bonds of a higher maturity. Especially the long-maturity bond yields compared to the short-maturity

yields will decrease. This assumption rests on the specific habitat demand theory which explains that a subset of investors prefers bonds of certain maturities. (Krisnamurthy and Vissing-Jorgensen, 2011)

The average maturity of the future cash flows that the bond generates is called duration. Investors holding a bond with high duration need to wait for a longer time in order to get the coupons and principal invested back. If interest rates rose abruptly, the agents who have invested in bonds with a higher duration would experience losses since the holdings would become less valuable. The price of a bond would now adjust to a certain level so that the bond gives the same expected return as the new bonds. The duration risk is the risk of rising interests and their impact on the higher-duration bond price.

The duration risk channel theory implies that by purchasing longer-maturity bonds, the central bank gives the markets a signal that it will keep the interest rates low – otherwise it would experience losses as in the signalling channel effect. The markets can now expect no rise in the interest rates in the future and require less duration premium in the bond returns. This leads to lower bond yields.

4.3.3 Portfolio rebalancing channel

Joyce et al. (2012) introduce the portfolio substitution channel, here referred as the portfolio rebalance channel. The theory implies that the purchases dampen the yield curve because the central bank creates scarcity in the sovereign bond markets and this scarcity will push up the prices of the bonds – resulting in lower yields. This ex-post effect happens after the central bank has purchased assets. When a central bank purchases bonds, it reduces the amount of them in the market and increases the reserves held by commercial banks.

This theory also rests on the preferred habitat theory: If the bonds and reserves were perfect substitutes, the purchases would have no effect. (Joyce et al., 2012) The investor would only change the asset type, resulting in no change in the real economy. In addition, according to Brunner and Meltzer as well as Tobin, a central bank can affect the yields by modifying the relative supply between different assets because the assets are imperfect substitutes (see Joyce et al., 2012). Moreover, Gern et al. (2015) also argue that the short-term and long-term bonds need to be imperfect substitutes for this channel to work.

Through long-term asset purchases, the central bank “reduces the stock of privately held, relatively long-dated assets” (Joyce et al., 2012). Agents holding these assets are likely to repurchase other long-

maturity assets such as corporate bonds with the reserves they received from the central bank. Usually, institutional investors, especially pension funds and insurance companies, want to replace the sold long-dated bonds with other longer-maturity assets. (Joyce et al., 2012) When the relative supply of longer-maturity assets decreases, the price for them increases, which means lower yields.

Valiante (2016) explains that the asset purchases create a scarcity in the sovereign bond markets. The purchased assets (by the ECB) are investment-grade assets. Many investors prefer safe assets that have low default risk so the reduction of them in the markets affects their risk premium and lowers their yields. In addition, the purchases reduce the risk premium of other assets as well, by reducing the risk-free interest rate component in the risk premium. (Valiante, 2016) The risk premium consists of the risk-free interest rate and the premium linked to the asset.

4.3.4 Liquidity premium channel

Benford et al. (2009) bring forward the liquidity premium channel. When a market is illiquid, as in a financial turmoil, the liquid premium that the investors demand for assets can be significant. The central bank reduces this liquid premium, thus yields, since the central bank purchases send a signal to the investors that they can sell the assets more easily if needed. (Benford et al., 2009) The liquidity premium channel should be effective for the Eurozone, since the secondary markets for certain government bonds turned out to be illiquid during the sovereign bond crisis.

4.4 How lower yields affect nominal spending

In the following, I will discuss the impact of lower yields on nominal spending. Lower yields mean higher asset prices. According to Benford et al. (2009), higher asset prices lead to decreasing borrowing costs for companies and households. The balance sheet of a bank holding a bond experiences increased valuation, which means that the bank has more capital (Andrade et al., 2016). Through the increased valuation of the assets the banks have more collateral they can use in interbank operations, which means enhanced opportunities to acquire liquidity. However, Andrade et al. (2016) point out that the lower yields have a negative effect on the bank profitability.

The enhanced liquidity situation means the bank could invest in riskier claims and reduce its margins. The reduced borrowing costs lead to higher consumption and investment spending, thus higher

inflation. Firms will adjust their investment spending so that the marginal return of them is the same as the borrowing cost (the interest rate). When the borrowing costs decrease, more investments become lucrative.

In addition, the higher asset prices translate into wealth effects of private sector. The agents, holding an asset with an increased price, will experience increased wealth, which boosts their spending (Benford et al. 2009). This effect derives from the wealth elasticity of demand theory that explains that an increase in wealth leads to a proportional change in spending.

The purchases have also an effect on the exchange rates. According to Priftis and Vogel (2016), quantitative easing has a depreciating effect on domestic currency. They argue that the demand for foreign-currency assets increases when the agents seek substitutes for the bonds. The strengthened demand for foreign-currency assets leads to capital outflow, which means currency depreciation and eventually, stronger export demand.

5 Empirical evidence: APP lowers yields

In this chapter, I will present empirical evidence regarding the impact of the asset purchases, especially the sovereign bond purchases. The research is documented mainly in working papers since the programme has been implemented only just two and a half years ago and the purchases are still on going. The results suggest that the purchase programme has had an immediate impact through signalling channel, as Andrade et al. (2016) and De Santis (2016) report, whose research concentrates on the market reaction of the announcement and implementation of the APP. Later research (see Gambetti and Musso, 2017) also suggests that there are macroeconomic impacts on inflation and GDP as well.

There are a few issues in the research that are needed to take into account regarding the signalling effects according both Andrade et al. (2016) and Altavilla et al. (2016): Even before the announcement of the APP, the markets suspected a QE programme from the ECB. The central bank has implicitly signalled the markets already in August 2014 that it might conduct a QE programme. On 22 August, the ECB president Mr. Draghi held a speech in Jackson Hole about inflation and unemployment in Europe comparing the development of the EU and the US, which made the markets suspect a QE programme. What is more, the markets received information about the QE gradually: first the announcement of the

programme on the January 22nd, the launch on the March 5th and then there have been several announcements about the extension of the programme (Altavilla et al., 2016 and Andrade et al., 2016).

5.1 Early results and ex-ante effects in the markets

In this section, I will present research that focuses on the immediate effects of the announcement and implementation of the APP. Kojien et al. (2016) use micro-level data of securities in investors' portfolios in order to investigate the portfolio flows and the risk exposure dynamics that the quantitative easing programme created. In addition, they find out what kind of effect the APP has had on the portfolio holdings of different investor types which are (1) insurance companies and pension funds, (2) banks, (3) mutual funds that encompasses hedge funds as well, (4) households and (5) other as well as the foreign sector. The data period is Q2/-Q4/2015 also right after the sovereign purchases started.

In their research, Kojien et al. (2016) found out that the effect of the APP on adjusting the portfolio composition is heterogeneous across different investor types. The following results are from the period of Q2-Q4/2015 and are reported on average per quarter. During this period, the ECB bought on average €135 billions of eligible government debt per quarter. The insurance companies and pension funds (ICPF) increased their total holdings of eligible government debt with €17 billion. In total, banks reduced their eligible government debt holdings with €47 billion. Moreover, banks sold their investment-grade corporate bond holdings with €37 billion and asset-backed securities and covered bonds with €65 billion. Mostly foreign sector sold eligible bonds: They reduced the eligible bonds in their portfolio with €123 billion on average per quarter. This implies that the non-euro-area investors operate more elastically and shift their portfolios into a more profitable composition when the yields in Europe fall. However, the asset demand of insurance companies and pension funds seems inelastic: They prefer the bonds purchased by the ECB and do not adjust their portfolios that much. (Kojien et al., 2016)

Next, I will present the findings of De Santis (2016) and Andrade et al. (2016) who focus on the yields of the sovereign bonds. De Santis (2016) examined whether news about the APP influenced the 10-year government bond yields. The news had an ex-ante effect on the markets. The sovereign yields of the 10-year euro area bonds declined. Moreover, the stock prices rose and exchange rate declined. The yields declined the most in Portugal where duration risk premium was highly demanded during the crisis. The effect may have come through the duration risk channel. The least effect on yields was detected in Germany and the Netherlands. (De Santis, 2016)

Andrade et al. (2016) conducted an event study on government bond yields around the announcement and implementation of the PSPP. They noticed a decline of the yields in every duration and maturity class. On average, the yields dropped 22 basis points around the announcement 22 January 2015 and 25 basis points around the implementation 9 March 2015. The effect on longer maturities was more significant than on shorter maturities. However, the extent of the purchases did not matter regarding the depth of the decline. Moreover, Andrade et al. (2016) illustrated the impact of the APP on yield curves around the announcement and the implementation. They considered the yield curve of Germany and Italy. The yield curves dampened regarding both duration and maturity in both countries after the announcement and implementation. (Andrade et al., 2016) We can assume that these are ex-ante effects: The news about the programme and the implementation signalled the markets easy monetary policy in the future.

5.2 Impact on the economy

This section focuses on later research from 2017 that brings out also the macroeconomic impact the APP has created. On the other hand, the profound effects on real economy can be perceived later since this kind of a purchase programme affects the economy many indirect ways.

Valiante (2017) conducted an empirical research using a difference-in-differences model to investigate the impact on 10-year government debt yields and HCPI-inflation rate (harmonised consumer price inflation). The data comes from the period of January 2008 and March 2016. The treatment group encompasses euro area countries directly affected by the purchases: Germany, Spain, Italy and France. The control group consists of countries not directly affected by the purchases and the policies of which were not consistent with the ECB's quantitative easing (UK, Denmark, Sweden and Poland). (Valiante, 2017)

The results are the following: The 10-year government yields declined more than in the control group on a one per cent significance level with β_1 being -0.546. In other words, the 10-year government bond yields declined 0.546 percentage points more in the treatment group than in the control group due to the asset purchases by the ECB. However, there is no significant impact on the HCPI. (Valiante, 2017) It may take more time to fully see how the purchases affect the economy, not only the markets.

Gambetti and Musso (2017) conducted a research on the macroeconomic impact of the APP using a time-varying parameter VAR model with stochastic volatility that considers also macroeconomic

changes. They found out that the asset purchases led to higher GDP and inflation. The purchases raised the real GDP by 0.18 percentage points in the first quarter of 2015 and the impact was similar until the end of 2015. However, during 2016, the impact became small. In addition, the contribution of the APP to the inflation was 0.18 and 0.36 percentage points by the end of 2015 and by the last quarter of 2016, respectively. The effect on the GDP was stronger short-term but the HCPI starts to rise gradually because of the APP. (Gambetti and Musso, 2017)

5.3 The effects concluded

The portfolio rebalance channel theory rests on the assumption of the preferred habitat theory. According to Koijen et al. (2016), pension funds and insurance companies did not change the total amount of eligible government debt in their portfolios during the last quarters of 2015. The assumption of the preferred habitat theory may apply to the markets.

Instead, non-euro-area investors reduced their holdings in euro-denominated government and corporate bonds as well as asset-backed securities (Koijen et al., 2016). According the portfolio rebalance theory, we can assume that the investors shifted their funds to the stock market or abroad where the yields were more attractive. The demand of foreign assets should increase (Priftis and Vogel, 2016). This would result in depreciation of the currency. In graph 7, we can see the strong depreciation of euro against dollar, which started already during 2014. According to standard macroeconomic theory, the depreciation of a currency should create a positive aggregate demand shock due to the increased demand in imports.



Graph 7. ECB euro reference exchange rate: US dollar (USD). Graph source: ECB

The research presented previously stated that the yields of bonds declined due to the QE programme. As we can see in the graph 8, the yield of the German 10-year government bond started to decline in the beginning of 2014, even before the announcement of the expanded asset purchase programme. The ECB has purchased the German sovereign bonds the most and it serves as a floor for Eurozone long-term interests, so we can refer to it as a baseline. During 2014, the yield decreased by almost 1.5 percentage points. After an increase in the beginning of 2015, the yields started to decline again.



Graph 8. Germany 10-year government bond yield 2012-2016. Graph source: Trading Economics

Furthermore, according to the quantitative easing theory, this decline in long-term yields should boost inflation and affect aggregate demand, thus revive the GDP growth. In the graph 4, we can see that the HCPI-inflation started to accelerate in mid-2016. We can expect this effect to come with a lag because of the complexity of macroeconomic changes. The inflation of 2017 has varied between 1.3 and 2.0 per cent.

6 Conclusion

The aim of this thesis was to understand how quantitative easing should influence the euro area economy and whether it has had any significant effect yet, as well as go through the situation that made the ECB adopt balance sheet policy. The condition behind the shift from interest setting policy to balance sheet policy was the zero lower bound and the fears of deflation; the transmission of its monetary policy was in risk. The ECB announced its quantitative easing programme, the APP, in January 2015 to stimulate the low inflation. At the end of October 2017, the ECB had holdings of 2,180,526 million euros under the expanded asset purchase programme (ECB).

According to theory, the asset purchases should lower the yields through different channels, presented by Krishnamurthy and Vissing-Jorgensen (2011). By purchasing assets, the ECB sends a signal that it will keep the short-term interest low, which reduces the price of longer-maturity bonds. In addition, this reduces the risk premium and liquidity premium demanded by investors. Moreover, the scarcity of bonds in the market makes their prices rise, resulting in lower yields. The wealth effects and the increased valuation of banks' balance sheets should revive nominal spending; hence, boost inflation.

The early research on the impacts of the QE programme are promising: The announcement and implementation have had a negative effect on sovereign yields (see De Santis, 2016, and Andrade et al., 2016). Long-term, the purchases have also stimulated euro area inflation and even had a subtle positive effect on the real GDP (see Valiante, 2016; Gambetti and Musso, 2017). During 2016, inflation has started to accelerate and even peaked to 2.0 per cent in the beginning of 2017 (graph 4).

The question arises when the ECB should exit from the QE and with what kind of exit strategy. With so many prolongations, the QE has become a massive purchase programme. On the 26 October 2017, the Governing Council of the ECB decided to taper the programme: the ECB will carry on the QE until September 2018 with reduced monthly purchases of €30 billion starting from January 2018. (ECB Press Release, 22 October 2017) The issue is how the markets will react to the exit. Will the yields spike, as it happened in the US when the FED thought about reduction of its asset purchase programme (The Economist, 26 Oct 2017)? Another question is when to raise the short-term interests from the zero lower bound.

Overall, the asset purchases have sparked a lot of discussion and speculation. The markets have responded immediately to the news of the QE (De Santis, 2016). Completely, the macroeconomic impact remains to

be seen. As time passes, there will be more evidence of the effects of the asset purchases and more empirical research, to be sure.

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Appendix

Appendix 1: The acronyms in this paper

ABSPP	Asset-backed securities purchase programme
APP	Expanded Asset Purchase Programme
BOE	Bank of England
Core Tier	Tier 1 Capital - bank's equity capital and central bank reserves
CSPP	Corporate sector purchase programme
EA19	19 member states of the European monetary union
ECB	European Central Bank
FED	Federal Reserve
GDP	Gross domestic product
HICP	Harmonised consumer price inflation
ICPF	Insurance companies and pension funds
LCR	Liquidity coverage ratio
LTRO	Long-term refinancing operations
M1	Sum of currency in circulation and overnight deposits
MRO	Main refinancing operations
OMT	Outright Monetary Transactions
PSPP	Public Sector Purchase Programme
QE	Quantitative easing
SMP	Securities Markets Programme

Appendix 2: Annual consolidated balance sheet of the ECB, liabilities. Data source ECB Balance Sheet

