



# Quantitative Easing: Success or Failure? Differences Between the United States and Euro Area

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## Abstract

Based on the research of (Bowman, et al., 2011) regarding the effectiveness of Japanese QE, this thesis aims to evaluate the effectiveness of QE programs in the US and Euro Area regarding lending growth. In order to do so, commercial banks from the US and Euro Area have been analyzed. Using panel regressions on banks' balance sheet data, results identified that only the third round of the QE (2012-2014) in the United States had a significant effect on lending growth, while the first two QEs in US (2009-2011) mainly used to ease the distress in the banking sector. In the Euro Area, the recently (2015) implemented QE program did not have any significant effect on lending growth. However, results provide evidence that in both areas, banks used that extra liquidity mostly to reduce their interbank borrowings. Moreover, in US, the main driver of lending growth other than the obvious customer deposits, was the ratio of nonperforming loans. While, in Europe, EA banks' recapitalizations in 2013, allowed them to fire sale their NPLs reducing thus their ratio.

Keywords: QE, monetary policy, bank lending channel, U.S., Euro Area, THE FED, ECB

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## Section 1 – Quantitative Easing “an introduction”

Under normal economic conditions Central Banks aim for financial stability and sustainability to economic growth, using as their principal tools their official interest rates and the open market operations. With the former, Central Banks are able to affect the interbank interest rates which are the principal component of market's interest rates. Whereas with the open market operations, Central Banks altering the money supply in the economy, which affect expectations regarding the future inflation rates. Thus, in periods of low economic activity Central Banks lower their interest rates resulting in a reduction to the cost of borrowing, similarly through assets purchases could also increase money supply. Consequently, corporations and households have incentives to increase their investments and consumption, which in turn could improve economic output and reduce unemployment.

At times where big economic shocks occur, the interest rate tool has a limited effect on economic output, if at all. Even though that in most of the cases, Central Banks reacted quickly upon the occurrence of such shocks, crisis' effects on stability and creditworthiness of Banking and Corporate Sector proved to be significantly strong resulting into a Liquidity Trap. That is, Central Banks reduce their official interest rates at the zero percentage (Zero Lower Bound), diminishing thus (in theory) the effectiveness of conventional monetary policy.

Given that, Central Banks have been forced to initiate other tools in order to stimulate economic growth, with Quantitative Easing Programs to be the most commonly used by Central Banks in such circumstances, as such, QEs have been employed by the Bank of Japan, Bank of England, The Federal Reserve and recently European Central Bank. In principal, through these programs Central Banks purchase assets from the financial sector such as government bonds aiming to decrease the long-term yields in a broad range of financial assets. Moreover, the extra reserves available to banks could lead to an increase in bank lending to households and corporations. Consequently, QEs aiming to increase private and public sectors wealth, as the targeted by the program bonds

value higher as interest rates decline, and also to ease credit conditions by lowering the cost of borrowing to households and corporations. Combining the above, an increase in investments and consumption could be expected resulting in economic recovery.

Nonetheless, the effectiveness of an Asset Purchase Program depends on three main transmission channels. The first one is the forward guidance, which is the ability of the Central Bank to convince market participants about its intentions in the long run, recent research (section 3.1) shows that this channel could increase or diminish the effectiveness of the QE. The second transmission channel which is the portfolio rebalancing channel, through which the QE could have a spillover effect to a broader range of financial assets, increasing thus its effectiveness, although the strength of the portfolio rebalancing channel depends mainly on the risk aversion of market participants. Evidence from research (section 3.2) about the US quantitative easing programs depicts that when financial markets are distressed then the spillover effect is smaller compared to periods when financial distress has been reduced. Finally, the last transmission channel of a QE, is the bank lending channel, in principle, the extra reserves available to banks could increase bank lending, although when the banking sector is distressed, that is, a high ratio of nonperforming loans and equity losses, banks may use these extra reserves in order to support the interbank market rather than to increase their lending.

Thus, in order to evaluate the effectiveness of QE programs in the US and Euro Area, on the lending growth of 180 commercial banks from the US have been analyzed, over the period between 2002 – 2015, while in the Euro Area the available data were restricted to the period between 2011 - 2015, as such, the EA findings should be taken with a considerably smaller degree of confidence than in the US. Using panel regressions on banks' balance sheet data, results identified that the first two rounds of the QE (2009-2012) in the United States had a significant yet relatively small effect on lending growth, while they were mainly used to ease the distress in the banking sector. In contrast, to the third QE round (2012-2014), the conditions in the banking sector had improved, where the QE did in fact increase the lending of commercial banks. In the Euro Area, the recently (2015) implemented QE program did not have any significant effect on lending growth,

instead results provides evidences that EA. banks used that extra liquidity mostly for interbank transactions. Additionally, in both areas, the main driver of the lending growth other than the obvious customer deposits was the nonperforming loans ratio as results depict. Finally results, provide evidence of spillover effects from QE to banks profitability resulting in an increase in lending growth.

The remainder of the thesis is structured as follows.

**Section 2** presents the transmission channels of the conventional monetary policy.

**Section 3** presents the channels through which unconventional monetary policy is transmitted to the economy

**Section 4** presents the time line of all unconventional monetary policy measures taken by The Fed and ECB.

**Section 5** provides relevant literature review about the effectiveness of QEs in US and Euro Area.

**Section 6** describes the econometric model and its results for the US and European Commercial banks.

**Section 7** concludes and provides a succinct synopsis of how QE has affected lending growth.



## Section 2 – Monetary Policy Transmission Mechanisms

In principal, Central Banks have the ability to affect interest rates and liquidity, using three specific tools, the first one is the official interest rates, the second is the open market operations, while the third one is the reserves' requirements.

The most common among of these three tools used, is the open market operation through which Central Bank purchases or sells financial assets in the open market. The second one, is where the reserves requirements which more or less has the same effects on the market interest rates as the open market operation but usually is used by Central Banks when they want to adjust the composition of the banking system liabilities. The last one, official interest rates, is the least often used by Central Banks (Friedman, 2001) and due to its time lagging effectiveness on prices (Bank of Canada, 2012), thus Central Banks implementing this facility in order to set the barriers among which want the interbank rates to be, and to alter the expectations about the future interest rates.

### 2.1 - Official Interest Rates & Expectations<sup>1</sup>

While the least used tool among the three (official interest rates) that Central Banks have at their disposal in order to achieve their objectives, official deposit and lending interest rates play a central role in the monetary policy. Even though Central Banks do not intervene in the official rates very often, understanding the channel through which interest rates affect economic output is essential.

The prime target for most of the Central Banks around the globe is for price stability at the level that will foster sustainable economic growth. In particular, European Central Bank aims for inflation rates below but near 2%<sup>2</sup>, where The Federal Reserve aims at

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<sup>1</sup> <https://www.ecb.europa.eu/mopo/intro/transmission/html/index.en.html>

<sup>2</sup> <https://www.ecb.europa.eu/mopo/html/index.en.html>

the same percentage<sup>3</sup> of inflation, although it has the ability to overlook this target in order to maintain unemployment, which is its objective as well, at the desired levels. Therefore, by adjusting appropriately the cost of the money, in other words the interest rates, Central Banks can reduce inflationary pressures. Inflation, in principal, comes when the demand for products or services exceeds the relevant supply, yet could be imported through the supply side as well when exchange rates altering (depreciation) and the cost of imported goods increasing. That is, when an economy slows down, Central Bank can reduce the cost of money by lowering its official interest rates, forcing the banks rate downwards making investments on durable goods more affordable for the public and private sector, stimulating in this way the economy. Conversely, the opposite could occur (increasing the interest rates) held on as well, when economic growth overruns the sustainable level imposed by Central Bank.

Announcements regarding an alteration of the official rates depict, in general, the view of Central Bank regards the long term economic outlook, thus Central Banks foresee the effect the price of the long term financial assets such as government and corporate bonds will have. For instance, when a Central Bank announces a decrease or (increase) in its official rates along with the commitment to keep it stable for a fair amount of time, then investors and other market participants, value higher (lower) the price of financial assets such as bonds, reducing in parallel the cost of new debt or equity issuance. The creditworthiness of the Central Bank plays a vital role in the expectations channel, in order for the latter to be effective. The flow of expectations channel run through the expected by investors future short term interest rates, that is, a decrease in official interest rates would result in also a decrease in the expected future short term interest rates, lowering in turn the long-term part of the yield curve. (E.Yu, 2016).

As previously described, the transmission mechanism of the interest rate tool, has its weak points as well, the first is that the bond prices and other long term assets could be affected in the opposite direction of the monetary policy, by other exogenous

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<sup>3</sup> [https://www.the.federalreserve.gov/faqs/money\\_12848.htm](https://www.the.federalreserve.gov/faqs/money_12848.htm)

macroeconomic variables such as sovereign risk and exchange rates. In parallel, risk premia influenced by several financial and economic variables, among other the key variable is the creditworthiness of the customers. Finally, in many cases bubbles in financial markets could reduce, if not eliminate, the spillover effects of interest rate policy to financial assets.

In general, the interest rate tool has the ability to adjust the market's interest rates and force the economic output to the desired direction according to the Central Bank's objectives, provided that no economic shock occurs and official interest rates are significantly affect the demand and supply of credit. Additionally, the interest rate tool suffers significant time lag until its full impact on prices, as (Gruen, et al., 1997) states this could take up to 6 quarters before it is fully implemented in the prices. Making this tool appropriate for use under normal economic conditions and usually to communicate how the Central Bank perceives the future economic conditions, altering thus the expectations.

In some circumstances, such as an economic shock the interest rate channel has another limitation, except for the time lag, of the effective lower bound, that is official interest rates (deposit) cannot be reduced below the zero percentage if that should happen then the depositors would have the incentive to withdraw all their deposits and thus force the economy into a liquidity trap. Therefore, the interest rate tool cannot stimulate the economy enough in order for the latter to overcome an economic sock.

## 2.2 - Open Market Operations

As already discussed the interest rate tool is an effective way for a Central Bank to achieve its long-term objectives regarding inflation and price stability, with the shortcoming of the time lag in its absorbance by the prices. The open market operations is the most common tool that Central Banks use in order to execute their role in price stability, this has the advantage of direct affect in short terms interest rates.

In order to promote economic activity when the economy slows down, the Central Bank purchases government bonds from the banking sector in an attempt to increase the reserves of banks held at it, while usually providing a very small -almost zero- deposit rate for these reserves. Hence, banks have the incentive to exchange the excess reserves that they do not need with other interest bearing assets such as short term government bonds, this extra demand for these assets would increase their price (reducing their yields) (Friedman, 2001), which in turn increasing the wealth of households and corporations. In addition, the extra liquidity in the banking sector combined with the decrease in short term interest rates, would decrease the cost of borrowing for corporations and households, promoting the consumption and investments resulting in an increase in the economic output.

The opposite scenario is held as well, that is, when the economy is overheating then the Central Bank sells government bonds to banks reducing thus their reserves, which in turn would make banks increase their cost of money -interest rates- reducing thus the price of financial assets such as corporate bonds. While in parallel, this will force households and corporations more to reduce their spending and investments and increasing their savings.

As in the case of the interest rate tool, the shortcoming of open market operations lies in situations where the economy suffers a huge economic shock disregarding if this comes from an exogenous or endogenous variable. In such situations, injecting extra

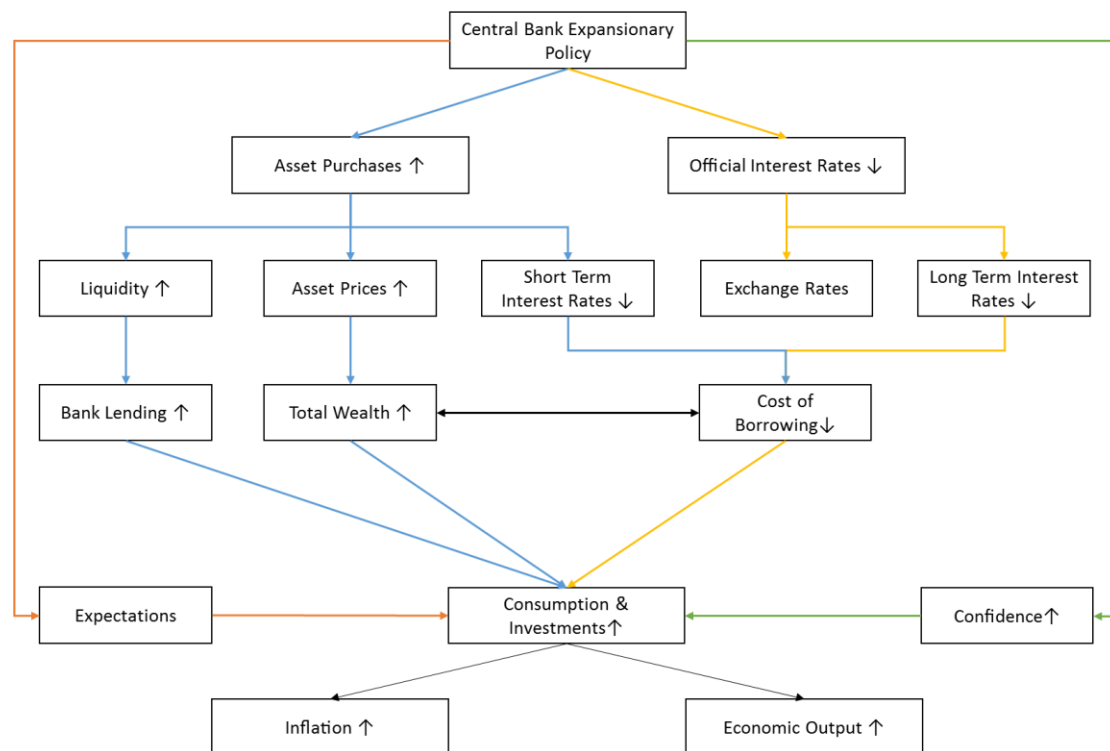
liquidity in the banking sector cannot reduce its interest rates below zero thus making this policy ineffective, in theory at least.

### 2.3 - Reserve Requirements

The last means of monetary policy is the reserves' requirements which usually have the same effect on interest rates as the open market operations. In principal, reserves requirements are the obligatory deposits of the depository institutions in the Central Bank which stand as an insurance of their deposits. In other words, when a customer makes a deposit in a Bank account, the Bank has the obligation to deposit a specified amount by the Central Banks proportion of this money in the Central Bank in order to secure that the Bank will meet its liability whenever the customer will demand to do so. Thus, altering the reserves requirements Central Bank could provide or strain liquidity from the Banking sector. It is rarely been used compared to the open market operations, and usually Central Banks change their reserves requirements when they want to change the composition of the liabilities held by Banks (Friedman, 2001).

## 2.4 - A Snapshot of Monetary Transmission Mechanism

The previous section discussed means of monetary policy and how easily this could be depicted by the following flow chart inspired by (Joyce et al., 2011) which represents the major but not all the possible interactions between monetary policy decisions and economic variables. For the ease of use, the flow chart represents the instance of an expansionary monetary policy; in case of contractionary monetary policy the interactions have the opposite directions.



## Section 3 – Unconventional Monetary Policies in Theory

In this section, will be presented how the unconventional monetary tools work in theory and what are their transmission mechanisms to the real economy.

### 3.1 - Forward Guidance

Under normal economic conditions any adjustment in the official interest rates by a Central Bank, are usually followed by an announcement for the reasons behind this decision, which usually has been anticipated by the investors as well. Given the creditworthiness of Central Banks such as The Fed or ECB, these forward-looking adjustments, affecting the long-term part of the yield curve in the desired direction of the Central Bank.

During the recent economic crisis, the necessity arose for more transparency and wider information regarding to the objectives of each decision taken by a Central Bank. That is, when a Central Bank announces a new unconventional measure such as an official rate at or below zero, or for instance another QE program, it should be accompanied with information about how long and under what conditions the Central Banks would seize that measure and what it is going to do after the closure of that program. In a nutshell, if a Central Bank failed to convince the investors about its future policies, for instance, to retain the interest rates at the zero lower bound for a specified period even if the inflation reach or goes above the targeted, then investors would assume that the future interest rates would be increased again which in turn will mean a decrease in bond prices, all in all diminishing the effectiveness of the policy.

Thus, all the major Central Banks (The Fed<sup>4</sup>, ECB, BoE, BoJ) announced their intentions to adopt more actively a forward guidance policy regarding their decisions,

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<sup>4</sup> <https://www.the-federalreserve.gov/faqs/what-is-forward-guidance-how-is-it-used-in-the-the-federal-reserve-monetary-policy.htm>

foreseeing to stabilizing money market conditions through lowering expected volatility in interest rates and uncertainty in general, which in turn make their monetary policy more effective (Praet, 2013).

### 3.2 - The Portfolio Rebalancing Channel

As stated in the previous section, open market operations seem to have a limited effect, if any, on interest rates and, in general, in the economic output when it comes to situations where the official interest rates reach the Zero Lower Bound. Literature provides us with theory and evidence of another existing channel of monetary policy transmission and that is the portfolio rebalancing channel.

Under this theory, open market operations such as large government bond purchases from the Central Banks could produce a spillover effect to non-targeted assets, reducing thus the yield curve (Altavilla, et al., 2015). The process unfolding as follows, when the Central Bank purchases long term (20 years) government bonds, this automatically reduces their aggregate supply in the market, imposing a supply shock for specific maturity financial assets force their clientele, such as Pension Funds, to replace them with other similar maturities assets, in parallel carry trade arbitragers are those whom enhance this spillover effect, the level of their effect depends primarily on their risk aversion (Vagiannos & Villa, 2009).

An asset purchase program could force a specific part of the yield curve, related to the underlying asset, downwards, increasing the prices of similar maturity financial assets. Thus, even if the official short term interest rates are near or at the zero lower bound monetary policy could still be effective through open market operations, by reducing the long-term yield curve, creating incentives for increase in consumption and investments as the wealth would have been increased due to lower interest rates, and in parallel the cost of borrowing would have been reduced.



### 3.3 - Bank Lending Channel

Among academics the least touched channel among unconventional monetary policy transmission channel is the bank lending channel. While, intuitively an injection of extra liquidity in the banking sector is expected to increase the supply of credit, matters become more complicated when the options and the behavior of the total bank sector are inserted in the equation. Even though many would argue that the money multiplier theory does not hold as an unconventional transmission mechanism, it should be examined at the aggregate level of the bank sector, how bank lending corresponds to unconventional policies. Recent literature does not provide with ample empirical evidence whether this theory holds or not, therefore this thesis will examine the effect of unconventional monetary policies in term of bank lending.

In theory, when a Central Bank issues money, the money multiplier generates additional deposits in the banking system increasing thus the total amount of money in the economy, in such cases the Central Bank can control the total available amount of loans by the constrain of reserve requirements.

The flow of this channel is as follows: assuming that a Central Bank adopts an expansionary monetary policy by purchasing government bonds through the banking system (the same holds in case of reducing reserves requirements ratio), that action will increase the Asset size of the Central Bank's balance sheet with the purchased amount of bonds and in parallel will also increase its liabilities. In the case of a Central Bank, among others, liabilities content, a mix of Currency and Commercial Bank Deposits at the Central Bank. From the Commercial Bank perspective at this stage only a transformation of its balance sheet will have happened, as the Commercial Bank has exchanged one asset (government bond) with another (reserves at C.B.). Up until now, the new money in the total economy is that which the Central Bank has provided through the asset purchase, from this point on, the money multiplier will determine what the total amount of broad money in the economy will be. That is, the Commercial Banks behavior in terms of Loans issuance and their Customers behavior towards Loans

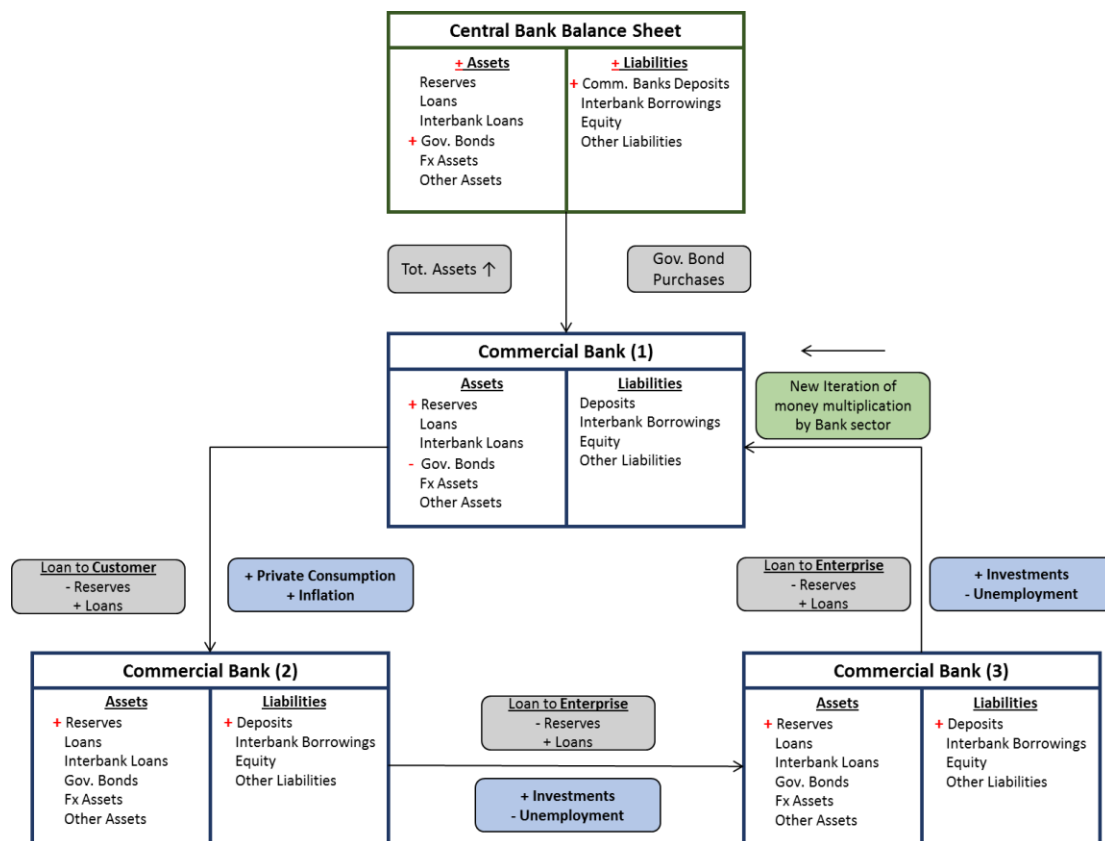
Demand and the use of it will determine the outcome. Moving forward with the money multiplier, it is highly likely that these extra reserves that our Bank (A) holds up until now, will be transformed to another asset, which one we cannot say for sure, but given that Central Banks deposit rate is the lowest of the market under normal economic conditions, and could be at the zero (if not negative) at extreme economic conditions such as the recent economic crisis, our Bank will have the incentive to transform them into an interest-bearing asset. In general, Banks could either issue a Loan to a customer (given its demand), or buy another liquid asset such as government bond. The former case seems more realistic although as Commercial Banks, this does not provide the incentive to buy government bonds, which in our assumption have been purchased by Central Bank from Commercial Banks. If this happened then Commercial Bank would just cancel the previous exchange made by repurchasing the same asset. In order to go forward with the money multiplier, it will be assumed that the Commercial Bank(A) issue a mortgage loan to one of its customers, which is the most likely to happen. With this issuance, automatically the Commercial Bank (A) generates additional money into the economy; the reason is that upon the Loan issuance the Commercial Bank will have increased its Balance Sheet with the same amount. That is, the asset size will be increased with the Loan Value, while its Liabilities will be increased with the same amount as the Customer's account in Bank will be credited with the Loan's money. At this point, the customer (unintentionally) will decide if this extra money will be increased or cancelled by the use of it. If the customer decides to pay their existing debt, automatically, this cancels the previous generated cash, but if he decides to spend the money let say to purchase building material to build his house then this money will further be increased. As mentioned, in case of debt repayment then the new money will be canceled with a null effect on consumption and in general economic output. Having our Customer purchase the necessary materials to build his house, the new created money goes as deposits to other commercial banks, for the ease of use assuming only to Bank (B), therefore this deposit from our customer will increase the balance sheet of Bank (B) with the value of the loan issued by Bank (A). That is, the balance sheet of Bank (A) will be reduced, while the balance sheet of Bank (B) will be increased with new reserves and deposits. If Bank (B) issues, another loan<sup>5</sup> to a corporation for a future

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<sup>5</sup> This loan could exceed the proceeds from the sale of government bond, provided that the Bank will meet the reserves requirements.

investment with its money going to another Bank (C), and given that in our ecosystem only the three previously mentioned banks exist, then each new Loan that will be made in it will automatically generate new “broadened” money. If one steps back and sees the whole picture, then an increase in the aggregate lending should be expected, which in turn could result in a boost in consumption and investments. Considering the size of the asset purchase programs adopted by The Fed & ECB (among many others), then this liquidity injection in the banking system could force the economy out of the danger of deflation and in general stimulus the economic recovery.

The process above could easily be depicted by the following diagram.



In general, the bank lending channel is another channel of monetary transmission mechanism, and as expressly presented by (Peek & Rosengren, 2013) depends on the level of market segmentation between market participants who have access to Public Credit Facilities (such as corporate bonds) and those who depend on Bank Loans for funding, in order to determine its effectiveness.

For instance, when a Central Bank expands its Balance Sheet with asset purchases, as was presented in the previous section, this reduces the short-term interest rates and given how effectively its policy is communicated, then long term rates will be reduced as well. Given that decrease in the cost of borrowing for firms, they have little (if any) incentives to exchange their market credit with Bank Loans, yet customers (households & firms) who do not have access to money markets for funding are restricted to Bank Credit, thus the Bank Lending Channel effectively increase the effects of monetary policy in the economy. Moreover, bearing in mind the size of recent quantitative easing programs, it is likely that through this channel Central Banks can stimulate the economic recovery. This theory imposes to existing clients regarding their preferences on means of Credit, though the very existence of the Bank Sector lies in the fact that primarily Banks are the intermediaries between depositors and borrowers, who do not have access in the money market. That is, Banks who collect the deposits, usually from the private sector, use these in order to provide Loans (create money) or other credit facilities to its customers, based on their creditworthiness.

While primarily adopting the above point of view about how Banks could create money in the modern economy, a recent research by (McLeay, et al., 2014) presents a different view about how an asset purchase program affects bank lending. They stood on two “misconceptions” about how the QE works through the banking system. Their (McLeay, et al., 2014) first argument is that while Commercial banks take part in a quantitative easing program facilitation, their role is limited only to act as an intermediary, without to be able to create additional money. Their reasoning is that Central Banks targeted through QEs government bonds and other similar assets, their holders are not the Commercial Banks but other financial institutions (Pension Funds) and investors as well. Thus, with QE purchases Central Banks do actually increase the

asset size (reserves) of the Commercial Bank but simultaneously increase their liabilities to the other financial institutions who are the holders of these assets. Consequently, their second argument is that these newly created reserves cannot be multiplied into new loans and broad money, mainly because banks cannot create additional loans from these extra reserves, but instead these can only be used by Commercial Banks in order to make repayments to each other. In order for this theory to hold, Banks should only make Loans which are matched by extra deposits.

A point which this research oversees is the fact the provided extra reserves through QE programs could allow Commercial Banks to use them, in order to meet their reserve requirements. Therefore, this will allow them to make additional Loans even though they are not matched by extra deposits, at least up to the point that Commercial Banks meet the reserve requirements. In other words, if the Banking sector is constrained by reserves requirements due to (let's say) high level of Non-Performing Loans and as a result they cannot make any additional loans, then the extra reserves at the Central Bank from the implementation of the Quantitative Easing could loosen up these restrictions and thus allowing Commercial Banks to make new loans to creditworthy customers.

It is true that the assessment of the effectiveness of Quantitative Easing Programs on the Economy (increase in spending) is hard to be conducted, mainly due to the difficulty in measuring their effects on macroeconomic variables. Nevertheless, how a QE affects bank lending can be assessed, through examination of specific items that constitute a Commercial Bank's Balance Sheet.

## Section 4 – THE FED & ECB

The collapse of the housing market in the United States and the bankruptcy of Lehman Brother in September 2008, generated turmoil in the Financial Markets, which in turn had spillover effects to several other economies (Euro Area included). Consequently, several major Central Banks (The Fed & ECB included) for fear of a broader financial and economic collapse, decided to take some “unconventional” monetary measures in order to stabilize their financial market and economies in general.

Given that, it is essential to be depicted how The Fed & ECB reacted during the financial distress and how vast the measures were that were undertaken in order to restore the normality in the markets. Therefore, in this section, it will be presented in chronological order all the unconventional measures undertaken by the Fed and ECB.

### 4.1 - THE FED’S QEs & Monetary Policy Diary

#### 4.1.1 - September 15, 2008 – Lehman Brothers (\$639 billion)

September 15, 2008 Lehman Brothers filed for bankruptcy with \$639 billion in assets and \$619 billion of debt<sup>6</sup>, came as a result of the biggest economic crisis after the Great Depression in the United States which has generated by the bubble in the housing market of the United States and has been called by many as the Great Recession. Thus, an economic turmoil has been produced in the Financial Market of the United States increasing spreads due to high uncertainty and deteriorating the economic conditions (Adu-Gyamfi, 2016). It is said, that after Lehman’s collapse the economic outlook of the United States could only be compared with that of the Great Depression.

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<sup>6</sup> <http://www.investopedia.com/articles/economics/09/lehman-brothers-collapseEAsp>

#### 4.1.2 - November 25, 2008 – QE 1 (\$600 billion)

As spreads in the GSEs (government-sponsored enterprises) and GSEs guaranteed mortgages had already increased, the The Fed decided to step in and attempt to reduce these. In more details, as declared in its announcement it was an attempt to “reduce the cost and increase the availability of credit for the purchase of houses, which in turn should support the housing markets and foster improved conditions in financial markets<sup>7</sup>”. In addition, in the announcement stated that The Fed planned to purchase mortgage backed securities (MBS) up to \$500 billion and direct obligations of housing-related (GSEs) up to \$100 billion. The duration of this program remained unknown at that time, yet the The Fed declared that it would last for several quarters.

#### 4.1.3 - December 16, 2008 – Discount Rate Reduction to 0 – 0.25%

The economic depression in the United States had not yet revealed its true magnitude, and as the economy slowed down even further, and with it, credit condition deteriorated even further, the The Fed decided to maximize the usage of any available conventional monetary tools, and thus reduced the already shrunk The Federal fund discount rate to the level of 0 – 0.25%.<sup>8</sup> In addition, the The Fed tried to reassure the public that it “would employ all available tools to promote the resumption of sustainable economic growth and to preserve price stability”. That was the first use of forward guidance tool for The Fed, given the economic situation in the US The Fed also stated in the same announcement that was evaluating a Large-Scale Asset Purchase program possibly deployed at the beginning of the following year.

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<sup>7</sup> <https://www.theFederalreserve.gov/newsevents/press/monetary/20081125b.htm>

<sup>8</sup> <https://www.theFederalreserve.gov/newsevents/press/monetary/20081216b.htm>

#### 4.1.4 - March 18, 2009 – Expansion of QE 1 (\$1,150 billion)

Consistent with its previous announcement, and as US economy deteriorated even further with job losses and credit tightening, the The Fed announced the continuation and expansion of the first phase of QE, another \$750 billion purchase of agency MBS totaling up to \$1.150 trillion, while in parallel doubled the agency debt (GSEs) to \$200 billion. The expansion thought, did not stop there, as the The Fed recognized that the credit markets conditions remained far more optimal, and therefore decided to incorporate into the QE, purchases up to \$300 billion of Long-Term Treasury Securities<sup>9</sup> over a period of 6 months. Moreover, the The Fed launched the Asset-Backed Securities Loan Facility in order to help easing the credit conditions to households and small firms.

#### 4.1.5 - November 3, 2010 – QE 2 (\$600 billion)

While economic variables depict a slow yet uncertain recovery of the economy, that is, unemployment and credit conditions remained unchanged as well as corporate investments were sluggish, the The Fed answered through a new round of Quantitative Easing program which consisted of a purchase of a further \$600 billion of Long Term Treasury Securities, at a pace of \$75 billion per month. In addition, The Fed declared through its announcement that it would keep an eye on the economic variables and will undertake any required action or adjustment, while reassuring that the Discount Rate will remain untouched.<sup>10</sup>

#### 4.1.6 - September 21, 2011 – Operational Twist

Aiming at the high unemployment rate (9.0%)<sup>11</sup> and the still slow economic growth along with price stability, the The Fed decided to improve the financial conditions on the market by hitting the Long-Term interest rates of Treasury securities. Therefore,

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<sup>9</sup> <https://www.the.federalreserve.gov/newsevents/press/monetary/20090318a.htm>

<sup>10</sup> <https://www.the.federalreserve.gov/newsevents/press/monetary/20101103a.htm>

<sup>11</sup> <https://data.oecd.org/unemp/unemployment-rate.htm>



the Fed announced that it will purchase \$400 billion of Treasury securities with durations of 6 to 30 years; while simultaneously selling an equal amount of Treasury securities with durations of 3 years or less. In the aforementioned announcement, the Fed made it clear that the Discount Rates will remain unchanged and also that it will reinvest the principal payments of the agency Debt & MBS in mortgage markets, in order to support conditions of the latter.<sup>12</sup>

#### 4.1.7 - June 20, 2012 – Operational Twist Extension

As economic growth remained stable but slow, unemployment had only a marginal improvement and the housing sector remained depressed, the Fed extended its operational twist program by \$267 billion of Treasury securities, under the same restrictions of the original one, that is, buying long-term assets (6-30 years) and selling short-term ones. With this decision, the Fed targeted the Long-Term interest rates of Treasury securities which in turn could reduce the borrowing costs or as stated making the “financial conditions more accommodative”, at the same time the Fed was seeking for an improvement in the labor market conditions in a price stability context.<sup>13,14</sup>

#### 4.1.8 - September 13, 2012 – QE 3 (\$1,725 billion)

Probably the game changer regarding the stimulus of the US economy was this one. Weak signs of economic recovery due to high unemployment rates and slow business investments, forced the Fed to set up another quantitative easing program, QE3. Even though the Fed did not announce the level of the purchases, instead, declared that it would purchase MBS at the rate of \$40 billion per month, and Long Term Treasury Securities at a rate of \$45 billion per month<sup>15</sup>. Additionally, the Fed announced that will continue the operation twist program (buy assets with Long Duration, and sell assets with short duration), aiming thus the long-term part of the term structure of interest rates. The purchase rates (\$40 & \$45 billion) remained unchanged

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<sup>12</sup> <https://www.federalreserve.gov/newsevents/press/monetary/20110921a.htm>

<sup>13</sup> <https://www.federalreserve.gov/newsevents/press/monetary/20120620a.htm>

<sup>14</sup> [https://www.newyorkfed.org/markets/opolicy/operating\\_policy\\_120620.html](https://www.newyorkfed.org/markets/opolicy/operating_policy_120620.html)

<sup>15</sup> <https://www.federalreserve.gov/newsevents/press/monetary/20120913a.htm>

until the FOMC (The Federal Open Market Committee) Meeting of December 18<sup>th</sup> 2013, from that meeting onwards The Fed decided to reduce (taper) the purchase rates by \$5 billion on each category on every FOMC meeting. Signaling thus that QE has been effective and the exit of Zero Lower Bound era is coming for the United States, yet as mentioned in the same announcement an increase in the official interest rates should not be expected until the mid-2015. The end of QE3 took place on October 29<sup>th</sup> 2014<sup>16</sup>.

#### 4.1.9 - December 16, 2015 – Discount Rate Increase to 0.25% – 0.50%

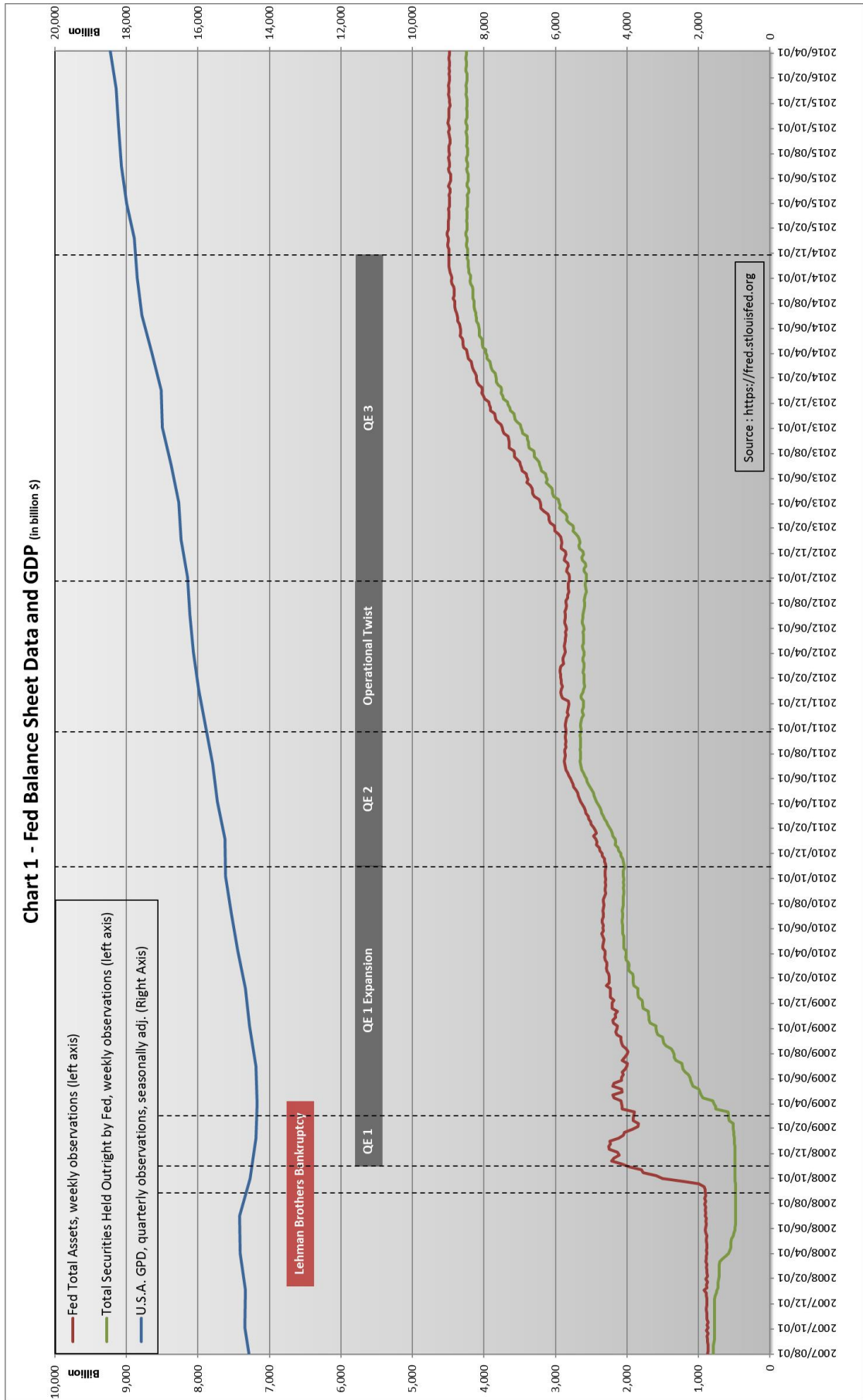
Exactly 7 years after its previous act in a series of The Federal funds discount rates reductions, the The Fed decided to increase its Discount Rates by 0.25% to 0.25% - 0.50% from the previous 0.00% - 0.25%<sup>17</sup>. This decision came as a consequence of the general improvement in both economic and labor markets, despite the anticipation of medium term inflation above 2%, which still is today The Fed's target inflation rate. This increase in the official rates declared the exit of the financial crisis era in the United States.

*The following chart (chart 1) depicts the timeline of the above discussed measures taken by Fed (securities held outright) against the evolution of United States Gross Domestic Product (quarterly, seasonally adjusted). Data provided by Federal Reserve Bank of Saint Louis.*

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<sup>16</sup> <https://www.the-federalreserve.gov/newsevents/press/monetary/20141029a.htm>

<sup>17</sup> <https://www.the-federalreserve.gov/newsevents/press/monetary/20151216a.htm>



## 4.2 - ECB's QEs & Monetary Policy Diary

### 4.2.1 - July 2, 2009 – CBPP1 (€60 billion)

With the European Debt crisis on its doorsteps (October 2009) and important spill-over effects through the Great Recession in the United States, ECB announced its first Program of Covered Bonds Purchase (CBPP1) through both primary and secondary markets, the program length had been set for 1 year (July 2009 to June 2010). The qualification for purchase of bonds was those with total issuance value above 500 million and rating at least BBB. Should be mentioned though the lack of use of forward guidance tool. Upon its fulfillment, ECB had purchased €60 billion of Covered Bonds, as was the original planning<sup>18</sup>.

### 4.2.2 - May 10, 2010 – SMP

The abnormal conditions that certain market's segments experienced at the beginning of 2010 reduced the effectiveness of the monetary policy in Euro Area as ECB stated in its announcement. Forcing thus the ECB to implement, in parallel to the first CBPP, an additional program, securities market program as it was called. The aim of this program was through ECB's interventions in public and private debt securities markets to provide the necessary for their liquidity in these market segments that were malfunctioning, restoring thus the effectiveness of the monetary policy. In parallel, ECB announced that will conduct additional (3 and 6 months) Long Term Refinancing Operations. In contrast to its previous announcement, ECB made use of the Forward guidance tool stating that it "will take all measures needed to meet [their] fiscal targets this year and the years ahead in line with excessive deficit procedures". Also, in the same announcement the ECB made it clear that this program would not have had any effect on its Monetary Policy.<sup>19</sup>

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<sup>18</sup> [https://www.ecb.europa.eu/press/pr/date/2009/html/pr090604\\_1.en.html](https://www.ecb.europa.eu/press/pr/date/2009/html/pr090604_1.en.html)

<sup>19</sup> <https://www.ecb.europa.eu/press/pr/date/2010/html/pr100510.en.html>

#### 4.2.3. - April 7<sup>th</sup> & July 7<sup>th</sup>, 2011- Increase of ECB Key Rates (0.25%)<sup>20</sup>

On each of these dates, ECB increased its key rates by 25bps, a controversial action by many, as the economic recovery in the Euro Area was still far from considered established. This hike in the interest rates, despite the improvement of the economic indicators, perhaps prevented the further success of programs adopted by ECB and triggers another economic slowdown in the Euro Area. As many questioned in the press conference<sup>21</sup>, at that time economies at the Euro zone's periphery were far from the ideal conditions, thus the increase in interest rate could deteriorate even further their economies. One possible explanation of this decision could be the attempt from the ECB primarily to retain its creditworthiness regarding its prime objective and secondary to distinguish the responsibilities between monetary policy and fiscal policy, that is ECB's would be remained devoted to its prime target of price stability among the Euro zone, regardless of the unemployment rate or other political pressures. Truth is, at this time inflation rates had been above (2.6%) targeted inflation rate of ECB (2%), nonetheless that increase in interest rates should be postponed as EU economy started to slowdown from then after.

#### 4.2.4 - November 3, 2011 – CBPP2 (€16.4 billion)

As the European economy started declining once again, ECB implemented another Covered Bond Purchase Program (CBPP2), this time the targeted amount was €40 billion, with the qualified bonds to have issue volume above €400million, to be rated at least as BBB and have maximum residual maturity 10.5 years which was an additional rule compared to the requirements of the first program.<sup>22</sup> In the announcement of program's ending ECB mentioned also its two specific targets, the first one was to improve funding conditions for credit institutions and enterprises while the second one was to stimulate the lending supply for private sector, increasing thus the spending. Nevertheless, ECB purchased only €16.4 billion instead of 40billion as planned, also in April's 4<sup>th</sup> 2012, decided to reduce the purchase pace due to both “increasing investors

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<sup>20</sup> <https://www.ecb.europa.eu/press/pr/date/2011/html/pr110407.en.html>

<sup>21</sup> <https://www.ecb.europa.eu/press/pressconf/2011/html/is110707.en.html>

<sup>22</sup> [https://www.ecb.europa.eu/press/pr/date/2011/html/pr111103\\_1.en.html](https://www.ecb.europa.eu/press/pr/date/2011/html/pr111103_1.en.html)

demand for euro area covered bonds and to the decline in the supply of covered bonds”.<sup>23</sup> In both CBPP2 announcements ECB has not mentioned anything about the forward guidance.

#### 4.2.5 - June 5, 2014 – TLTRO 1

In order to enhance the transmission mechanism of Monetary Policy, ECB decided to conduct a series of Targeted Long-Term Refinancing Operations, on June 2015. This program was a two phase – 2018 maturing – refinancing program for the major Europe’s Financial Institutions, aimed to increase the liquidity in the banking sector and support lending to the real economy. The first phase of the program has been conducted in September and December of 2014, through which counterparties received financing up to 7% of their total private sector loans excluding loans to households for house purchase. In the second phase, which was from March 2015 to June 2016, counterparties had the ability to receive additional borrowing amounts; the cumulative amount of the additional borrowing could reach three times each institution lending.<sup>24</sup> On January 22, of 2015 ECB decided to remove the 10 basis points spread onto ITS Main Refinancing Operations Rate that was initial implemented in the first two TLTROs.<sup>25</sup>

#### 4.2.6 - October 2, 2014 – CBPP3 & ABSPP (\$215 billion - ongoing)

As the credit conditions and monetary policy effectiveness deteriorated even more ECB decided to start another two programs<sup>26</sup>. The first one was an Asset Backed Securities Purchase Program (ABSPP), through which ECB provided 70% funding on qualified non-financials’ private sectors debt with rating at least BBB<sup>27</sup>. While the second one was the third implementation of the Covered Bond Purchase Program (CBPP3), which

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<sup>23</sup> [https://www.ecb.europa.eu/press/pr/date/2012/html/pr121031\\_1.en.html](https://www.ecb.europa.eu/press/pr/date/2012/html/pr121031_1.en.html)

<sup>24</sup> [https://www.ecb.europa.eu/press/pr/date/2014/html/pr140605\\_2.en.html](https://www.ecb.europa.eu/press/pr/date/2014/html/pr140605_2.en.html)

<sup>25</sup> [https://www.ecb.europa.eu/press/pr/date/2015/html/pr150122\\_2.en.html](https://www.ecb.europa.eu/press/pr/date/2015/html/pr150122_2.en.html)

<sup>26</sup> [https://www.ecb.europa.eu/press/pr/date/2014/html/pr141002\\_1.en.html](https://www.ecb.europa.eu/press/pr/date/2014/html/pr141002_1.en.html)

<sup>27</sup> [https://www.ecb.europa.eu/press/pr/date/2014/html/pr141002\\_1\\_Annex\\_1.pdf?46d1733e12fa2737fb16e547efdb4e92](https://www.ecb.europa.eu/press/pr/date/2014/html/pr141002_1_Annex_1.pdf?46d1733e12fa2737fb16e547efdb4e92)

in reality was the supplementary part of the ABSPP as through former ECB qualified covered bond issued by credit institutions across the Euro Area with minimum rating of BBB.<sup>28</sup> Through the implementation of these two programs ECB (acting in parallel with the TLTRO program) aimed to enhance the monetary policy transmission mechanism, and foster an improvement in the credit conditions. The fact that ECB did not announce their maturity dates, even though the ECB stated that they will last at least for two years, was the first use of the forward guidance tool by ECB aiming to convince the markets that “will do whatever it takes”<sup>29</sup> to stimulate European Economy. As of the end of September 2016, ECB held on €215 billion of purchased assets through these two programs, which purchases has an average pace of €9 billion per month.

#### 4.2.7 - January 22, 2015 – PSPP (€1,075 billion - ongoing)

European Economy deterioration, particularly the actual and expected inflation levels, brought the necessity for ECB to take additional measures in order to counter fight it. In January 22, 2015 ECB announced the Public Asset Purchase Program which will run in addition to the other two active programs (CBPP3 & ABSPP), the total monthly purchases of these three programs have been set by ECB at the level of €60 billion. With this expansion, ECB included in the eligible asset portfolio of purchases central government bonds and other international and supranational (euro located) securities with remaining maturity between 2 and 30 years.

The ECB was initially planning to keep these programs active “at least until September 2016 and in any case until the Governing Council sees a sustained adjustment in the path of inflation”<sup>30</sup> (forward guidance).

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<sup>28</sup>[https://www.ecb.europa.eu/press/pr/date/2014/html/pr141002\\_1\\_Annex\\_2.pdf?3e00514deb4f16bcdd8daea36b6b93e7](https://www.ecb.europa.eu/press/pr/date/2014/html/pr141002_1_Annex_2.pdf?3e00514deb4f16bcdd8daea36b6b93e7)

<sup>29</sup> <https://www.ecb.europa.eu/press/key/date/2012/html/sp120726.en.html>

<sup>30</sup> [https://www.ecb.europa.eu/press/pr/date/2015/html/pr150122\\_1.en.html](https://www.ecb.europa.eu/press/pr/date/2015/html/pr150122_1.en.html)

#### 4.2.8 - March 10, 2016 – CSPP (€29.7 billion - ongoing) & TLTRO 2

Another expansion of the Assets Purchase Program from the ECB, was taken on in March 2016, at that date the ECB announced that it will incorporate purchases as well from the corporate sector (CSPP) in its assets purchase programs, while at the same time lift its monthly purchase target to €80 billion from €60 billion, in order to include these new purchases.<sup>31</sup> From all the above ongoing assets purchase program ECB holds on almost €1.3 trillion.

In parallel, ECB announced another round of Targeted Long-Term Refinancing Operations, this program was an add-on to the previous TLTRO, by which ECB wanted to “reinforce its accommodative monetary policy stance and to foster new lending”<sup>32</sup>. These new operations have been scheduled to be conducted on a quarterly basis starting on June 2016 to March 2017, through these counterparties could borrow up to 30% of their eligible loans excluding those that had already used in the first TLTRO.

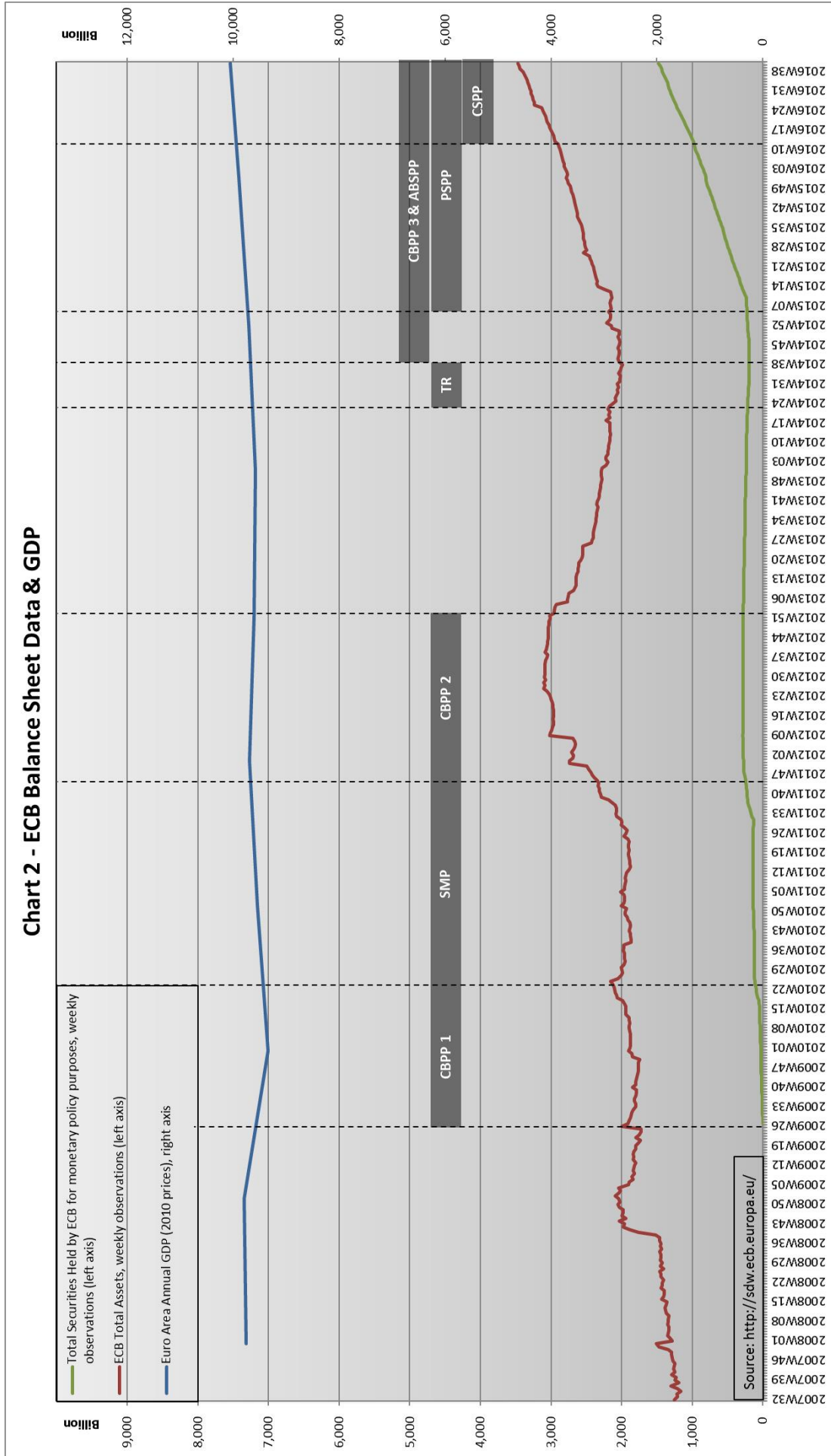
*The following chart (chart 2) depicts the timeline of the above discussed measures taken by ECB (total securities held for monetary policy purposes) against the evolution of Euro Area of 19 (annual, 2010 prices). Data provided by the European Central Bank database.*

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<sup>31</sup> [https://www.ecb.europa.eu/press/pr/date/2016/html/pr160310\\_2.en.html](https://www.ecb.europa.eu/press/pr/date/2016/html/pr160310_2.en.html)

<sup>32</sup> [https://www.ecb.europa.eu/press/pr/date/2016/html/pr160310\\_1.en.html](https://www.ecb.europa.eu/press/pr/date/2016/html/pr160310_1.en.html)





## Section 5 - Empirical Evidence of UMPs in US & EU

In this section the results of recent literature will be presented about the effectiveness of Unconventional Monetary Measures taken by both The Fed and ECB. The aim of this section is to depict whether or not the previous discussed transmission mechanisms worked during quantitative easing programs, or in general how effective they could be the unconventional monetary policy. Given the fact that both ECB and The Fed reduced their official rates to zero lower bound, academics researched the effectiveness of the large-scale asset purchases and other measures, that Central Banks implemented under the condition of Zero Lower Bound.

### 5.1 - Forward Guidance

In their research, (Hamilton & Wu, 2010), attempted to find what the effect of QEs in the term structure of interest rates, compared to an attempt by The Fed to flatten the yield curve under normal conditions, i.e. out of the Zero Lower Bound. Using pre-crisis data (1990-2007), they found that in 2006, it was required by the The Fed to purchase about \$400 billion of short-term Treasury debt and use the proceeds to purchase all the existing long-term (>10 years) Treasury debt in order to reduce by 14bps the long-term maturity part of the yield curve while in parallel that exchange would have increased short-term maturity yields by 11bps. Using the above as a counterargument, in Zero Lower Bound conditions the same exchange would have also decreased the long-term maturity yields by 13bps without increasing the short-term yields, something which was The Fed's target when implementing the QEs. That is, under normal conditions asset purchases programs could only alter the term structure but without any effect on the overall level of interest rates, instead under zero lower bound conditions such asset purchases could influence the overall interest rates level by reducing the long-term part of the term-structure. Their model indicates also the importance of expectations (Forward guidance channel), that is the effectiveness of QEs depends on a large scale about how investors perceives the economic fundamental after the QE period, when normal conditions have returned. A policy that failed to convince investors that will keep the supplies (Treasury Bonds) after the zero lower bound periods could have

limited effectiveness, likewise an announcement about what the official short-term rates would be once the economy escaped the Zero Lower Bound. Finally, their model indicates, with a limited certainty though, that also the size of a QE plays significant role on its effect on the interest rates, and as the model suggests, a liner effect should be estimated, that is twice the size of the QE twice its effect would be on the long-term interest rates.

Summarizing their research, the effectiveness of a QE depends on primarily how effectively the Central Bank could convince (forward guidance) investors about its after crisis interest rates, and secondly on its size.

Further evidence regarding the Forward Guidance channel, provided by (Filardo & Hoffman, 2014) who analyzed announcements with Forward guidance content from the four major Central Banks (The Fed, ECB, BoE, BoJ). They ascertained that in most cases Central Banks were able to reduce the near-term volatility (risk) of the expected future official interest rates, where the Central Banks failed was when it came to long term expectations. They also found that, as economic conditions improved the forward guidance effect on the market reduced, for instance after the August 2011 The Fed's announcement the 2-year-ahead future rate reduced by 20bps, in contrast to January's 2012 announcement which caused a reduction by only 5bps, with December's announcement of the same year to have no effect on future rates.

That is, the above research provides us evidence that Forward Guidance channel operates effectively only in times where the financial markets are distressed and the economic uncertainty is still increased, as economies moving away from distress conditions, this channel has limited effectiveness regarding their effects on expected future interest rates.

Contrary, Forward Guidance can still be effective in times where financial distress has been reduced, but from a different perspective, as the same research indicates when The

Fed announced its tapering in the assets purchases in December 2013, the announcement was able to convince the market participants in such way that long-term rates did not increase, securing thus that the program would remain effective. Thus, forward guidance could be used to enhance or at least as a securitization toll of the monetary policy even at times where distress in the financial market has been reduced.

Another interesting research about the impact of Unconventional Monetary Policies coming from (Kaoru & Shogo, 2014), they investigated the impact of unconventional monetary measures announcements controlling the market expectations (Forward Guidance). Their findings are in line with previous presented papers, as they also find that measures announcements incorporating forward guidance had greater impact than without it, capturing the surprise component as the “change in government bond futures around policy announcements”. In particular, they found that Unconventional Measures taken by Fed, ECB, BoE and BoJ had significantly reduced the long-term government bonds yields (primary target of QEs), as an example, the announcement of the expansion of the first QE program in the US reduced by 47.4bps the 10 year spreads. Moreover, the same announcement depreciated the USD against the other currencies, while also decreasing the BBB corporate bond (36.5bps) with its effects resulting in an increase in the S&P 500 as well. In addition, the same announcement reduced the interbank loan spreads and increased radically the S&P 500 Bank index. Identical spillover effects to the above, have had similar announcements of all major Central Banks about Unconventional Measures, as the authors point out, their findings indicate that except for the impact on the financial markets that UMP has, it could be a very useful tool in order to “restore confidence in domestic financial assets”. The only exception of the rule, which more amplifies it than cancel it, was the Feds credit policy which caused an appreciation in the USD, the authors believe that this originated as a result of (international) confidence restoration regarding the US financial market than anything else, still the same policy reduced the corporate bond spreads.

## 5.2 - Portfolio Rebalancing Channel

(Gagnon, et al., 2011), assessed the Large-Asset Purchase Programs (2008-2009) in the United States and estimated its impact on 10-years risk premium between 30 and 100bps, moreover they found significant spill-over effects on agency debt and mortgage backed securities. Thus, they provide important evidence about the existence of the portfolio rebalancing channel, that is, the QE1 did effectively lower rates in a broad spectrum of financial assets, including borrowing costs for corporations (corporate bonds) and households (mortgage). In addition, their research was consistent with the previous discussed mechanism, i.e. Forward Guidance, as they took into account how these unconventional measures were communicated by the Fed.

(Chen, et al., 2011) analyzed the effectiveness of the first two rounds of LSAP programs in the United States, on the macroeconomic variables using a DSGE model. More specifically, they found that LSAP programs have a constant impact on GDP, while their effect on inflation is very limited. The way that DSGE model works, is by producing a counterfactual under the hypothesis that LSAP programs was never in existence. That is, the researcher can compare the outcome of his model to the realized figures and find if the LSAP model had been effective. Therefore, the researchers assuming a 30bps decrease in risk premium and a commitment for 1 year by the CB about its policy found that the QE1 had a annualized impact on GDP of 0.4% while its effect on inflation was only 0.05%, with the effect on GDP lasting at least about 6 years. In contrast, according to their model QE2, had smaller and more uncertain impact than QE1, similar to a 50bp cut in the official short-term rates, also they found that the commitment of the CB about its policy could double the effect of LSAP program which as previously discussed enhance the importance for any given LSAP program to be accompanied by forward guidance announcements and commitments.

Similarly, (Krishnamurthy & Vissing-Jorgensen, 2011) researched the effectiveness of the first two rounds of purchases that The Fed implemented, i.e. QE1 & QE2, on interest rates. More specifically using event study methodology combined with daily and intra-day data, they found that the first two rounds of QE in the United States had a significant effect on nominal rates on long-term safe assets. In more details, using intra-day data following the Fed announcements, they found that QE1 which had as targeted assets both long-term Treasury and Mortgage Backed Securities reduced significantly the interest rates on both assets, while it also had a spillover effect on other safe assets such as AAA corporate bonds, with that effect to be reduced on other riskier long-term assets such as BAA corporate bonds. That is, the QE1 increased market's confidence and effectively reduce the risk premium on safe corporate bonds (by 100bps), providing evidence that the portfolio rebalancing channel has effect even under the condition of ZLB. They also, assessed the QE2 which had as targeted assets only Treasury Bonds, that differentiation in targeted assets proved to change the effectiveness of QE2 as it had only a minor impact on Mortgage rates, nonetheless its effect on Treasury Yields proved to be significant while its spillover on AAA bonds had been smoothed to (20bps).

Given the above, their evidence indicates that the selection of the underlying assets of a Quantitative Easing program is crucial, as it limits or enhances its spillover effect to other assets, also they provide significant evidence of the existence of portfolio rebalancing channel but only limited to safe assets with spillover effects on riskier assets to be existed but reduced.

For the Euro Area, (Altavilla, et al., 2015) provided evidence about the effectiveness of the QEs. More specifically, using an event study methodology they analyze the reaction of the market interest rates between the announcement of the program and its actual implementation, finding that the impact on market rates are more significant on the announcement date than its actual implementation suggesting the existence of a stock effect rather than a flow effect in the market rates. Accordingly, the announcement of the QE in Euro Area had significantly affected yields on a broad set of market segments, imposing bigger spill-over effects compared to a QE implementation under distressed

financial markets, which suggested by the previous research. That is, while some channels of QE transmission indeed weaken when the financial distress reduced, some others strengthen enhance thus the QE effectiveness especially when the maturity and the riskiness of assets growing.

The difference between the previous studies is the fact that, the former analyzed the first two rounds of QEs in US where the financial market were still under pressure especially during the first round, while in contrast the latter research analyzed data from the EU where the implementation and the announcement of the QE took place when the distress in the financial markets had been reduced. Combining the previous researches, it should be expected a smaller spill-over effect when the QE implemented during a period of high financial distress and stronger spill-over effect when the same QE take place during a period of lower financial distress. In either case, a QE expected to have effect on market rates, reducing thus the long-term yields without increasing the short-term ones. Additionally, the effects expected to be bigger at the announcement date rather than during its actual implementation.

In contrast to (Altavilla, et al., 2015), a research conducted by (Szczerbowicz, 2011) for the US quantitative easing programs, found that while the QE1 had effectively reduced the long-term interest rates (on average by 20bps), instead QE2 failed to decrease them. The difference between the effectiveness of these two QEs was their ability or not, to increase the expected long-term inflation rates, that is, the first QE did not increase inflation expectation, while the second one increased them (6bps) canceling thus its effect on long-term interest rates. One possible explanation could be that QE1 conducted in a period of high financial instability while the second round of QE implemented in a period where the financial distress has been lowered. Providing the similar (Krishnamurthy & Vissing-Jorgensen, 2011) results regarding the general effectiveness of the QE2 in the United States, especially for its spill-over effects, yet the reasoning for its ineffectiveness is not the same but perhaps it is supplementary. That is, the range of purchased assets could have played an important role in the spill-over effects of QE2, while the improvement in the Financial Markets reduced the general effect of QE2 in the interest rates.

Additional evidence about the effectiveness of UMPs in the United States, provides a research conducted by (D'Amico & King, 2010), whereby analyzed with daily panel data the flow and stock effects of first QE in the United State on various assets, their findings are almost in line with the previously conducted researches. Their findings are similar to that of the Euro Area; stock effects (announcement) are significantly stronger than flow effects (actual implementation). Particularly, spill-over effects are greater between similar to QE underlying assets than assets with different maturity, imposing thus a greater effect of portfolio rebalancing channel. In, addition they found that the stock effects on the underlying assets could be up to 30bps whereas the flow effects are limited to 4 bps, similarly identical maturity assets had affected by 50bps and 3.5bps respectively. They also found that less-liquid assets had limited affect from the announcement of the program, but instead they are affected more persistently from the actual implementation of the program, which in turn depicts that investors present, as (Vagiannos & Villa, 2009) instructs, a more preferable habit behavior of portfolio rebalancing. That is, investors such as Pension funds want specific duration portfolio and the reduce availability of long term Treasury debt induce them to replace these assets with similar maturity other increasing thus the spill-over effect.

Likewise, evidence arising from another study of (Szczerbowicz, 2014), this time from the Euro Area, who used event-based regressions and measured how unconventional measures in Euro Area taken by ECB influenced sovereign and bank bonds. Her findings are in line with previous researches in the United States, specifically she found that sovereign bond purchases not only reduced the yields of sovereign bonds but also had significant spill-over effect to bank covered bonds. Moreover, bank bonds purchases by ECB had additional effects in the yields of sovereign bonds; enhanced thus the transmission of policies in the financial markets. In addition, her research provides evidence that the stronger distress of the sovereign bonds market the greater the effectiveness of the QE is in these markets, which is the countries in the troubled peripheral of the Euro Area and benefited more from sovereign bond purchases than Germany for instance. Furthermore, by simultaneously analyzing banks and sovereign bond markets she found that interdependence exists between these two markets which



impose that any asset purchase in each of these markets could be amplified by any additional purchases on the other one. Given that the distress in sovereign bond markets in Euro Area which was a consequence of the debt crisis, was also the main reason for the increase in the bank bonds in the pre-QE period, that is, sovereign bond purchases could be even more effective as their spill-over effect to bank bonds are greater than the opposite. She also found, that the reduction in the official deposit rate of the ECB helped to reduce the distress in the money market.

### 5.3 - Bank Lending Channel

Even though that a large portion of academics involved in Unconventional Monetary Policy Effectiveness, only a very small proportion of them touched the Bank Lending Channel, instead the majority put their efforts on how Quantitative Easing programs actually affected interest rates.

Nonetheless, the Japanese Quantitative Easing inspired (Bowman, et al., 2011), who and assessed the bank lending channel during the Quantitative Easing Program adopted by the Bank of Japan. While they analyzed how Japanese Quantitative Easing Program affected Bank Lending, their study provides evidence about at least a supplementary effect of QE in the general credit supply during a QE. Before the Japanese QEP, its economy has suffered an extended period of deflation and with the QEP Bank of Japan was aiming to stimulate its economy until CPI stop declining. The researchers found that Quantitative Easing Program in Japan and the injected liquidity that it offered to Banks had a positive and significant effect on Bank Lending although a small one. That is, without these liquidity injections from BoJ the condition of the Banking Sector in Japan would have been deteriorated and the Bank Lending significantly lowered, reducing thus the total effectiveness of a QE program which above all others aiming to increase the consumption in the economy. Their findings are interesting, and provide incentives for one to make the similar analysis in United States and Euro Area.

As previously discussed research from (Szczerbowicz, 2011) regarding the first two QE rounds in the United States, provides us also with some interesting findings about the decrease in the LIBOR-OIS spread generated by the liquidity facilities that The Fed adopted, which in turn provides evidence about the effectiveness of UMP in interbank market reducing the cost of borrowing for the companies and households that do not have access in the financial market (bank lending Channel).

*For the thesis coherence, the Bank Lending Channel and its effects in U.S. and Euro Area has been discussed widely in the next section, where one may find also the relevant econometric analysis.*

## 5.4 - International Spill-Overs

Another aspect of how Large-Scaled Asset Purchases Programs could affect an economy, is through international spill-overs that is, through the exchange rates channel, which is to some extent, an exogenous variable in an economy. A relevant research originated by (Neely, 2010), who examined how an implementation of a large scale asset program by one country could influence both the domestic and foreign economies. The concept behind this is that investors (especially the larger ones) are to a certain extent, an international player, thus a QE program which as previously discussed, lowering the yields over a relevant broad spectrum of long term financial assets could alter the weight in investors' portfolios. For instance, an investor who might have 20% of its portfolio exposed in US market could reduce it to 15% and use the proceeds in order to invest in another country pushing up the prices of bond in that country as well, in other words generating a spill-over effect. In his research, (Neely, 2010), found that the first two rounds of the QEs in the United States reduced the 10-year yields on several countries (Australia, Canada, Germany, Japan and UK) without though any effect on the short-term part of the term structure, in addition QEs depreciate the US dollar against the currencies of countries above.

That is, a QE by itself could enhance economic activity by reducing long-term interest rates and generating a competitive depreciation which in turn boosting exports, stimulating thus the economic recovery, even if the economy reached the Zero Lower Bound, imposing also that a coordination among different Central Banks about the implementation of Quantitative Easing Programs could enhance even further the QE effectiveness in their economies.

## Section 6 – The Bank Lending Channel in US & Euro Area

This thesis scope is to evaluate the effectiveness of bank lending channel of the Unconventional Monetary Policies, in the United States and Euro Area. As ECB mentioned in several of its announcements (previously presented) regarding asset purchase programs, Central Banks are aiming at increasing the consumption of the private sector by injecting extra liquidity in the banking system. In theory, these extra reserves that Central Bank became available to Commercial Banks, could be transformed to new Commercial Loans such as mortgage loans, credit lines to corporations or investments purposes loans. The level of credit market segmentation enhances or reduces the strength of this channel. Additionally, the general economic conditions could play a vital role regarding the effectiveness of the channel, as long as uncertainty surrounding households and firms it is highly likely that the demand for additional credit will be reduced. Furthermore, the injected extra liquidity in the bank sector could restore the proper functioning in the interbank market as the sounder financial institutions could provide interbank loans to the smaller ones who are more likely to be capital constraint with the necessary liquidity.

The research of (Bowman, et al., 2011) regarding the effectiveness of the Japanese QE in Bank Lending growth provides us with a base model regarding the evaluation of quantitative easing policies on bank lending.

In their analysis, they used semi-annual balance sheet data from 137 banks in Japan covering a period between March 2000 and March 2009, with their data provided by the Japanese Bank Association (JBA). They also used as control variables the liquid assets over total assets, with liquid assets to be the “sum of cash and due from banks and call loans”, the term “due from banks” includes reserves at the Bank of Japan and deposits with other banks. Moreover, they used lags of log loan growth, without distinguishing between commercial loans and loans to other banks, lags of log deposits growth and lags of log Total Assets growth. Furthermore in order to control for the soundness of bank sector, they used also the ratio of Equity over Total Assets, and for

controlling the quality of the Loans they used the ratio of Non-Performing Loans over Equity. Additionally, in order to capture alterations between different Bank types and whether or not Quantitative Easing Program had been successful, they used dummy variables.

Their findings using panel data regressions are interesting, they extract a significant, positive yet small correlation between banks liquidity (0.13) during the period of Quantitative Easing Program and lending growth, with that relationship to be inverted during the non-QE period (-0.03), something which is expected as under normal economic and liquidity conditions Banks do not held excess reserves, instead they exchange them with other interest bearing assets such as loans. Furthermore, as they assessed the interbank market deduce that one probable reason of small effect of the extra liquidity on Bank Lending was due to the decrease of the Bank deposits among themselves. In addition, they found that equity ratio (0.03) did not have a significant relationship with loans growth, a result that depicts Japanese Banks were not capital constrained either during or not QE period. Although, Non-performing Loans represented a statistically significant negative correlation (-0.01) with the Bank Lending growth, imposing thus that Banks whose Loans underperformed had not increased their lending as much as otherwise could possibly done as the reserves requirements for these Loans are significant higher than performing loans, straining thus a part of the injected extra liquidity.

Concluding, even if the Quantitative Easing in Japan had not helped Banks to increase their Loans substantially, it had provided the necessary liquidity in the Japanese Banking sector in order for the latter to operate properly. That is, in the absence of the QE, Banking Sector in Japan would have been even more distressed.

## 6.1 – The Model & its Variables

Examining several announcements of assets purchases programs, it becomes clear that the main target of such programs is to provide enough boost in the banking sector in order for the latter to increase its commercial loans. In theory, beyond all the other subsequent effects that a QE may have, as its main objective, is to stimulate the economy by increasing the spending and consumption.

In a nutshell, even constrained by the ZLB a Central Bank is able to affect the cost of borrowing (portfolio rebalancing) which in turn increase the wealth of participants in the financial markets and make investing plans more affordable for them. In parallel by injecting extra liquidity in the banking system the Central Bank could, on the one hand prevent (or ease) distress in the bank sector, while on the other hand could increase liquidity (lending growth) of the private sector to whom participants do not have access to the financial markets, resulting in an increase in both consumption and investments stimulating thus the economy.

Given the above, an assessment of the commercial loans which includes mortgages, corporate loans, and all other generic loans issued to customers is essential. Interbank market should be taken into account as well, as it could reduce the effectiveness of the QE. Moreover, banks wealth and customer's deposits could be another explanatory factor of bank lending.

That been said, in the following paragraphs will be presented the reasoning regarding the selection of each explanatory variables included in the model, having in mind the theory of the bank lending channel as discussed in the second sector, the previous mentioned research and in general, how a QE could affect any given bank balance sheet.

### 6.1.1 - Liquid Assets

The channel through which, the implementation of a Quantitative Easing program affect the bank lending is the injected extra reserves (liquidity). Under normal economic conditions one might expect a negative relationship between the liquid assets of a given Bank and its Loans, that is, when a Bank has excess reserves it is expected to exchange them with another interest-bearing asset such as loans.

In contrast, when a Bank is liquidity constrained, one might expect that any additional liquidity injection could reinforce the issuance of new loans, as the Bank even if it cannot lend directly the extra liquidity, it could use them in order to meet its reserve requirements, releasing thus reserves that could be used for additional loans issuance.

However, the fact remains that not all banks behave in the same way when they get additional reserves, for instance the incentives for new loans, by a Large Commercial Bank which might not be liquidity constrained could be limited, contrary, the extra liquidity could be used by such a bank for decreasing its interbank lending reducing thus the direct effects of the asset purchase program to the lending growth. Nevertheless, even in this case the interbank loans repayments, these could improve the conditions in the interbank market, which in turn could as a side-effect increase the lending capacity of the smaller banks.

Consequently, the liquid asset log growth could depict to a great extent the effects of assets purchases from the central bank on bank lending. Given the data provided by the Orbis database, Liquid assets include: cash and balances with CB, Financial Assets at their Fair Value, Net Loans and Advances to Banks, Reverse Repos, securities borrowed & cash collateral minus Reserve Requirements at CB. However, in its original form the Liquid Assets variable fails to “isolate” the additional injected liquidity as includes both cash and balances with CB and Interbank borrowings. Therefore the Net Loans and Advances to Banks, Reverse Repos, securities borrowed

and cash collateral (Loans & Deposits from Banks) have been deducted from Liquid Assets, in order to exclude any effects of Interbank Market in Liquid Assets.

Moreover, and in order to extract the effect of the Assets Purchases Programs, interaction terms between time dummies (value of 1 during QEs, 0 otherwise) and log growth of liquid assets have been used.

### 6.1.2 - Commercial Loans

The prime target of a QE program is to promote consumption by increasing the credit supply both in the financial markets and beyond them. By setting this as the dependent variable, and more specifically the (log) growth of it, important evidence about the effectiveness of the QE in lending growth could be extracted. The term “commercial loans” includes mortgages, consumers and corporate loans.

### 6.1.3 - Customer Deposits

In order to control the level of dependence between new loans issue and new deposits, the (log) growth of customer deposits which include Demand Deposits, Saving Deposits, Time Deposits and Other Customer Deposits, should be implemented in the model.

That is, if banks issue new loans only when they are matched by additional deposits then a significant and positive relationship between these two variables should be expected, in contrast if banks issue new commercial loans upon their demand regardless whether or not they are matched by additional deposits then a relative smaller coefficient would be expected. As in the case of Liquid Assets, interaction terms



between time dummies and Customer Deposits have been used in order to extract alterations in coefficient through QEs periods.

#### 6.1.4 - Equity

Controlling for the degree of leverage of each individual bank could shed some light on how the capital constraints affect the bank lending capacity. Similarly to (Bowman, et al., 2011) the ratio of Equity over Total Assets has been implemented, with interaction terms between time dummies and Equity ratio to have been used in order to extract alterations in coefficient through QEs periods.

#### 6.1.5 - Non-Performing Loans

Non-performing loans are an important factor of general economic conditions and banks' loans portfolio performance, the correlation though between NPLs and bank lending could be either negative or positive and depends mainly on how bank behave towards risk. That is, when a bank facing losses above the anticipated level, then its managers have the incentives to further increase bank's lending in order to keep the profits at the desired level, in that case a positive relationship between NPLs and loans growth should be expected. This behavior imposes two things, firstly that banking sector would have the necessary liquidity, and thus banks could easily borrow from each other, secondly that the newly created loans will be performing as expected. These conditions could rarely be met during a financial crisis, as in such period the liquidity in the banking sector could be diminished as a side-effect of exponential growth of NPLs (which require greater reserve requirements) and due to high uncertainty among banks which deteriorates the conditions in interbank market.

As such, the (log) growth of ratio of NPLs over Total Loans could be used as a proxy of economic conditions, and its coefficient could provide evidences on how bank lending affected by the alteration of NPLs ratio. Moreover, interaction terms between time dummies and NPLs ratio have been used in order to extract alterations in coefficient through QEs periods.

#### 6.1.6 - Interbank borrowings / lending

One possible use of the extra liquidity supplied to Banks from asset purchase programs, could be the reduction of their borrowings from other banks, something which acting similarly as debt repayment (section 3), can reduce the effectiveness of the QE programs. Usually the interbank market is a highly active market as banks borrow (short-term) and lend (short-term) to each other, depending on their needs, with the cost of the money to be depicted on the overnight interbank interest rates. During a financial distress period though, banks have incentives to reduce their interbank transactions as the uncertainty among the financial institutions skyrockets especially in the beginning of the crisis. That is, the coefficient of these two variables could be either positive or negative, depending mainly on the interbank financial conditions. Thus, the (log) growth of these two variables should be included in the model as they could explain in some extent the movements of the loan growth, and more specifically whether or not banks use the extra injected liquidity for debt repayment among themselves or to increase their commercial loans. As in the case of Liquid Assets, interaction terms between time dummies and Interbank Borrowings / Lending have been used in order to extract alterations in coefficient through QEs periods, with interbank lending to be constructed as the sum of net loans and advances to Banks, reverse repos, securities borrowed and cash collaterals. While the Interbank borrowings constructed as the sum of bank deposits, repurchase agreements, securities loaned and cash collaterals.

### 6.1.7 – The Model

$$CommLoans = a + \beta_1 Liquid + \beta_2 CustDep + \beta_3 EquityTA + \beta_4 NPLs + \beta_5 IntLoans + \beta_6 IntBorr$$

$$CommLoans_t = \log \left( \frac{Total\ Commercial\ Loans_t}{Total\ Commercial\ Loans_{t-1}} \right)$$

$$Total\ Commercial\ Loans_t = Mortgage\ Loans_t + Consumers\ Loans_t + Corporate\ Loans_t$$

$$Liquid_t = \log \left( \frac{Liquid\ Assets_t - Loans\ and\ Advances\ to\ Banks_t}{Liquid\ Assets_{t-1} - Loans\ and\ Advances\ to\ Banks_{t-1}} \right)$$

$$CustDept = \log \left( \frac{Customer\ Deposits_t}{Customer\ Deposits_{t-1}} \right)$$

$$EquityTA_t = \frac{Equity_t}{Total\ Assets_t}$$

$$NPLs_t = \frac{Non\ Performing\ Loans_t}{Total\ Commercial\ Loans_t}$$

$$IntLoans_t = \log \left( \frac{Loans\ and\ Advances\ to\ Banks_t}{Loans\ and\ Advances\ to\ Banks_{t-1}} \right)$$

$$IntBorr_t = \log \left( \frac{Deposits\ from\ Banks_t}{Deposits\ from\ Banks_{t-1}} \right)$$

## 6.2 - Data

The analyzed data originates from the “Orbis bank focus” database (former Bankscope) and DataStream, both provided by the Financial Lab of University of Piraeus.

As a first step and having in mind that the research aimed at loan growth of the generic commercial sector, all the available Commercial, Cooperative and Real Estate and Mortgage Banks had been selected, over a period between 2002 and 2015. For the United States the available banks with respect to the above criteria was 13,555, while for the Euro Area 2,432 banks were available.

Thus, the first 1,000 banks downloaded with respect to their asset size as of the end of 2015. At this point, two important issues arose; the first one was the fact that in US data the Orbis database had figures only for 190 banks, of which 10 displayed both as a group and as individuals. Additionally, from the 180 remaining Banks, 28 eliminated as they did not have data on all model variables in any given analyzed year. Therefore, 152 individual entries (1,619 annual observations) have been used over the period between 2013 and 2015 with the smallest, median and biggest bank to have \$320, \$6,357, \$2,074,981 million on their Asset Size respectively.

The second issue was that the Orbis did not have data prior 2011 for the Euro Area Banks, as such, a compromise had to be made with limited data for Euro Area. With 85 banks had figures on all model variables for at least one year, which in turn limited the total annual observations to 216, while the analyzed period cover years between 2012 and 2015. In contrast to US Banks, Euro Area (in sample) Banks are bigger in terms of their Asset Size with the smallest, median and biggest Bank to have \$785, \$16,779 & \$2,655,067 million respectively.

### 6.3 – U.S. Analysis

Similarly, the results of (Bowman, et al., 2011) on Japanese Banks, US commercial banks' liquid assets have a negative and statistically important relationship ( $-0.05^{***}$ ) with the lending growth under normal economic conditions. That is, when a bank issues a new loan its liquid assets are reduced as they are either proportionally transformed in reserves at CB, in the form of reserves requirements or they are transferred to another bank as deposits (client's banks account). This relationship implies that under normal economic conditions banks do not hold non-interest bearing assets such as excess reserves or cash, and they try to transform them to loans or another interest-bearing asset.

Moreover, regarding the effectiveness of Quantitative Easing programs on Bank lending, two different panel regressions have been implemented, the first one incorporates a single interaction term between a dummy variable which has a value of 1 during QEs periods (2009-2014) and the (log) growth of Liquidity (Table 1.1). While, the second regression incorporated two discrete interaction terms between two time dummies and (log) growth of Liquidity (Table 1.2). The first DummyQE<sub>(2009-2011)</sub> has a value of 1 during the period between 2009 and 2011 and zero otherwise, while the second one DummyQE<sub>(2012-2014)</sub> has a value of 1 during the period between 2012 and 2014, the reasoning of this separation has to do with the different economic conditions between the first two rounds of US QEs and the third one, while the aggregate amount of the first two rounds is identical to the third one. Thus, alterations in QE effectiveness on lending growth during distressed and normalized economic conditions could be extracted. Results depict interesting evidences, the first model (Table 1.1) reveals that QEs in US had a positive yet relatively small effect on Bank Lending growth ( $0.02^{**}$ ), however the second regression (Table 1.2) with two different QE periods reveals that only the third QE program had a positive and significant effect ( $0.04^{***}$ ) on lending growth, while the first two rounds (2009-2011) had a positive yet insignificant effect (0.01) on lending growth. Given that, QE programs seems to be more effective in periods of normalized economic conditions, instead to distressed periods where QEs

mainly restore the functionality of financial markets rather than boost the Lending growth.

Moving on to Customer Deposits, as model results depict, lending growth is significantly driven by the growth of customer deposits (0.68\*\*\*) in US banks. That is, commercial banks in the US, to some great extent are used to issue loans when they are matched by additional deposits. However, as expected, the extra injected liquidity of QE programs reduced significantly (0.16\*\*\*) the effectiveness of Customer Deposits on Lending growth during the first two rounds of QEs in United States. During the third program the necessity for US banks to accompany new loans with new deposits was not significant (-0.09).

Another aspect of banks' lending growth is the equity ratio, that is the proportion of equity in total assets, results identify a significant positive relationship between equity ratio and lending increase (0.47\*) during only the first two rounds of QE in U.S where the economic conditions were still distressed. In contrast to Non-QE and QE3 (2012-2014) periods where the Equity ratio was an insignificant factor of lending growth for US Commercial Banks. In order to evaluate this alteration in significance of Equity ratio, it is essential to analyze how this ratio could be affected. On the one hand, the equity is mainly driven by the bank's profitability that is when the latter experience losses its equity ratio would decline also, in turn that means its capacity in issuing new loans will be decreased as well. While, on the other hand, total assets affected by the loans and financial assets are held in bank's portfolios. Given that, under distressed economic conditions only sounder banks (greater equity ratio) are able to issue new loans, while more leveraged banks facing difficulties to sustain if not increase their lending growth.

In addition to the above, another significant variable in lending growth is the ratio of non-performing loans, i.e. the proportion of non-performing loans in the total outstanding loans. Regressions identify a significant negative relation between NPL ratio and lending growth ( $-1.08^{***}$ ) under normal economic conditions. Which in turn means that when US banks face an increase in their NPLs ratio, their (new) lending capacity decreased as the reserves requirements for the NPLs are significantly higher than the performing loans, depleting thus their liquidity. However, the extra injected liquidity of QE programs gave incentives to Banks to issue additional loans in order to restore both their NPLs ratio and profitability, something which depicted in positive and significant coefficient of NPLs ratio ( $1.22^{***}$ ) during the period of the first two QE rounds in the United States.

Finally, the funding of lending growth presented in the interbank variables coefficients which as expected are significant under normal economic conditions, while during QE periods the extra injected liquidity reduce significantly their correlation with lending growth. As results depict, under normal economic conditions an increase in interbank loans will reduce the lending growth ( $-0.01^{**}$ ) as the “lender” bank will transfer its reserves at Central Bank to the “borrower” bank reducing thus reserves which could be used in issuance of new commercial loans. Similarly, banks borrow from each other usually in order to meet their reserves requirements, which could be increased by the issuance of additional loans, thus a positive and significant correlation between interbank borrowings and lending growth exists ( $0.04^{***}$ ). However, during the QE periods the extra reserves available to commercial banks by central bank reduce the significance of interbank market, although during the third round of QE in the United States a negative and significant coefficient between interbank borrowings and lending growth exists ( $-0.03^*$ ) as a consequence of banks decisions to use a relatively bigger proportion of the injected extra liquidity to reduce their interbank borrowings.

Concluding with the effectiveness of Assets Purchases Programs on Lending growth in the United States, results instruct a positive and significant effect on lending growth. In more details, even if these programs came as a countermeasure of general economic distress which is depicted in the significant increase of NPLs in US, were able primary to ease the conditions in interbank market and consequently to increase the lending to households and corporations. In turn this impose a successful implementation of QE programs in the United States, as they achieved their target, while should empirical evidences from other research considered, Fed by the end of 2014 had actually achieved its main target of restoration the economic growth.



| <b>TABLE 1.1</b>   |   |                       |                          |
|--|---|-----------------------|--------------------------|
| <b>Panel Regressions on U.S. Commercial Banks Data</b>   |   |                       |                          |
| <i>Model Type:</i>   | <i>Pooled OLS</i>                                       |                       |                          |
| <i>Years analyzed:</i>   | <i>2003,2004 ... up to 2015</i>                         |                       |                          |
| <i>Num. of Individual Banks</i>  | <i>152</i>  |                       |                          |
| <i>Observations Frequency</i>  | <i>Annual</i>   |                       |                          |
| <b>Dependent variable:</b>   | <b><math>\Delta\log(\text{Commercial.Loans})</math></b> |                       |                          |
| <b><i>Independent Variables</i></b>  | <b><i>Coefficient</i></b>                               | <b><i>P-Value</i></b> | <b><i>Std. Error</i></b> |
| constant   | 0.0316  | **                    | (0.0151)                 |
| DummyQE <sub>(2009-2014)</sub>   | -0.0597   | **                    | (0.0266)                 |
| $\Delta\log(\text{liquidity})$   | -0.0458   | ***                   | (0.0071)                 |
| DummyQE <sub>(2009-2014)</sub> * $\Delta\log(\text{liquidity})$  | 0.0203  | **                    | (0.0101)                 |
| $\Delta\log(\text{CustDep})$   | 0.6753  | ***                   | (0.028)                  |
| DummyQE <sub>(2009-2014)</sub> * $\Delta\log(\text{Custom.Deposits})$  | 0.0509  |                       | (0.0443)                 |
| Equity/TA  | 0.1290  |                       | (0.1323)                 |
| DummyQE <sub>(2009-2014)</sub> *Equity/TA  | 0.2957  |                       | (0.2172)                 |
| NPLs/Tot.Loans   | -1.0808   | ***                   | (0.366)                  |
| DummyQE <sub>(2009-2014)</sub> *NPLs/Tot.Loans   | 0.6897  | *                     | (0.4078)                 |
| $\Delta\log(\text{Interbank.Loans})$   | -0.0126   | **                    | (0.0051)                 |
| DummyQE <sub>(2009-2014)</sub> * $\Delta\log(\text{Interbank.Loans})$  | 0.0050  |                       | (0.0075)                 |
| $\Delta\log(\text{Interbank.Borrow})$  | 0.0359  | ***                   | (0.0062)                 |
| DummyQE <sub>(2009-2014)</sub> * $\Delta\log(\text{Interbank.Borrow})$   | -0.0257   | **                    | (0.0101)                 |
| <i>Adjusted R-squared</i>  | <i>0.4320</i>   |                       |                          |
| <i>Total Observations</i>  | <i>1.619</i>  |                       |                          |
| <i>P-Value / (Std. Error)</i>  | <i>0.0000</i>   | <i>***</i>            | <i>(0.1497)</i>          |
| <p><b><math>\Delta\log(\text{Commercial.Loans})</math></b> : y-o-y log growth of commercial loans, the term commercial loans refers to the summation of consumer, corporate and mortgage outstanding loans per bank.</p> <p><b><math>\Delta\log(\text{Liquidity})</math></b> : y-o-y log growth of liquid assets, the term liquidity refers to the summation of Cash &amp; Balances with C.B. and Financial Assets at their fair value minus the reserve requirements at C.B..</p> <p><b><math>\Delta\log(\text{Custom.Deposits})</math></b> : y-o-y log growth of customer deposits, consists of demand , saving, time and other customer deposits.</p> <p><b>Equity/TA</b> : equity ratio, i.e. equity over total assets as of the end of year.</p> <p><b>NPLs/Tot.Loans</b> : ratio of non-performing loans to customers and banks over total outstanding loans.</p> <p><b><math>\Delta\log(\text{Interbank.Loans})</math></b> : y-o-y log growth of loans and advances to other banks, consists of net loans and advances to banks plus reverse repos, securities borrowed and cash collateral.</p> <p><b><math>\Delta\log(\text{Interbank.Borrow})</math></b> : y-o-y log growth of other banks deposits, repurchase agreements, securities loaned and cash collateral.</p> <p><b>DummyQE<sub>(2009-2014)</sub></b> : dummy variable that takes the value (1) during the period between 2009 and 2014, otherwise its value is (0).</p> <p><b>DummyQE x Independent Variable</b> : interaction term between Dummy and the independent variable.</p> <p><b>Standard Error</b> of each coefficient are represented in parenthesis in the far right column of the table.</p> <p><b>***, **, *</b> denotes the statistical significance of each variable coefficient at the level of 1%, 5% and 10% respectively.</p> <p><b>Data</b> provided by Orbis database (former bankscope), at annual frequency.</p> |   |                       |                          |

| <b>TABLE 1.2</b>  |   |                       |                          |
|---|---|-----------------------|--------------------------|
| <b>Panel Regressions on U.S. Commercial Banks Data</b>  |   |                       |                          |
| <i>Model Type:</i>  | <i>Pooled OLS</i>                                       |                       |                          |
| <i>Years analyzed:</i>  | <i>2003,2004 ... up to 2015</i>                         |                       |                          |
| <i>Num. of Individual Banks</i>   | <i>152</i>  |                       |                          |
| <i>Observations Frequency</i>   | <i>Annual</i>   |                       |                          |
| <b>Dependent variable:</b>  | <b><math>\Delta\log(\text{Commercial.Loans})</math></b> |                       |                          |
| <b><i>Independent Variables</i></b>   | <b><i>Coefficient</i></b>                               | <b><i>P-Value</i></b> | <b><i>Std. Error</i></b> |
| constant  | 0.0316  | **                    | (0.015)                  |
| DummyQE <sub>(2009-2011)</sub>  | -0.1280   | ***                   | (0.0326)                 |
| DummyQE <sub>(2012-2014)</sub>  | 0.0190  |                       | (0.0365)                 |
| $\Delta\log(\text{liquidity})$  | -0.0458   | ***                   | (0.007)                  |
| DummyQE <sub>(2009-2011)</sub> * $\Delta\log(\text{liquidity})$   | 0.0082  |                       | (0.0114)                 |
| DummyQE <sub>(2012-2014)</sub> * $\Delta\log(\text{liquidity})$   | 0.0399  | ***                   | (0.0142)                 |
| $\Delta\log(\text{CustDep})$  | 0.6753  | ***                   | (0.0277)                 |
| DummyQE <sub>(2009-2011)</sub> * $\Delta\log(\text{Custom.Deposits})$   | 0.1590  | ***                   | (0.0524)                 |
| DummyQE <sub>(2012-2014)</sub> * $\Delta\log(\text{Custom.Deposits})$   | -0.0894   |                       | (0.0611)                 |
| Equity/TA   | 0.1290  |                       | (0.131)                  |
| DummyQE <sub>(2009-2011)</sub> *Equity/TA   | 0.4736  | *                     | (0.2586)                 |
| DummyQE <sub>(2012-2014)</sub> *Equity/TA   | -0.0848   |                       | (0.302)                  |
| NPLs/Tot.Loans  | -1.0808   | ***                   | (0.3622)                 |
| DummyQE <sub>(2009-2011)</sub> *NPLs/Tot.Loans  | 1.2153  | ***                   | (0.4319)                 |
| DummyQE <sub>(2012-2014)</sub> *NPLs/Tot.Loans  | 0.6666  |                       | (0.4816)                 |
| $\Delta\log(\text{Interbank.Loans})$  | -0.0126   | **                    | (0.005)                  |
| DummyQE <sub>(2009-2011)</sub> * $\Delta\log(\text{Interbank.Loans})$   | 0.0033  |                       | (0.0086)                 |
| DummyQE <sub>(2012-2014)</sub> * $\Delta\log(\text{Interbank.Loans})$   | -0.0019   |                       | (0.0103)                 |
| $\Delta\log(\text{Interbank.Borrow})$   | 0.0359  | ***                   | (0.0061)                 |
| DummyQE <sub>(2009-2011)</sub> * $\Delta\log(\text{Interbank.Borrow})$  | -0.0178   |                       | (0.0123)                 |
| DummyQE <sub>(2012-2014)</sub> * $\Delta\log(\text{Interbank.Borrow})$  | -0.0260   | *                     | (0.014)                  |
| <i>Adjusted R-squared</i>   |   | <i>0.4436</i>         |                          |
| <i>Observations</i>   |   | <i>1.619</i>          |                          |
| <i>P-Value</i>  | <i>0.0000</i>   | <i>***</i>            | <i>(0.1482)</i>          |
| <p><b><math>\Delta\log(\text{Commercial.Loans})</math></b> : y-o-y log growth of commercial loans.<br/> <b><math>\Delta\log(\text{Liquidity})</math></b> : y-o-y log growth of liquid assets.<br/> <b><math>\Delta\log(\text{Custom.Deposits})</math></b> : y-o-y log growth of customer deposits.<br/> <b>Equity/TA</b> : equity ratio, i.e. equity over total assets as of the end of year.<br/> <b>NPLs/Tot.Loans</b> : ratio of non-performing loans to customers and banks over total outstanding loans.<br/> <b><math>\Delta\log(\text{Interbank.Loans})</math></b> : y-o-y log growth of loans and advances to other.<br/> <b><math>\Delta\log(\text{Interbank.Borrow})</math></b> : y-o-y log growth of other banks deposits.<br/> <b>DummyQE<sub>(2009-2011)</sub></b> : dummy variable that takes the value (1) during the period between 2009 and 2011.<br/> <b>DummyQE<sub>(2012-2014)</sub></b> : dummy variable that takes the value (1) during the period between 2012 and 2014.</p> |   |                       |                          |
| <b>For Further information about the variables and the model, please see at Table 1.1 and Section 6.1</b>   |   |                       |                          |

## 6.4 – Euro Area Analysis

Before the analysis of the Euro Area results, it is essential to note the differences in banking sector between US and Euro Area. In the first place, Commercial Banks in Euro Area have a significantly different composition in their total assets (figure 2.7) than their US counterparts (figure 1.7). That is, commercial loans in Euro Area (in sample) Banks accounting for 34% of their total assets, which compared to the average proportion of 41% for commercial loans in US banks is significantly smaller. That difference mainly comes from the difference in credit market structure in Euro Area, which is highly driven by Banks' credit supply, instead to the US, where the credit market especially for corporations is outside the banking sector. In addition, Euro Area Banks are significantly bigger in term of Total Assets as they are involved in other sector such as corporate bonds as well.

Moving onto the Euro Area analysis, the restricted data that Orbis (former bankscope) database has before 2011 does not leave much room for a vis-a-vis analysis as the sample observations were only 216, which is considerably less compared to the 1,619 observations that the same Database has for the US Banks.

Departing, as in the case of US Banks, from the effect of liquid assets on lending growth, in Euro Area proved not to be a significant driver of lending growth either during the QE or not, in turn this implies that lending growth in EA Banks driven more by demand rather than liquidity availability, imposing thus that the extra liquidity injected by the QE does not have significantly affected lending growth.

Moreover, similarly to US Banks, banks in Euro Area under normal economic conditions match their additional loans with new customer deposits (0.55\*\*\*), although

as aforementioned the different decomposition of EA Banks assets decrease the effect of customer deposits in lending growth compared to the US Banks, as the former use part of these deposits for other uses. Additionally, as in the case of US Banks, this correlation diminished by the extra injected liquidity by the implementation of QE program.

In contrast to US banks, equity ratio for EA Banks and by that implied the soundness of EA Banks, did not have a significant relation with lending growth, in more details its coefficient is negative and statistically insignificant both during or not for QE. This came as a consequence of EA banks recapitalizations which took place in 2013, and by them EA banks were able to sale (as they could suffer the losses) their NPLs in order to restore the proper profitability and functionality in their loans portfolio. As the EA banks data reveals the NPLs ratio dropped from 16.25% in 2013 to 11.13% by the end of 2015.

Finally, interbank market (borrowing and lending) has a strong relation with lending growth under normal conditions, as banks funding their loan growth by exchanging reserves among themselves. However, relationship diminished during the QE period as extra liquidity removes the necessity for banks to search among themselves for additional reserves.

Concluding regarding the effectiveness of the QE programs in Euro Area, results do not provide evidence of any effectiveness in lending growth, instead it seems that QE affected other areas of Banks Balance Sheets such as the interbank transactions. Moreover, as recapitalizations of EA Banks took place in 2013, banks in Euro Area reduced their NPLs ratio by selling them, restoring thus the profitability ratio of their loans portfolio, although without replacing them with new commercial loans. Thus, considering its prime target, which was the increase in the availability of credit for households and enterprises, one might say that the QE in Euro Area did not achieve its goals.

However, it is strongly recommended a re-examination of Euro Area Banks data in the near future, where more data will become available for analysis.

| <b>TABLE 2.1</b>  |   |                |                   |
|---|---|----------------|-------------------|
| <b>Panel Regression on Euro Area Commercial Banks Data</b>  |   |                |                   |
| <i>Model Type:</i>  | <i>Pooled OLS</i>                                       |                |                   |
| <i>Years analyzed:</i>  | <i>2012, 2013, 2014, 2015</i>                           |                |                   |
| <i>Num. of Individual Banks</i>   | <i>85</i>   |                |                   |
| <i>Observations Frequency</i>   | <i>Annual</i>   |                |                   |
| <b>Dependent variable:</b>  | <b><math>\Delta\log(\text{Commercial.Loans})</math></b> |                |                   |
| <b>Independent Variables</b>  | <b>Coefficient</b>                                      | <b>P-Value</b> | <b>Std. Error</b> |
| constant  | -0.0148   |                | (0.0245)          |
| DummyQE <sub>(2015)</sub>   | 0.0199  |                | (0.0437)          |
| $\Delta\log(\text{liquidity})$  | -0.0001   |                | (0.0141)          |
| DummyQE <sub>(2015)</sub> * $\Delta\log(\text{liquidity})$  | 0.0294  |                | (0.0199)          |
| $\Delta\log(\text{CustDep})$  | 0.5516  | ***            | (0.0593)          |
| DummyQE <sub>(2015)</sub> * $\Delta\log(\text{Custom.Deposits})$  | -0.1528   | *              | (0.0841)          |
| Equity/TA   | -0.1329   |                | (0.2875)          |
| DummyQE <sub>(2015)</sub> * Equity/TA   | -0.4372   |                | (0.5135)          |
| NPLs/Tot.Loans  | -0.0354   |                | (0.0725)          |
| DummyQE <sub>(2015)</sub> * NPLs/Tot.Loans  | 0.0659  |                | (0.1178)          |
| $\Delta\log(\text{Interbank.Loans})$  | -0.0441   | **             | (0.021)           |
| DummyQE <sub>(2015)</sub> * $\Delta\log(\text{Interbank.Loans})$  | 0.0241  |                | (0.0301)          |
| $\Delta\log(\text{Interbank.Borrow})$   | 0.0397  | **             | (0.0156)          |
| DummyQE <sub>(2015)</sub> * $\Delta\log(\text{Interbank.Borrow})$   | 0.0224  |                | (0.0283)          |
| <i>Adjusted R-squared</i>   | <i>0.4709</i>   |                |                   |
| <i>Total Observations</i>   | <i>216</i>  |                |                   |
| <i>P-Value / (Std. Error)</i>   | <i>0.0000</i>   | <i>***</i>     | <i>(0.1176)</i>   |
| <p><b><math>\Delta\log(\text{Commercial.Loans})</math></b> : y-o-y log growth of commercial loans, the term commercial loans refers to the summation of consumer, corporate and mortgage outstanding loans per bank.</p> <p><b><math>\Delta\log(\text{Liquidity})</math></b> : y-o-y log growth of liquid assets, the term liquidity refers to the summation of Cash &amp; Balances with C.B. and Financial Assets at their fair value minus the reserve requirements at C.B..</p> <p><b><math>\Delta\log(\text{Custom.Deposits})</math></b> : y-o-y log growth of customer deposits, consists of demand , saving, time and other customer deposits.</p> <p><b>Equity/TA</b> : equity ratio, i.e. equity over total assets as of the end of year.</p> <p><b>NPLs/Tot.Loans</b> : ratio of non-performing loans to customers and banks over total outstanding loans.</p> <p><b><math>\Delta\log(\text{Interbank.Loans})</math></b> : y-o-y log growth of loans and advances to other banks, consists of net loans and advances to banks plus reverse repos, securities borrowed and cash collateral.</p> <p><b><math>\Delta\log(\text{Interbank.Borrow})</math></b> : y-o-y log growth of other banks deposits, repurchase agreements, securities loaned and cash collateral.</p> <p><b>DummyQE<sub>(2015)</sub></b> : dummy variable that takes the value (1) on 2015, otherwise its value is (0).</p> <p><b>DummyQE x Independent Variable</b> : interaction term between Dummy and the independent variable.</p> <p><b>Standard Error</b> of each coefficient are represented in parenthesis in the far right column of the table.</p> <p><b>***, **, *</b> denotes the statistical significance of each variable coefficient at the level of 1%, 5% and 10% respectively.</p> <p><b>Data</b> provided by Orbis database (former bankscope), at annual frequency.</p> |   |                |                   |

## Section 7 – Conclusion

We found that contrary to the first two Quantitative Easing Programs which were implied by the Fed primarily in order to help US commercial banks to restore their increased NPLs ratio and subsequently to ease the distress in the interbank sector. The third QE program in the United States, which had been implemented in a period of economic recovery, had strongly and positively affected the lending growth of commercial banks.

That said, QE programs in the US, supported in two-step the economic recovery which the Fed needed after the Lehman brothers collapse. As a first step, extra injected liquidity removed the uncertainty from the banking sector as the Central Bank became the prime lender to Commercial Banks, while in parallel the extra liquidity gave incentives to banks to sell or restructure their NPLs in order to restore their NPLs ratio and in general their loans portfolio profitability. As a second step the third QE program, which implemented during the recovery phase of banking sector, increased significantly the lending growth, supporting thus the economic recovery. Moreover, during all QE programs commercial banks used partially the extra liquidity to reduce their interbank borrowings, diffused it thus across all banking sector.

In contrast to the US QEs, the Asset Purchases Program adopted by ECB had limited, if any, effect on lending growth. However, as in the case of US banks, asset purchases programs provided liquidity to European Commercial Banks, enough to cancel the significance of interbank market during their implementation. While, Banks recapitalizations in 2013 helped Euro Area Banks decreasing their skyrocketed NPLs ratio by selling off NPLs. That said, the APP implemented by ECB mainly reduced the uncertainty in the banking sector, albeit without achieving its target of increase the lending.

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## Appendix

Figure 1.1 - U.S. Banks (Average Annual Liquid Assets)

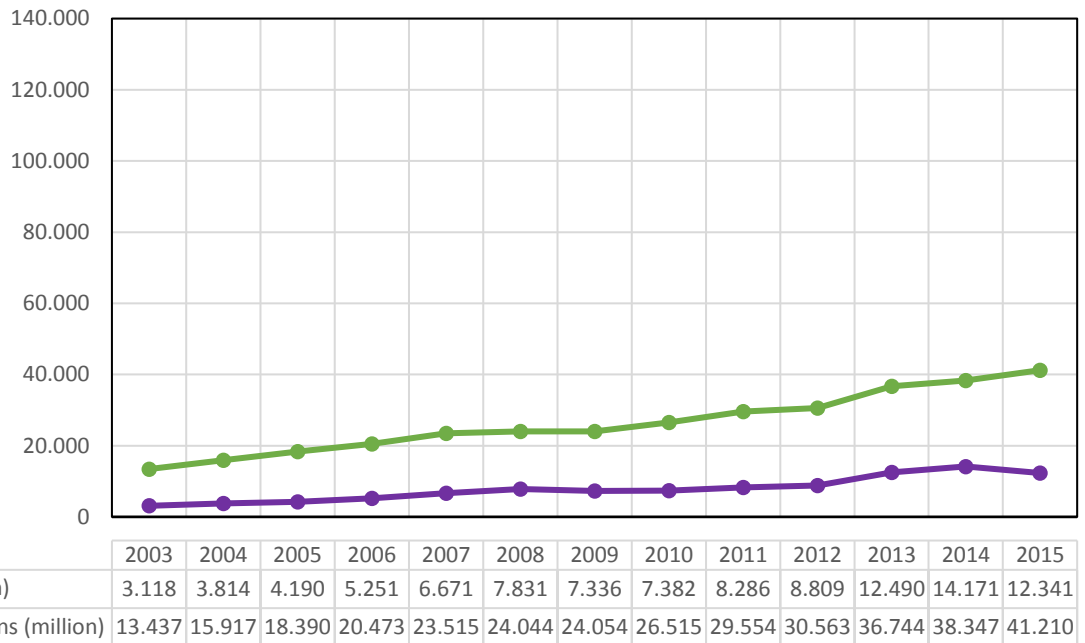


Figure 2.1 - E.A. Banks (Average Annual Liquid Assets)

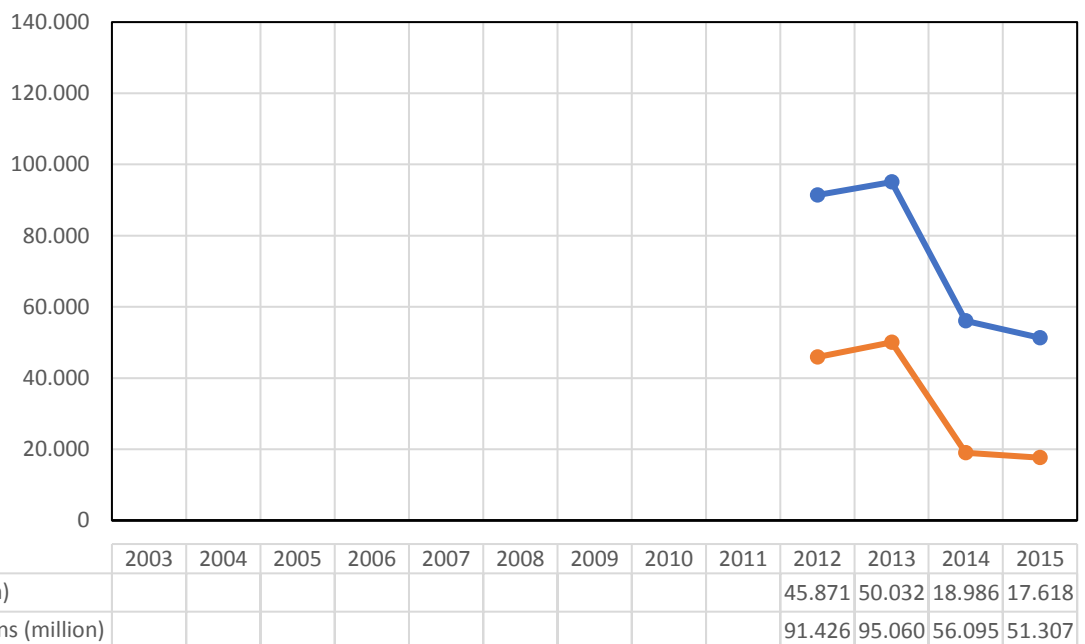
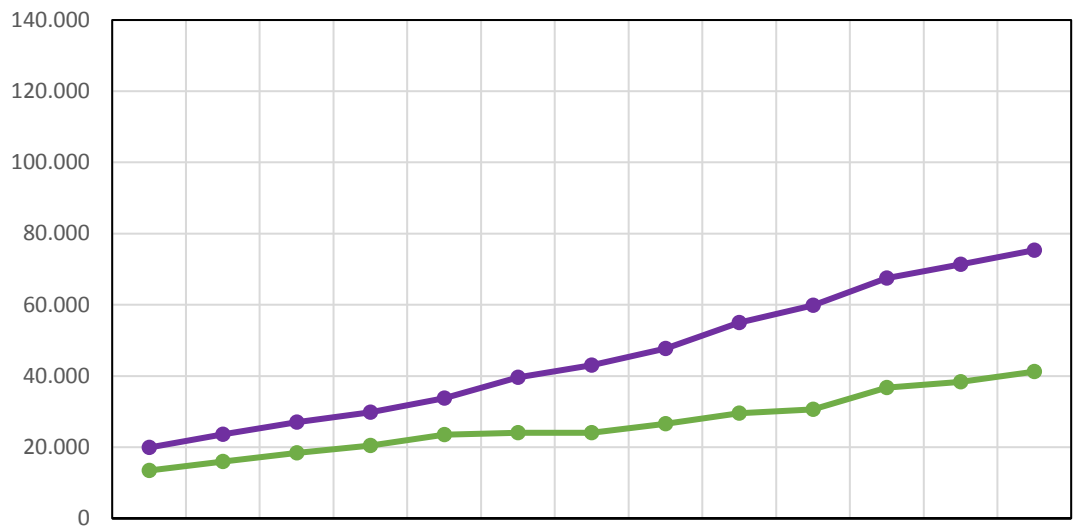
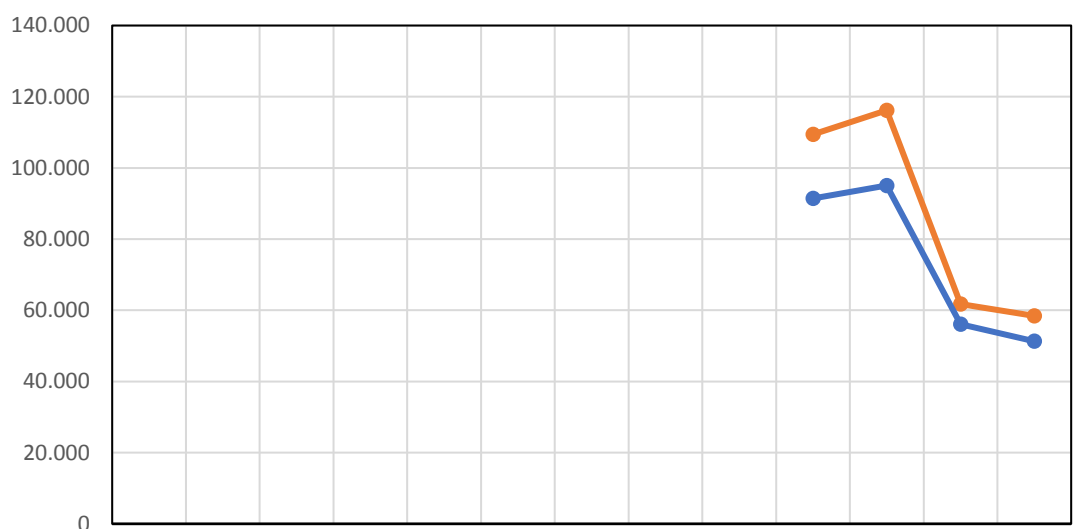


Figure 1.2 - U.S. Banks (Average Annual Customer Deposits)



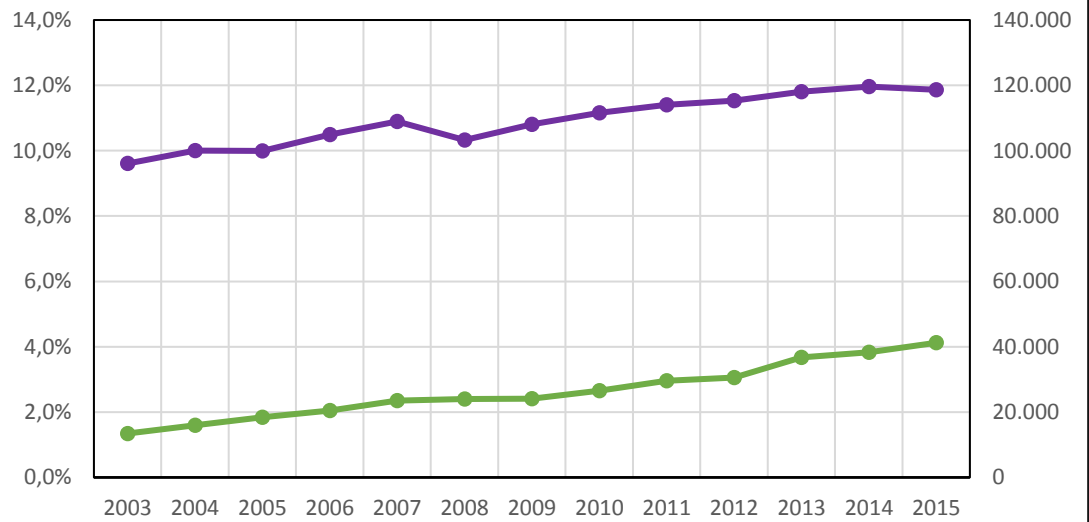
|                             | 2003   | 2004   | 2005   | 2006   | 2007   | 2008   | 2009   | 2010   | 2011   | 2012   | 2013   | 2014   | 2015   |
|-----------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| Customer Deposits (million) | 19.886 | 23.634 | 26.998 | 29.753 | 33.732 | 39.601 | 43.039 | 47.688 | 54.981 | 59.828 | 67.492 | 71.369 | 75.337 |
| Commercial Loans (million)  | 13.437 | 15.917 | 18.390 | 20.473 | 23.515 | 24.044 | 24.054 | 26.515 | 29.554 | 30.563 | 36.744 | 38.347 | 41.210 |

Figure 2.2 - E.A. Banks (Average Annual Customer Deposits)



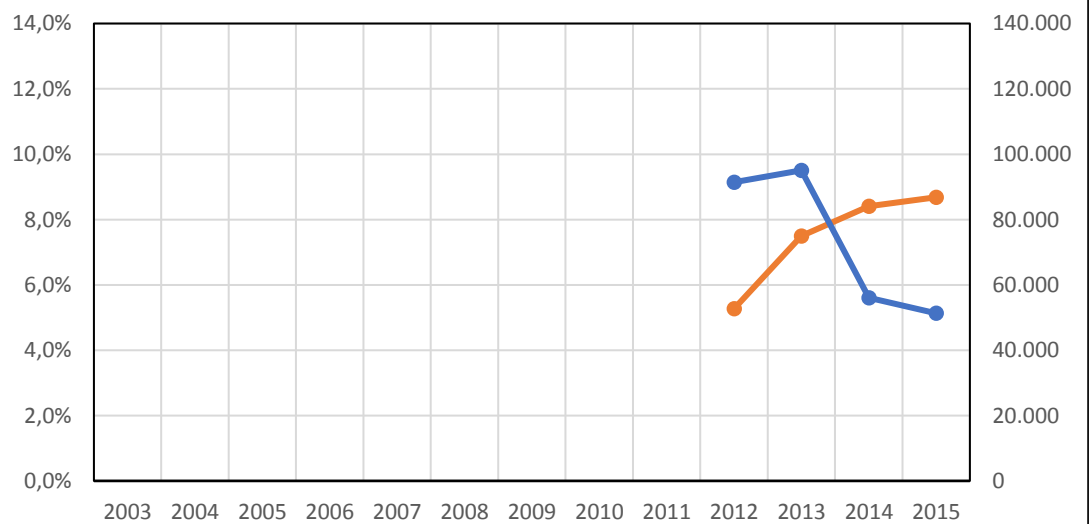
|                             | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012    | 2013    | 2014   | 2015   |
|-----------------------------|------|------|------|------|------|------|------|------|------|---------|---------|--------|--------|
| Customer Deposits (million) |      |      |      |      |      |      |      |      |      | 109.420 | 116.178 | 61.754 | 58.435 |
| Commercial Loans (million)  |      |      |      |      |      |      |      |      |      | 91.426  | 95.060  | 56.095 | 51.307 |

Figure 1.3 - U.S. Banks (Average Annual Equity Ratio)



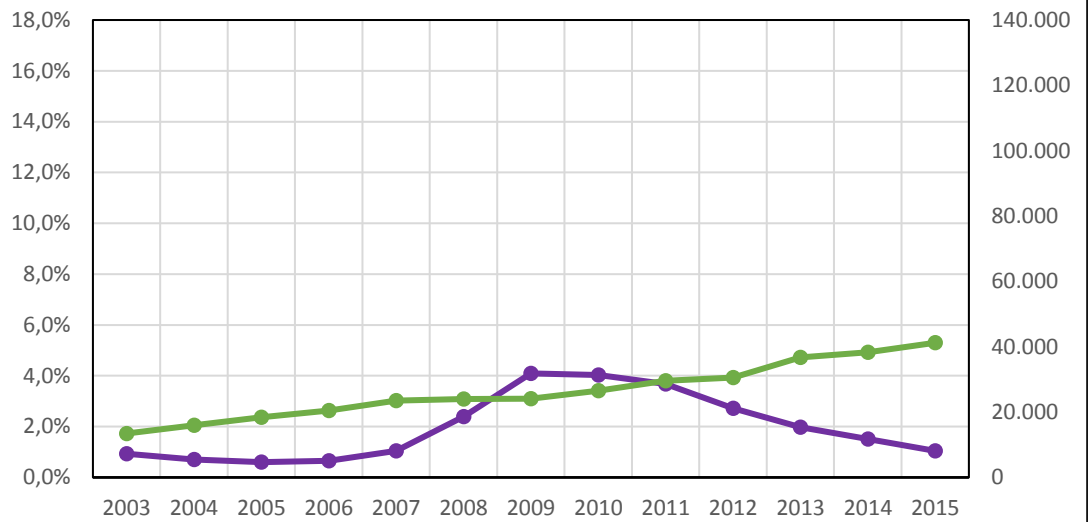
|                            |        |        |        |        |        |        |        |        |        |        |        |        |        |
|----------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| Equity/T.A. (%)            | 2003   | 2004   | 2005   | 2006   | 2007   | 2008   | 2009   | 2010   | 2011   | 2012   | 2013   | 2014   | 2015   |
| Commercial Loans (million) | 13.437 | 15.917 | 18.390 | 20.473 | 23.515 | 24.044 | 24.054 | 26.515 | 29.554 | 30.563 | 36.744 | 38.347 | 41.210 |

Figure 2.3 - E.A. Banks (Average Annual Equity Ratio)



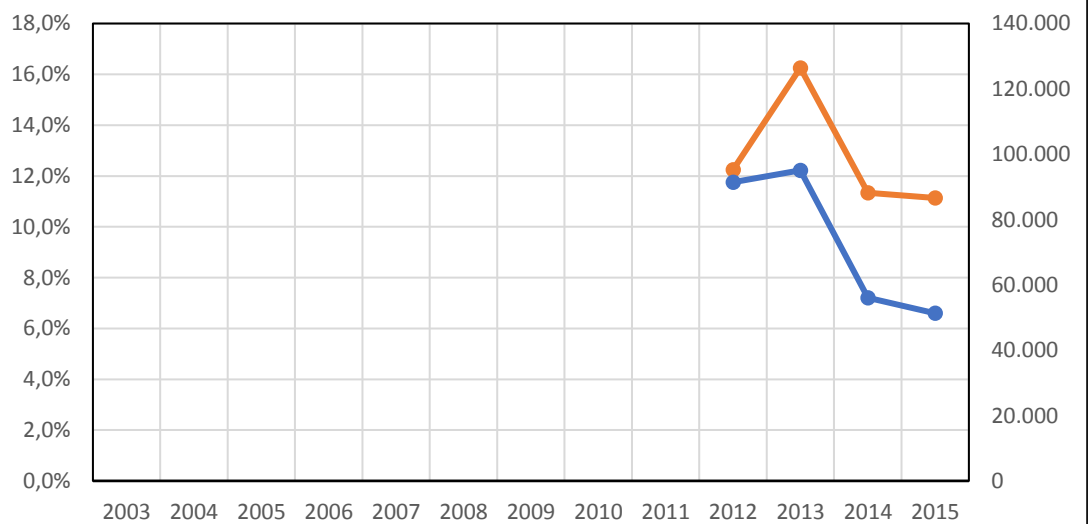
|                            |      |        |        |        |        |
|----------------------------|------|--------|--------|--------|--------|
| Equity/T.A. (%)            | 2011 | 2012   | 2013   | 2014   | 2015   |
| Commercial Loans (million) |      | 91.426 | 95.060 | 56.095 | 51.307 |

Figure 1.4 - U.S. Banks (Average Annual NPLs Ratio)



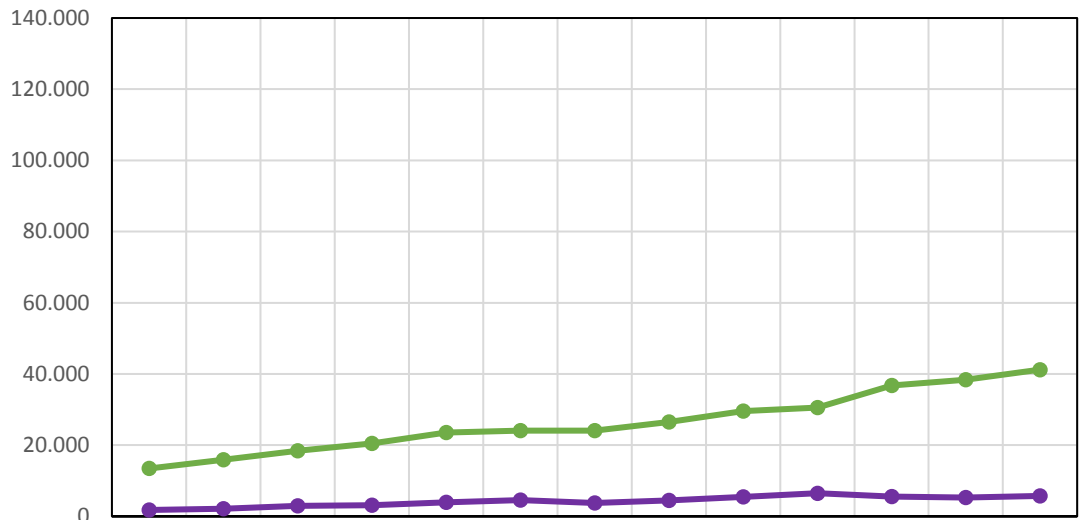
|                              | 2003   | 2004   | 2005   | 2006   | 2007   | 2008   | 2009   | 2010   | 2011   | 2012   | 2013   | 2014   | 2015   |
|------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| ● NPLs/Total Loans (%)       | 0,9%   | 0,7%   | 0,6%   | 0,7%   | 1,0%   | 2,4%   | 4,1%   | 4,0%   | 3,7%   | 2,7%   | 2,0%   | 1,5%   | 1,0%   |
| ● Commercial Loans (million) | 13.437 | 15.917 | 18.390 | 20.473 | 23.515 | 24.044 | 24.054 | 26.515 | 29.554 | 30.563 | 36.744 | 38.347 | 41.210 |

Figure 2.4 - E.A. Banks (Average Annual NPLs Ratio)



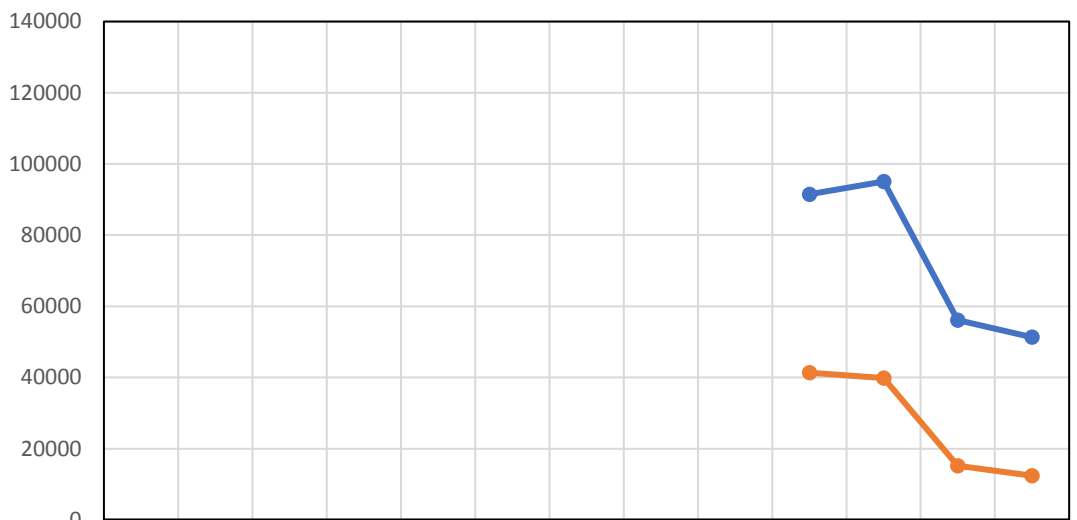
|                              | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013   | 2014   | 2015   |        |
|------------------------------|------|------|------|------|------|------|------|------|------|------|--------|--------|--------|--------|
| ● NPLs/Total Loans (%)       |      |      |      |      |      |      |      |      |      |      | 12,25% | 16,25% | 11,34% | 11,13% |
| ● Commercial Loans (million) |      |      |      |      |      |      |      |      |      |      | 91.426 | 95.060 | 56.095 | 51.307 |

Figure 1.5 - U.S. Banks (Average Annual Interbank Loans)



|                            | 2003   | 2004   | 2005   | 2006   | 2007   | 2008   | 2009   | 2010   | 2011   | 2012   | 2013   | 2014   | 2015   |
|----------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| Interbank Loans (million)  | 1.787  | 2.143  | 2.916  | 3.085  | 3.916  | 4.568  | 3.721  | 4.479  | 5.480  | 6.496  | 5.533  | 5.265  | 5.714  |
| Commercial Loans (million) | 13.437 | 15.917 | 18.390 | 20.473 | 23.515 | 24.044 | 24.054 | 26.515 | 29.554 | 30.563 | 36.744 | 38.347 | 41.210 |

Figure 2.5 - E.A. Banks (Average Annual Interbank Loans)



|                            | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012   | 2013   | 2014   | 2015   |
|----------------------------|------|------|------|------|------|------|------|------|------|--------|--------|--------|--------|
| Interbank Loans (million)  |      |      |      |      |      |      |      |      |      | 41.337 | 39.848 | 15.172 | 12.398 |
| Commercial Loans (million) |      |      |      |      |      |      |      |      |      | 91.426 | 95.060 | 56.095 | 51.307 |

Figure 1.6 - U.S. Banks (Average Annual Interbank Borrowings)

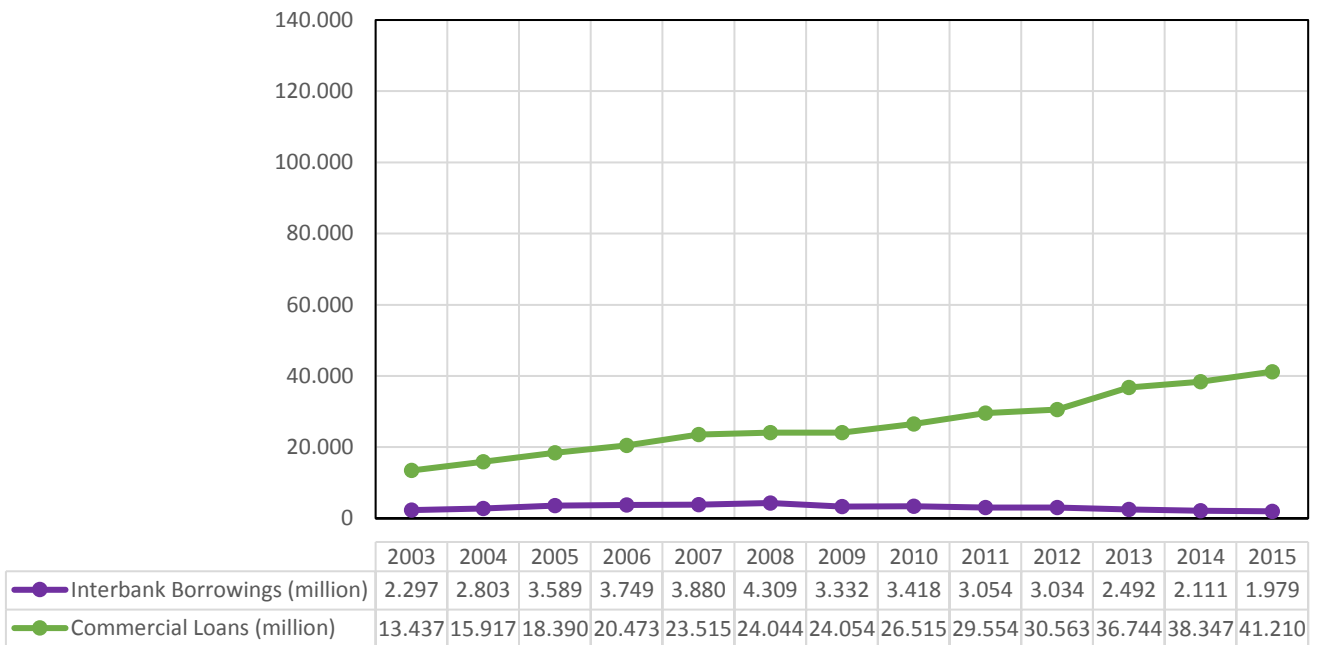


Figure 2.6 - E.A. Banks (Average Annual Interbank Borrowings)

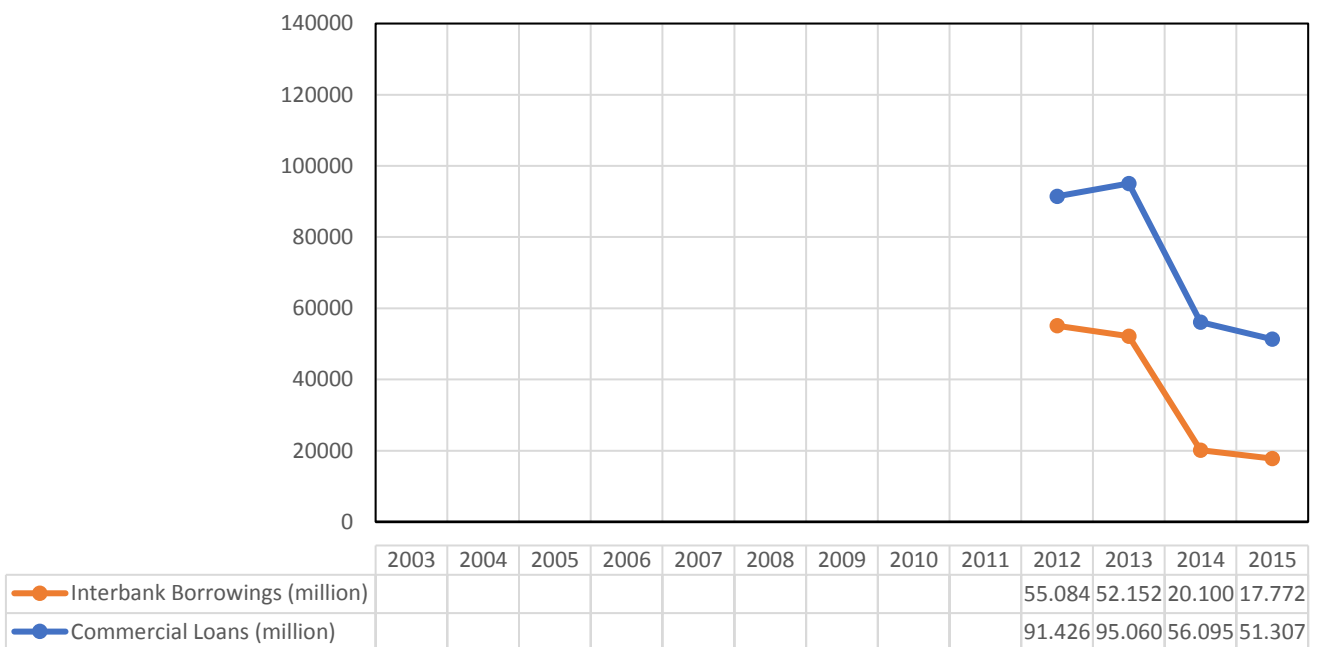
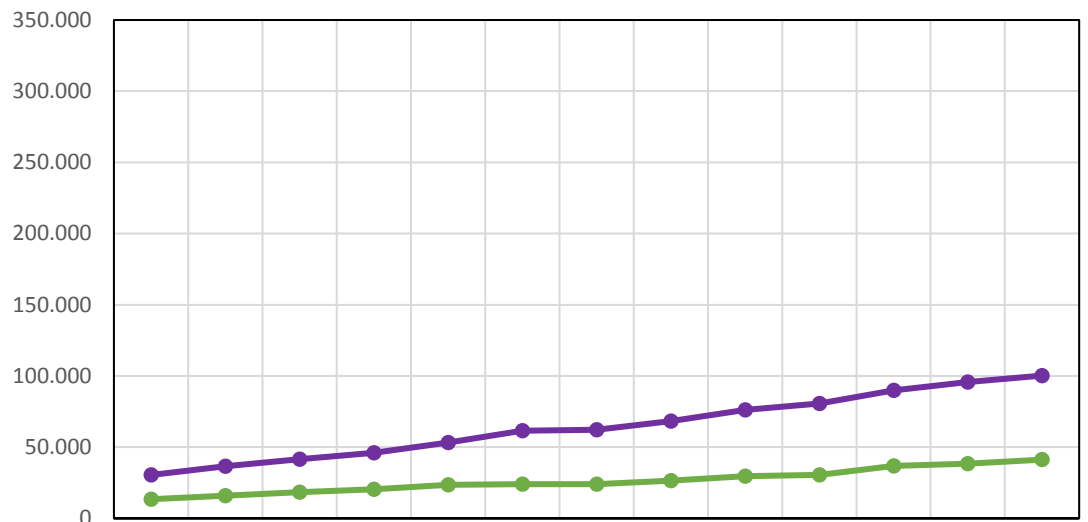
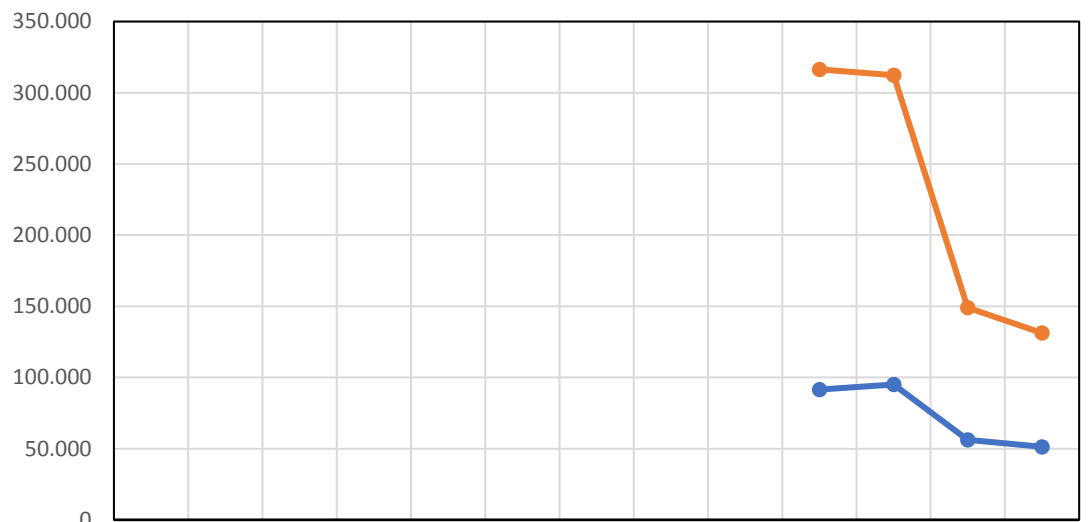


Figure 1.7 - U.S. Banks (Average Annual Total Assets)



|                              | 2003   | 2004   | 2005   | 2006   | 2007   | 2008   | 2009   | 2010   | 2011   | 2012   | 2013   | 2014   | 2015    |
|------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|---------|
| — Total Assets (million)     | 30.466 | 36.630 | 41.434 | 45.978 | 53.247 | 61.445 | 62.299 | 68.344 | 76.196 | 80.716 | 89.937 | 95.627 | 100.266 |
| — Commercial Loans (million) | 13.437 | 15.917 | 18.390 | 20.473 | 23.515 | 24.044 | 24.054 | 26.515 | 29.554 | 30.563 | 36.744 | 38.347 | 41.210  |

Figure 2.7 - E.A. Banks (Average Annual Total Assets)



|                              | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012    | 2013    | 2014    | 2015    |
|------------------------------|------|------|------|------|------|------|------|------|------|---------|---------|---------|---------|
| — Total Assets (million)     |      |      |      |      |      |      |      |      |      | 316.422 | 312.227 | 149.073 | 131.208 |
| — Commercial Loans (million) |      |      |      |      |      |      |      |      |      | 91.426  | 95.060  | 56.095  | 51.307  |