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International Business

Quantitative Easing and its Impact on Wealth Inequality

(Master's Thesis)

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Author's Declaration

Herewith I declare that I have written the Master's Thesis on my own and I have cited all sources.

Prague, 27th August 2016

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Author's Signature

Acknowledgements

I would like to thank Josef Taušer for his guidance and everyone who supported me in choosing this topic.

Abstract

The aim of this thesis is to show how the unconventional monetary policy rounds of Quantitative Easing introduced in the United States between 2008 and 2014 have led to an increase in wealth inequality. The need for the thesis arises due to the uncharted nature of QE and because of more and more information is surfacing to light which points to this connection. By analysing the distribution of these funds and adding it to the then base distribution of money supply, this study was able to determine a significant 10 % increase in the Gini Index. Furthermore it highlights how a large portion of wealth was transferred from the middle class over to the top 5 % income households. Starting from a set of assumptions the calculation is performed by extrapolating the data required and by isolating the system from any external variables. The result is a theoretical model meant to describe the mechanism that links Quantitative Easing to wealth inequality. Moreover a detailed comparison is provided with the effect of a conventional monetary policy such as Open-Market Operations. Finally solutions to this issue are being discussed from economical, political and fiscal standpoints.

Keywords

Quantitative Easing

Wealth Inequality

Income Inequality

Global Financial Crisis

Equity market

Conventional, Unconventional Monetary Policy

Mortgage Backed Securities

Short Term, Long Term Treasury Bonds

Gini Index

Extrapolation

Open-Market Operations

FED

Central Banks

Economy

Financial System

Stock Market

Bonds Market

Circulated, Uncirculated Funds

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List of Abbreviations (Figures, Graphs, Tables, etc.)

QE	Quantitative Easing
MBS	Mortgage-Backed Securities
ST TB	Short Term Treasury Bonds
LT TB	Long Term Treasury Bonds
OMO	Open Market Operations
PQE	People's Quantitative Easing
M4	An extended version of the Money Supply

Introduction

This topic is about showing the correlation between the implementation of Quantitative Easing, an unconventional monetary policy, and wealth inequality and how the former leads to increases in the latter.

Quantitative Easing has only been implemented on rare occasions but it is starting to be the “go-to” instrument used by western central banks in order to stabilise the economy during times of financial stress or post crisis. While it is efficient in the short run and it does achieve many of the central banks’ objectives, there is little known about its adverse effects and data is only now surfacing. For something so widely used in western societies it is important to know what long-term effects this may have.

This study will look at the mechanisms of QE and they lead to the increase of wealth inequality. The hypothesis is that Quantitative Easing has a significant effect in increasing wealth inequality, a lot more than a conventional monetary policy would. Furthermore the thesis presents a quantified value as to how severe this connection is. In terms of methodology, the study performs extrapolations of data from various sources, quantifies the injection of money, determines the distribution of the funds by income household percentiles and shows the relative and absolute change in wealth inequality.

1. Literature Review

1.1. Income Inequality – Wealth Inequality

In this section the paper will explain the concepts of Income Inequality, Wealth Inequality as well as the correlation between them. This section was introduced as a necessity in order to have the possibility to extract and understand the information from many of the previous studies related to this thesis as presented in this literature review. Basically many of them are concentrated on the notion of *Income Inequality* and without understanding the correlation between these terms, we would not be able to relate to the studies presented.

But why choose wealth inequality as the main discussion of this analysis when most studies are directed to income inequality? This will become clearer as the work progresses but basically Quantitative Easing tends to affect wealth to a much higher degree rather than income. The words of Hamilton Nolan (2015) say it rather well: “Income inequality is basically the staple indicator for “national discussions for class war” which doesn’t paint the whole picture and we instead should be focusing our attention to wealth inequality. The two are clearly correlated. It is only logical to assume that one who earns more is also wealthier, but this doesn’t mean that it is always true, even at a macroeconomic level.”

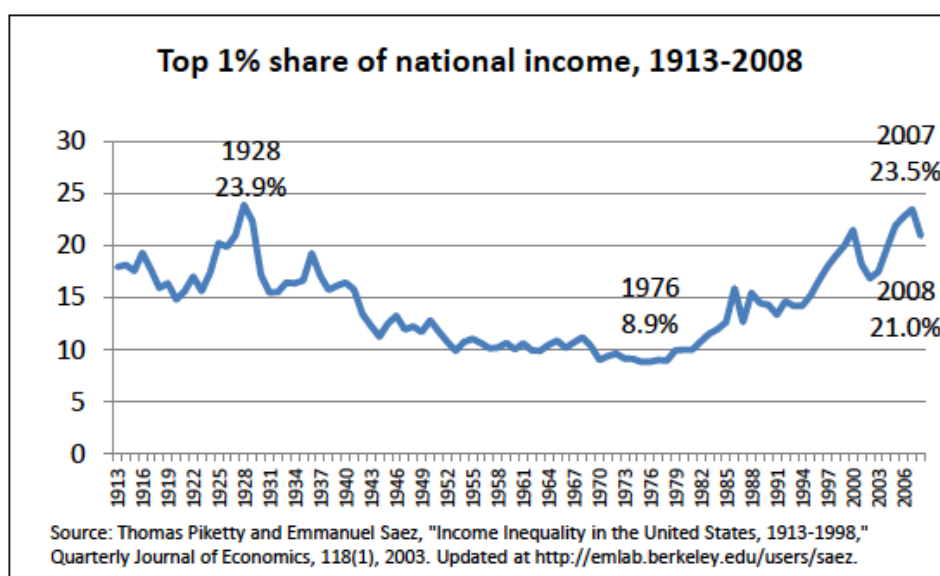
According to Inequality.org (2015): “Wealth inequality can be described as the unequal distribution of assets within a population.”

On the other hand Investopedia (2015) states that “Income inequality is the unequal distribution of household or individual income across the various participants in an economy”

We can already see there is a similarity between the 2 terms, but it has to be established the degree to which they are similar. Only if there is a strong correlation, will the aforementioned studies be relevant.

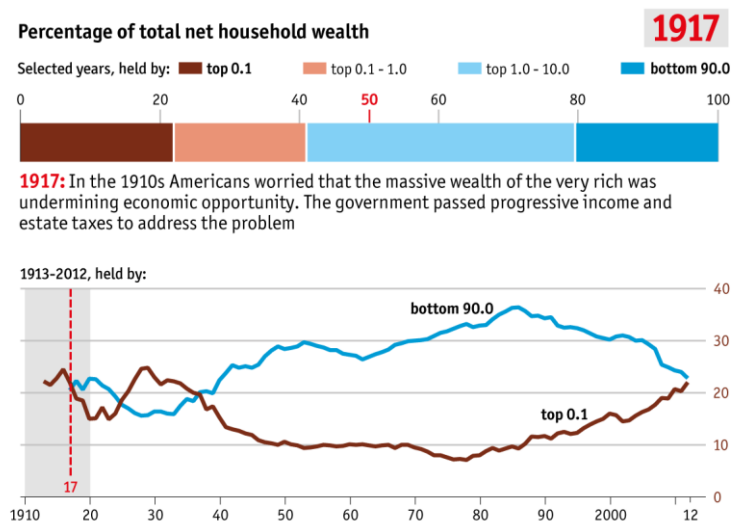
Example 1: We will now take a look at the graphical depiction of both notions as presented by Graph 1 and 2 shown below. Graph 1 shows the top 1%'s share of national income in the US while Graph 2, shows the percentage of total net household wealth specifically for the top 0.1 % and the bottom 90 %. If we look at the top 1% and the top 0.1 % in the two graphs we can see they both follow a very similar pattern throughout the entire period. In fact they look nearly identical.

Graph 1: Top 1% share of national Income 1913-2008



Source: Francis Menton, *The Cure for Income Inequality is Malaise* (2013)

Graph 2: Percentage of total household wealth

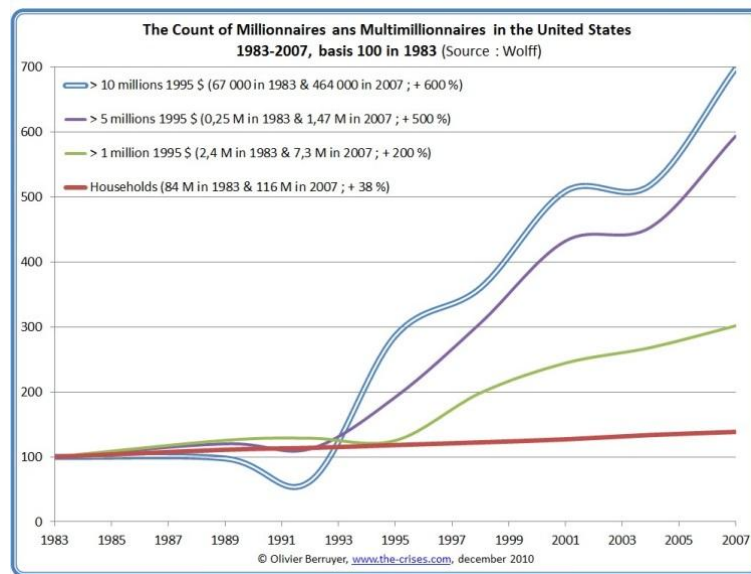


Source: The Economist, *Forget the 1%* (2014)

Example 2: Graph 3 is a depiction of the count of Millionaires and Multimillionaires in United States and their growth rate between 1983 and 2007 which are partitioned into four categories:

- > 10 millions
- > 5 millions
- > 1 million
- All other households

Graph 3: The Count of Millionaires and Multimillionaires in the United States 1983-2007, basis 100 in 1983

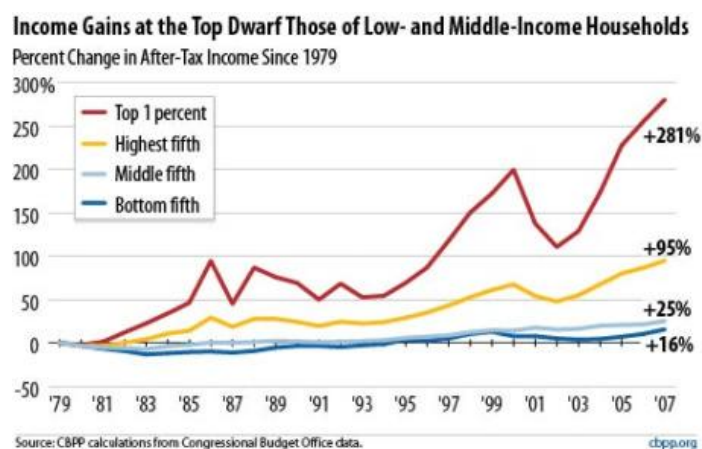


Source: Olivier Berruyer, *The Count of Millionaires and Multimillionaires in the United States 1983 – 2007, basis 100 in 1983*, (2010)

Graph 4 shows the growth rates of after-tax income in United States between 1979 and 2007 again partitioned into 4 categories:

- Top 1 %
- Top 20 %
- Segment between 40-60 %
- Bottom 20 %

Graph 4: Income Gains at the Top Dwarf Those of Low- and Middle-Income Households



Source: CBPP Calculations from Congressional Office Data (2010)

While it is very difficult to directly compare the graphs, we can see a lot of similarities. Looking at the fact that the population has been split between 4 categories and both are shown between 1983 and 2007. There are 2 periods to be discussed.

- Period A – 1983 to 1993.* This period doesn't show much correlation between income and wealth inequality. Firstly Income inequality (Graph 4) is more volatile and the categories don't seem to be centred towards the same values as wealth inequality (Graph 3). Secondly the 1st top elite categories from each Graph exhibit opposite reactions to the Market. The only similarity identified in this period is the absolute growth values which are closest to each other exactly at the beginning and end of Period A.
- Period B – 1993 – 2007.* This is the period I want to focus on. Firstly we can see that income as well as wealth inequality both start skyrocketing from the beginning of the period. Secondly if we take a look at the final growth percentages in 2007, by dividing the 1st category's growth rate by the 4th category's growth rate we get a coefficient of 15.78 for wealth inequality and 17.56 for income inequality during the entire period (A+B). The value 17.56 is only 11 % higher than 15.78 meaning they grew proportionately between category 1 and 4 almost identically.

Another figure that is important to this analysis is show in Table 1 below. We can see that inheritance accounted in average for 18.7 % of an individual's net worth back in 2007.

Table 1: Present Value of Wealth Transfers Received as a Percentage of Net Worth

<u>Category</u>	<u>2007</u>
All Households	18.7
<u>A. Income Level (1998\$)</u>	
Under \$15,000	42.8
\$15,000-\$24,999	36.6
\$25,000-\$49,999	28.1
\$50,000-\$74,999	16.5
\$75,000-\$99,999	19.4
\$100,000-\$249,999	19.1
\$250,000 or more	12.6

Source: U.S. Bureau of Labor Statistics, *Inheritance and the Distribution of Wealth or Whatever Happened to the Great Inheritance Boom?* (2010)

Clearly wealth inequality is a much more representative figure. This is not to say that income is unreliable, but wealth includes inheritance which plays a vital role as we can see (18.7 % in average per household). Any change in money supply and / or value of money has a clear effect on the entire wealth of an individual and not just on income. This is why wealth was chosen as the main basis for comparison.

Conclusion: There is a clear, strong correlation between wealth inequality and income inequality, as it was expected. Although there are factors (including, but not limited to inheritance) that lead to differences in growth rates, these 2 terms are strongly interconnected. Judging simply by the values mentioned in the previous table there is a 0.813 correlation between Income and wealth inequality. If the former increases by 10 %, the latter increases by 8.13 %. Therefore studies relating to income inequality can now be used in order to draw the parallel between the effects of Quantitative Easing and wealth inequality.

1.2. Income Inequality Metrics

We will now define some of the metrics that are used to measuring wealth inequality. In order to quantify the effect of QE on wealth inequality that number has to be expressed somehow. Unfortunately there are a lot of measurements of income or wealth inequality and choosing the right one is important for a number of reasons:

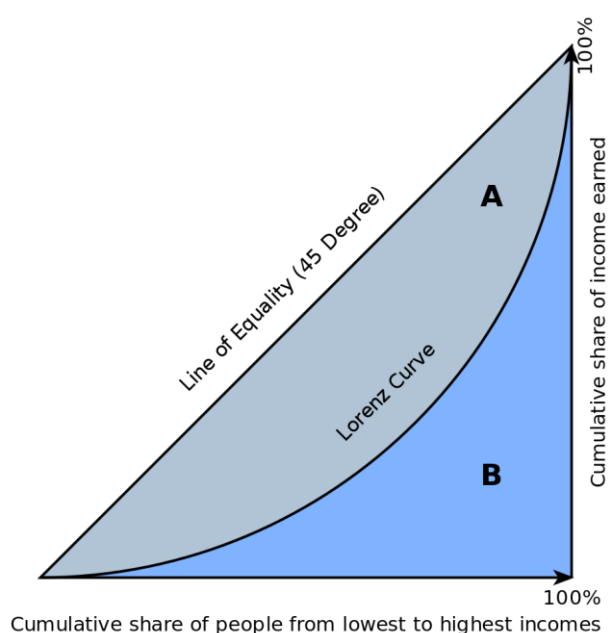
- It will determine the complexity of the thesis. Each metric's formula ranges from simple, to highly complex. Keeping in mind that a lot of the data that we need use is either incomplete or unavailable, complicating the work could even lead to a failure to complete the study it is wise to keep thing simple. However it is imperative to keep the data as accurate and representative as possible.
- It will determine the structure of the thesis. The study basically revolves around calculating changes in this particular variable. While many steps are independent of the choice of metric, this cannot be said for maybe half of them.
- It will determine the end result. The result is dependent upon the chosen method of measurement in not only the way it is expressed but also the actual final effect will vary. While all formulas are mathematically correct, they simply represent different data in different ways.

The most widespread metric for measuring Income Inequality is the **Gini Index**. According to Investopedia (2016) “the Gini Coefficient is a measurement of the income distribution of a country's residents. This number, which ranges between 0 and 1 is based on residents' net income, helps define the gap between the rich and the poor, with 0 representing perfect equality and 1 representing perfect inequality. It is typically expressed as a percentage, referred to as the Gini Coefficient. On the other hand the Gini index is a value between 0 and 100 and is a result of multiplying the Gini Coefficient by 100.

Typically it is represented by the area between the Lorenz Curve and a line of equality, as shown in the following Graph. The Lorenz curve is a relatively simple concept as it shows

what percentage of a nation's wealth is owned by a percentage of a nation's population. The Gini Coefficient is represented by the gray area A in the following graph. According to Investopedia, both the Lorenz Curve and the Gini Coefficient "can be altered to show wealth inequality, although it is more difficult to measure than income."

Graph 5: Gini Index and the Lorenz Curve



Source: Wikipedia, *Gini Coefficient* (2016)

The Gini Coefficient is not a perfect measurement though as it is only as accurate as macroeconomic statistics can be and it doesn't include shadow economies and informal economic activity. This is especially true for developing countries but fortunately, data relating to the US market, a highly developed economy should be very accurate.

Another measurement of inequality is the **20:20 Ratio**. This basically compares the wealth of the top 20 % of the population with the bottom 20 %. While this does offer some information but isn't as accurate as the Gini Coefficient. For example it doesn't accurately represent Area

A from the Graph, at it can be skewed in either direction (i.e. for the same 20:20 ratio the Gini Coefficient could be different).

Thirdly there is the **Hoover Index** which represents the amount of wealth which would need to be redistributed in order to achieve a state of perfect equality and is represented by a value between 0 (equality) and 1 (inequality). This should be equal to the Gini Coefficient. The most notable difference between them actually is usage. Because of how scarce data regarding QE actually is, it would be wise to choose a common metric. The more that can be used, the more accurate the final calculation will be as well.

Another measurement is the **Palma Ratio** which is defined as the ratio between the top 10 % of the population and the bottom 40 %. The values are chosen as they are because of the fact, according to Gabriel Palma, the middle class represents roughly 50 % of the income while the other half is split divided between the other two selected classes. It is a much more realistic approach to the 20:20 Ratio and is said to be more representative than the Gini Coefficient as it shows rather accurate trends. However this is not a great choice for our study because of the complexity involved. If we are to split the population by income into equal percentiles later on we will encounter a lot of difficulties. Furthermore it seems that this ratio is not being used to often and sources could be lacking.

To continue the next metric that can be used is the **Coefficient of Variation**. It is calculated by calculating the square root of the variance of incomes which is then divided by the mean income. It is a great metric for statistical analysis however it would elevate our study to a level of complexity which is simply not wanted. Furthermore it also lacks sufficient sources, making it unsuitable.

Finally there is the **Theil index**. This one is a little different compared to the others. An index of 0 indicates perfect equality, but an index value of 1 is equal to a distribution of 82:18. This is by far the most complex on the list and for this reason there is no point in getting into details, since it will not be used.

This thesis will conduct the analysis using the Gini Coefficient or to be more precise the **Gini Index**. While it is not as complex and descriptive as something like the Palma Ratio, it does offer sufficient detail (especially concerning a developed country such as the United States)

and considering the data that will be used for calculating the impact of Quantitative Easing on wealth inequality it is perhaps better to simplify things in order to not overcomplicate the study.

The Gini coefficient for United States is rather elusive. First of all there are no concrete values compiled for recent years, so we will have to extrapolate the value using technical analysis. Moreover the data is conflictive, according to the source used. Each of the sources, together with their corresponding data will be analysed in order to figure out the correct one to be used as a base for comparison.

1.3. Conventional Monetary Policies

According to Hurst (2007, p. 31) there are 9 primary causes that created and sustained the development of wealth inequality:

- *Monetary policy*
- Financial resources
- Money allocation
- Higher rate of savings hence asset accumulation by the wealthy
- Higher rate of return to assets owned by the wealthy
- Lower credit costs and credit constraints for the wealthy
- Inflation
- Tax policy
- Decline in unionisation

This thesis is focused on the first factor only. While others may be affected indirectly by the implementation of Quantitative Easing rounds, they are not being specifically targeted by this study.

According to Investopedia (2015) there are 3 conventional monetary policy tools that are used by Central Banks:

- Open-market operations – Central Bank buys or sells government assets (i.e. treasury bonds) in order to change the monetary base
- Setting the Discount Rate – directly affects money supply by altering the discount rate other banks can borrow / lend at
- Setting reserve requirements – changing the proportion of liquid asset reserves to loans has a direct impact on how much banks can loan.

All these tools use money supply as a means of regulating the market. According to Pragyandeepa Money (2015) there are 6 main objectives of monetary policy:

- Neutrality of money
- Stability of exchange rates
- Price stability
- Full employment
- Economic Growth
- Equilibrium in Balance of Payments

Reducing wealth inequality was never a concern for Central Banks although many of these objectives more or less affect it in different ways in an indirect manner.

Open-market Operations are will be used as a reference when showing the effects of Quantitative Easing because they present the most similarities as oppose to the other 2 conventional monetary policies and thus it is important to understand how this tool is being used. More specifically, we will look at how they are used in United States.

According to Federal Reserve Online (2016) “The Federal Reserve is the Central Bank of the US. Its unique structure includes

- A Federal Government Agency, the Board of Directors in Washington D.C. and

- 12 Regional Reserve Banks”

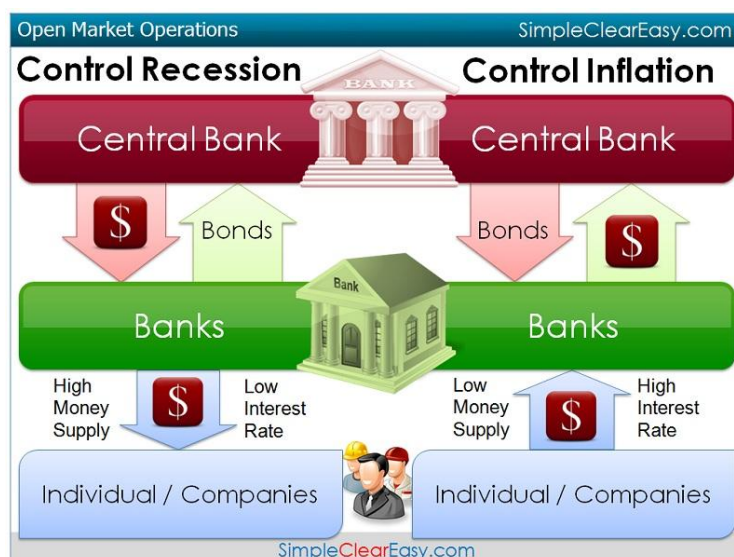
According to Kesavan Balasubramaniam from Investopedia (2016) “a Committee (FOMC) is comprised of the Board of Governors and five reserve-bank presidents, and it meets eight times throughout the year to increase or decrease the money supply within the economy.”

As most other Central Banks, the FOMC uses open market operations for this purpose. What this basically means is that the Committee buys or sells securities comprised of:

- Treasury Bills
- Bonds
- Notes

The mechanism is as follows: If the FOMC decides to increase Money Supply it will purchase government bonds from banks. This increase in liquidity allows the banks to lend more, leading to a decrease in interest rates. Borrowers will acquire additional funds due to the reduced interest rate and will increase consumer spending and investment. This stimulates the economy and increases economic growth. If the FOMC decides to decrease Money Supply it will decide to sell securities to banks, effectively retaining a portion of the available funds which would be kept as reserves. In contrast this leads to less lending due to higher interest rates and in consequence lower consumer spending and investments and thus a slowdown in economic growth. Image 1 shows a short summary of the mechanism:

Image 1: Open-Market Operations

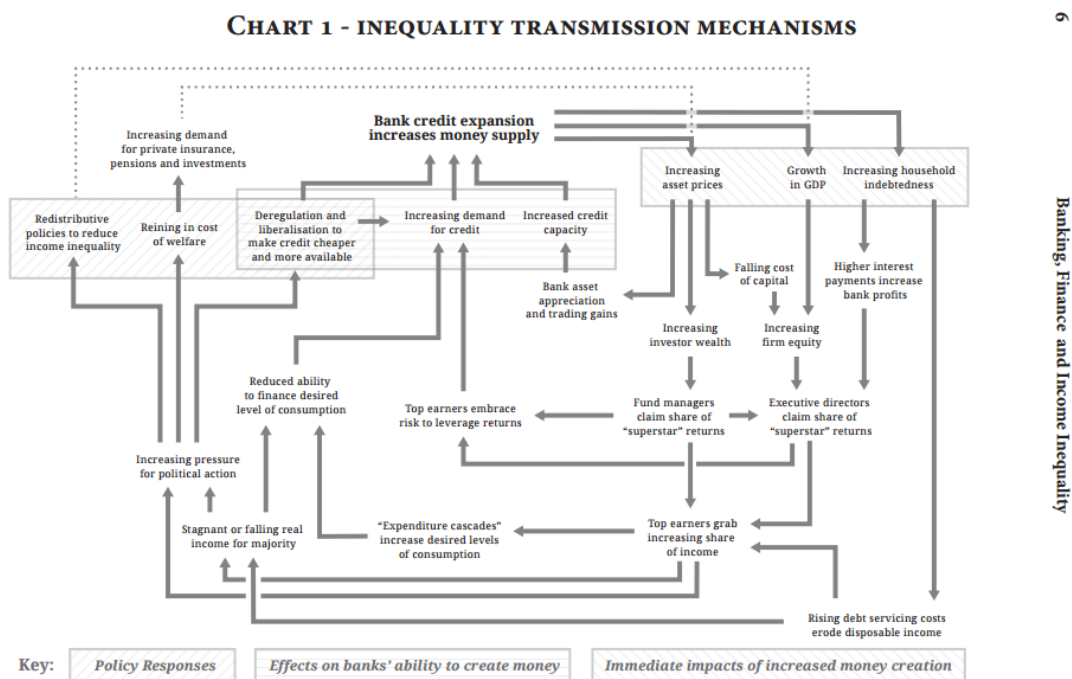


Source: “Open Market Operations” from AP Monetary Policy website

1.4. Conventional Monetary Policies and Income Inequality

There is a point that needs to be made in regards to open-market operations which is important in understanding a starting point for drawing the parallel between Quantitative Easing and wealth inequality. Graham Hodgson, in his work “Banking, Finance and Income Inequality” (2013, p. 6-11) basically shows how open-market operations are perpetually indirectly increasing wealth inequality. He created a chart showing the inequality transmission mechanisms (see Chart 1 below)

Chart 1: Inequality Transmission Mechanisms



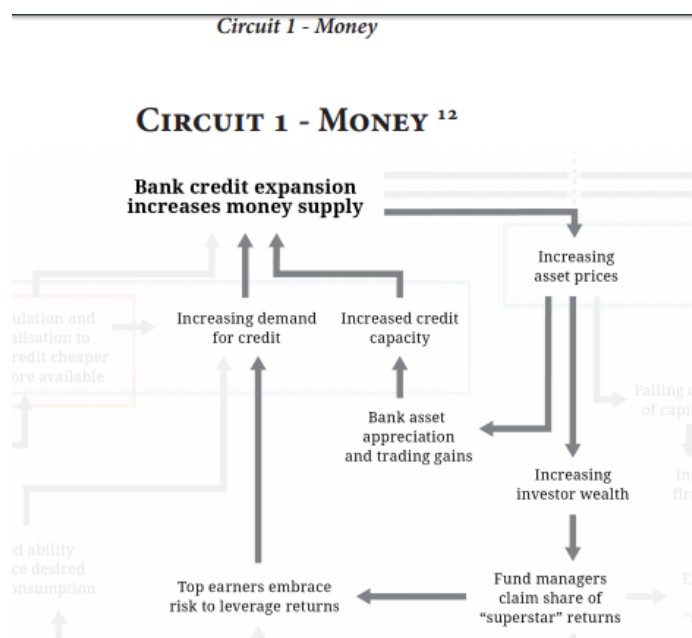
Source: Graham Hodgson, “Banking Finance and Income Inequality”, published by Positive Money, 2013

We will break down Chart 1 into 2 circuits and 2 linkages. Chart 2 represents the first circuit, money. According to Graham Hodgson’s study the main driver of this circuit is the injection of funds into financial assets and housing markets, increasing the prices on these markets. The main sources of these funds are:

- Existing money diverted from the market for goods and services
- *New money created by banks, lent for the purchase of these assets*

Because of the rise in asset prices (and thus wealth) the investors are persuaded to attribute increased amounts to those managing these assets as reward. In this inflationary period the managers’ incomes surge considerably more than others’.

Chart 2: Circuit 1 - Money



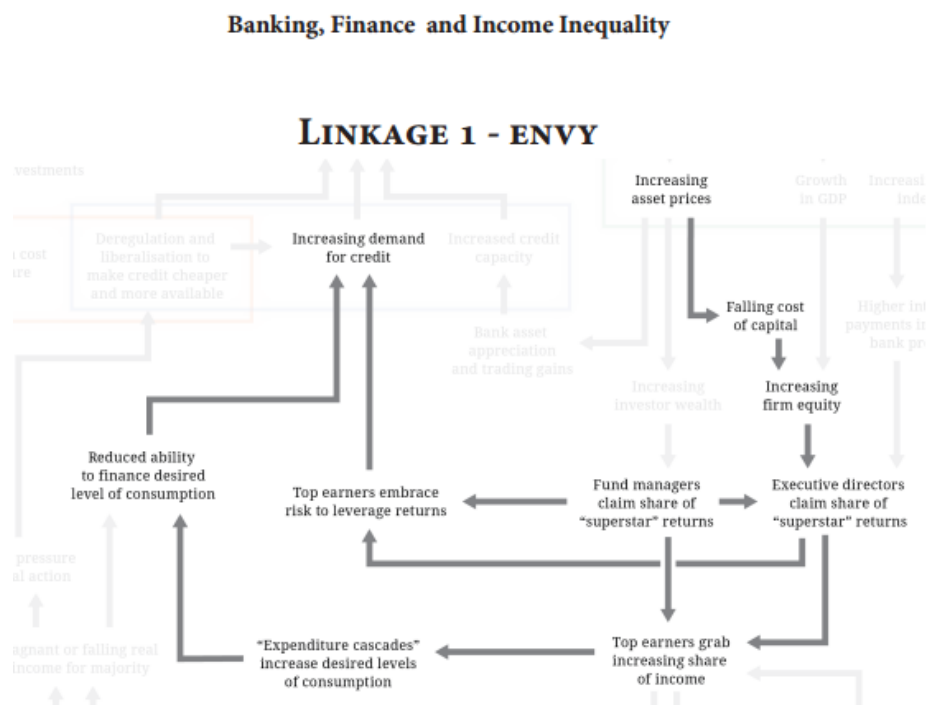
Source: Graham Hodgson, “Banking Finance and Income Inequality”, published by Positive Money, 2013

Moreover speculating on these assets is very tempting and banks are more than eager to lend and accept the purchase of the asset as a security. This coupled with the rise in prices increases their capital base and will allow them to provide even more credit.

This leads to investments funds (pooled from borrowed money) promising consistently higher returns and a motivation for the managers of these funds to be rewarded accordingly.

Chart 3 shows the Envy linkage which follows the Money circuit. To follow up, these high returns on corporate investment, whose large portion is paid to these investment managers, can be subsequently leveraged by borrowing, rather than issuing new stock. This increases the value of current stocks (including the manager's percentage). Other people see or hear about these success stories and wish to be like them, to share their lifestyles. This leads to, as Hodgson calls it, "expenditure cascades" and as they flow throughout society, inevitably a portion will have to resort to borrowing, repeating the cycle.

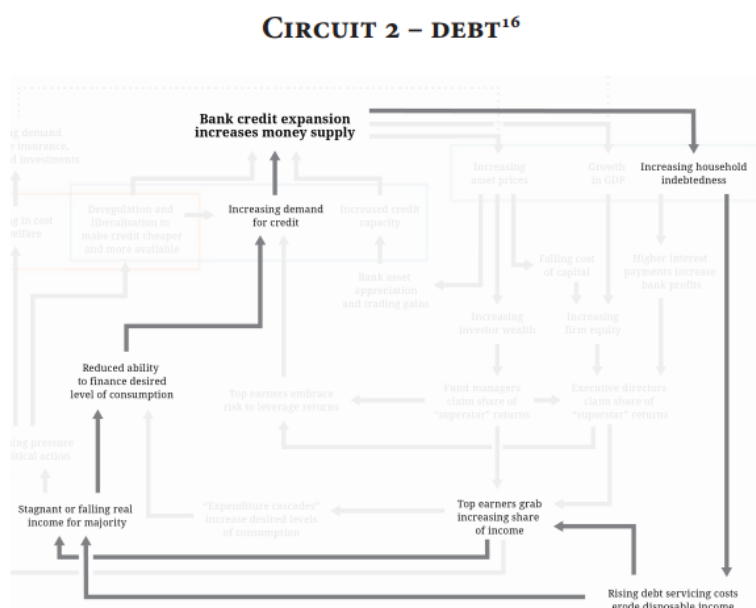
Chart 3: Linkage 1 - Envy



Source: Graham Hodgson, “Banking Finance and Income Inequality”, published by Positive Money, 2013

Chart 4 shows the Debt cycle. Since the extremely rich are now holding a larger part of the wealth, there is less available for the rest and the poorer population’s real income starts to stagnate or even worse. They become indebted and even though most of these interests retained by banks are transferred over to owners of deposits, a small part is retained in the form of loan interest and charges, which subsequently gets transferred to its staff, including high level executives, through stocks and dividends, which in turn are again managed by fund managers.

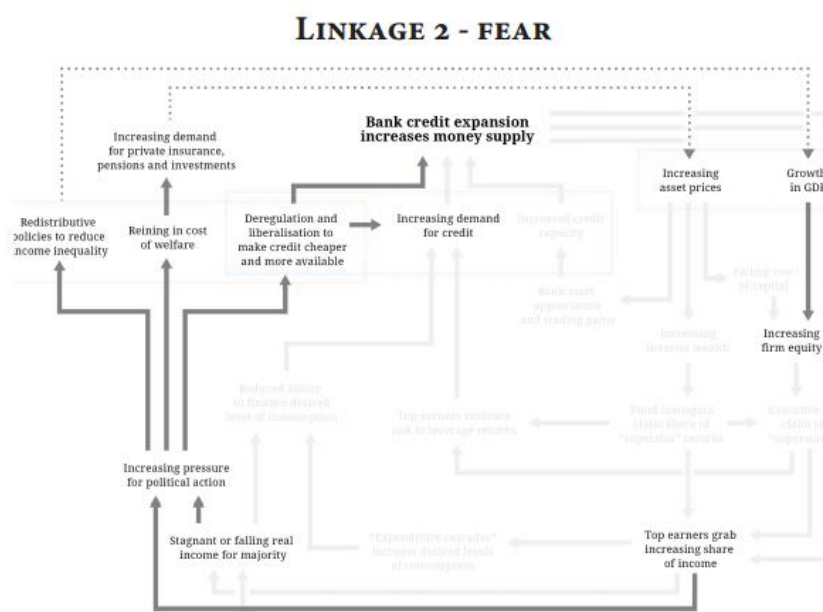
Chart 4: Circuit 2 - Debt



Source: Graham Hodgson, “Banking Finance and Income Inequality”, published by Positive Money, 2013

Chart 5 shows the last linkage, Fear. This explains subsequent behaviour based on everything stated before. Basically the rich wish to retain their lifestyle and are being conservative and careful about their choices while the rest call for action on this issue, realising that they cannot achieve a prosperous lifestyle by continuing this way. Because the rich have a higher influence in this matter (i.e. through lobbying) they can persuade policy makers to push for policies which on the surface seem to help shorten the wealth gap, but actually only strengthen it (such as making borrowing cheaper and easier).

Chart 5: Linkage 2 - Fear



Source: Graham Hodgson, "Banking Finance and Income Inequality", published by Positive Money, 2013

The mechanism presented above shows how open-market operations consistently increase wealth inequality and how this outcome is achieved. One part of the thesis will consist in showing what the effects of the QE funds on wealth inequality would be if they would have been injected using conventional open-market operations instead of QE. However, this entire process will be simplified as much as possible. Incorporating Graham Hodgson's work (the

one described above) would simply be too complicated and instead we will extrapolate a distribution of OMO funds which will be used to calculate the change in the Gini Index. Even if we would be able to implement his theory, it would not amount to any significant difference in the result because OMO's effect on income and wealth inequality should be minimal.

1.5. Unconventional Monetary Policies

Let's take a look at unconventional monetary policy tools. It is first important to understand why they are being implemented in the first place.

According to Investopedia (2015) when an economy enters a period of deep recession the following effects can be noticed:

- Interest rates are effectively zero which negates setting lower bank reserve requirements as a monetary policy tool due to the risk of default
- Such low interest rates prevent people from investing and they simply collect money without spending. This only contributes to deepening the crisis.
- At this moment a Central Bank would normally engage in open-market operations, but during a crisis, Government securities "become bid up due to their perceived safety" and they become less effective.

The Economic Journal 122 (2012) provides the following reasons for the ineffectiveness of conventional monetary policies in the aftermath of the 2008 Global Financial Crisis

- Zero lower bound on nominal interest rates – due to the depth of the crisis, the Taylor Rules (a monetary policy which states that for each 1% increase in inflation, the Central Bank should raise the nominal interest rate by more than 1%) would recommend, in many countries, negative nominal interest rates but "interest rates are

effectively bounded by 0 [...] because agents can always hold non-interest bearing cash”.

- Unreliable relationship between changes of interest rates and actual market interest rates due to the situation large banks found themselves, some facing insolvency. Fears sprung that some of the banks were holding onto a portion of the funds in order to stay afloat, reducing the amount being lent.

Basically the Taylor Rule, as described above would stop working during times of financial turmoil and Central Banks needed a different instrument with which to stabilise the economy.

According to Investopedia (2015) there are 3 unconventional policy instruments:

- 1st step Quantitative Easing (QE) – the purchasing of securities owned by financial institutions
- 2nd step QE - The purchasing of stock shares on the open market
- Negative Interest Rate Policy (NIRP)

According to the same article, “Securities purchased include bonds or debt instruments such as mortgage backed securities from financial institutions. Another method is the purchase of long-term bonds while simultaneously selling long-term debt which will influence the yield curve.”

Although the second step of QE (the purchase of stock shares on the open market) only takes place after the previous one has failed or is deemed ineffective, it is quite similar and will be analysed together.

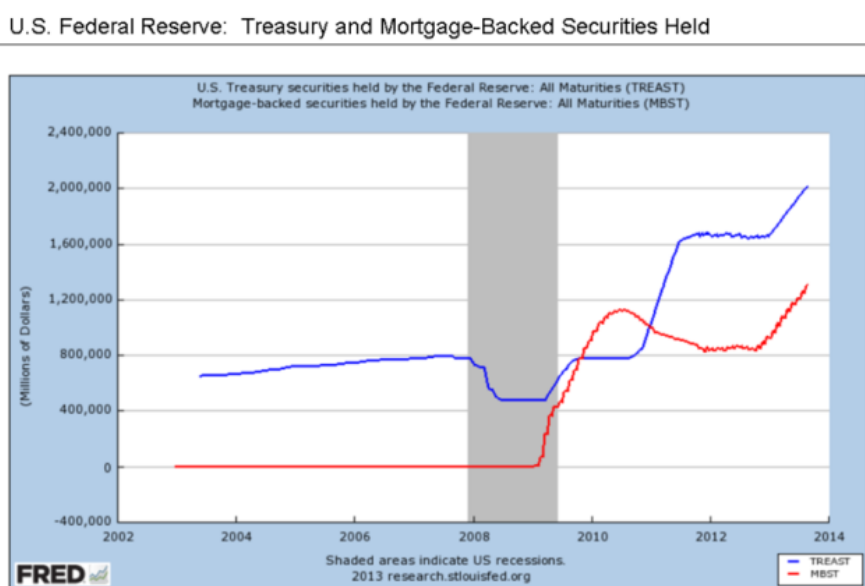
We can already see that QE uses different mechanisms in order to pursue the same general monetary policy objectives, other than money supply:

- Influencing the Yield Curve
- Props up certain markets and increases investor confidence

Although QE has been used in the 1930's and 1940's in the battle against the great depression, it hasn't been used since, until recently that is. Japan has used QE in 2001 and

after the global financial crisis of 2007-2008, US, UK and the Eurozone have used similar forms of QE. In Graph 5 we can see the levels of treasury notes (securities acquired using conventional monetary policy tools), shown in blue, as well as the mortgage-backed securities (acquired during rounds of Quantitative Easing) shown in red, in the United States.

Graph 5 Treasuries and Mortgage-Backed Securities Held



Source: David Chapman: *The FED and Rising Interest Rates*, published on SafeHaven – Preservation of Capital (2013)

We can see that Quantitative Easing has seen very little use. Because its usage in modern times / economies is very limited, there is not a lot known about its efficiency or its impacts on other factors. This thesis aims to fill some of these gaps in particular relating to wealth inequality.

Myles Taylor (2013) from the University of Bath calls Quantitative Easing a “very large gamble”. In 2013 he published a work bearing the above mentioned name in which he states

that “the first round of Quantitative easing reduced the yield of government bond rates by up to 100 basis points (1%) in the United States and 50 basis points (0.5 %) in the UK making it cheaper for business to raise capital” but further in his work he suggests that further Quantitative Easing rounds “have had a smaller impact. It is likely that the effects were short term, being reversed several weeks after the initial purchase.” One other point he makes is that “The impact of QE on the ‘real economy’ is less clear. The financial crisis is a recent event and there is not yet sufficient data on output and employment to conduct a full investigation.”

The following table is a summary of the differences between open-market operations and Quantitative Easing with a focus on the United States market. Data partially obtained from David Turfte (2016):

Table 2: Main Characteristics of OMO and QE

	Open- Market Operations	1st Step QE	2nd Step QE
Influence on Yield Curve	Indirect	Direct	Direct
Instruments used	Short term Government Securities (Bonds)	Long term Government Securities (Bonds) and Mortgage-Backed Securities	Mortgage Backed Securities and the purchase of Stock Shares on the open market.
Source of funds	Reserves	New (Printed) Money	New (Printed) Money
Intermediate Target	Interest Rates	Amount of Money in Circulation	Amount of Money in Circulation
Time Scale	Narrow (i.e. week-to-week)	Ample (A year or more)	Ample (A year or more)

1.6. Quantitative Easing in the US

The case study chosen for this thesis is the United States between 2008 and 2014 in the aftermath of the 2007-2008 Global Financial Crisis. The following are some of the main reasons for choosing this particular one:

- The QE policy has finished and its effects can be more easily studied compared to the EU or Japan where it is still ongoing. There are a lot of articles surfacing regarding the effectiveness of this policy and this makes our work a lot easier.
- The period in which QE was applied is more or less short compared to others. Japan's QE policy has been running since the early 2000s for example. It is easier to focus on a shorter period as it limits the extent of the data that has to be researched and compiled.
- It is a relatively new phenomenon. There would be very little point in studying Japan's QE from the 20th century because it would have little relevance nowadays.
- Ease of access to data. This is a bit of a double edged sword. First off it is much easier to obtain data regarding a market as large and as important as the United States compared to any of the other possible choices. On the other hand, this by no means guarantees perfect transparency since this unconventional policy is shrouded in a cloud of smoke. There are so many details that remain unknown and so many statistics missing, but this is the best that can be done.

UK was also an interesting candidate as a choice for a case study, however the US is clear winner according to the reasons stated above.

So now, let's take a look at the extent of the QE program:

The first round of Quantitative Easing, called QE1 was initiated by the FED in November 2008 and according to Forbes (2015) it proposed to buy \$100 bn. of agency debt and \$500 bn. of Mortgage-Backed Securities (MBS). They then announced they would buy an additional \$850 bn. of MBS and debt and, on top of this, \$300 bn. into long term treasuries in March 2009. This brings the total value for QE1 to

$$\mathbf{\$100\text{ bn} + \$500\text{ bn} + \$850\text{ bn} + \$300\text{ bn} = \underline{\underline{\$1.75\text{ trillion}}}.$$

In November 2010 the second round of QE was initiated when the FED announced it would buy \$600 bn. of long term treasuries by the first half of 2011. In September 2011 the FED also engaged into “Operation Twist” which, according to Forbes (2015) aims at “increasing the average maturity of the bank’s treasury portfolio” where the FED basically swapped \$400 bn. worth of treasuries with 3-36 month maturities for the same amount of maturities ranging between 72 and 360 months, requiring an additional payment of \$45 bn. per month which would continue past the end period of QE2. Thus QE2 is considered to have reached a total value of

$$\mathbf{\$600\text{ bn} + \$45\text{ bn} *12 = \underline{\underline{\$1.14\text{ trillion}}}.$$

In September 2012 the third round of QE was initiated but this time it is considerable different. Basically the FED would buy \$40 bn. MBS every month, while still paying \$45 bn. from the previous mentioned operation. Operation Twist ends by the end of December 2012 while QE3 ends, according to the FED, in October 2014, but monthly spending between December 2013 and October 2014 will be cut by \$10 bn. This brings the total to

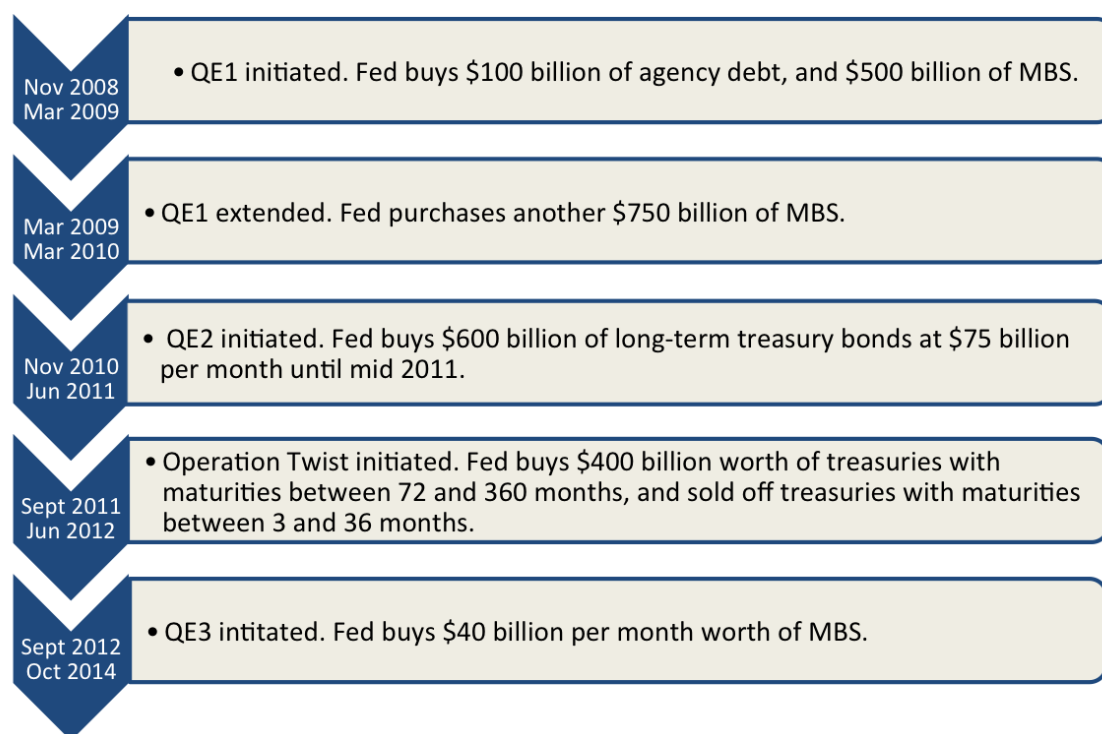
$$\begin{aligned} &\mathbf{\$85\text{ bn} *4 + \$40\text{ bn} *11 + \$30\text{ bn} *11 =} \\ &\mathbf{=\$340\text{ bn} + \$440\text{ bn} + \$330\text{ bn} = \underline{\underline{\$1.11\text{ trillion}}}} \end{aligned}$$

Summing up the total value of all three QE rounds is estimated at

$$\mathbf{\$1.75\text{ trillion} + \$1.14\text{ trillion} + \$1.11\text{ trillion} = \underline{\underline{\$4\text{ trillion}}}$$

The following Image summarises the 3 QE rounds initiated by the FED:

Image 2 Summary of QE in the US

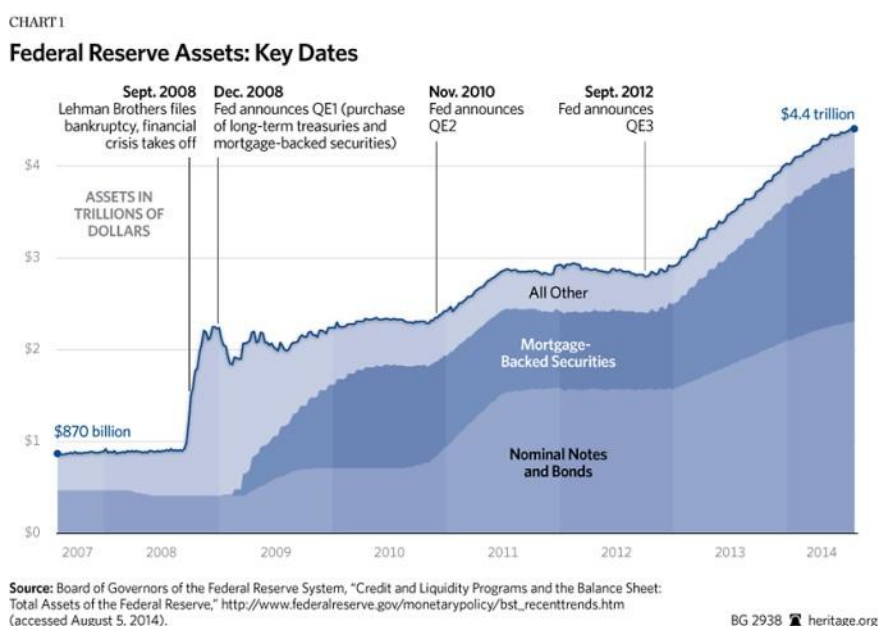


Source: Trefis Team *Quantitative Easing in Focus: The U.S. Experience*, Forbes (2015)

Graph 6 shows a representation of Treasury MBSs and other assets held by the U.S. Federal Reserve over this period. As we know that the FED was mostly interested in long-term rather than short term Treasury bonds after the crisis we can assume that short term bonds either stayed to a similar level or declined (due to the swapping activities from short to long term as described above) and the majority of the Nominal Notes and Bonds are represented by long term Treasury bonds.

For this study, we won't be focusing on long term treasury but rather on how the purchase of Mortgage-Backed Securities as the QE component responsible for the increase of wealth inequality in the U.S. since the Global Financial Crisis of 2008.

Graph 6: FED Assets: Key Dates and Composition



Source: Board of Governors of the Federal Reserve System, *Credit and Liquidity Programs and the Balance Sheet: Total Assets of the Federal Reserve* (2014)

1.7. Quantitative Easing and Wealth Inequality

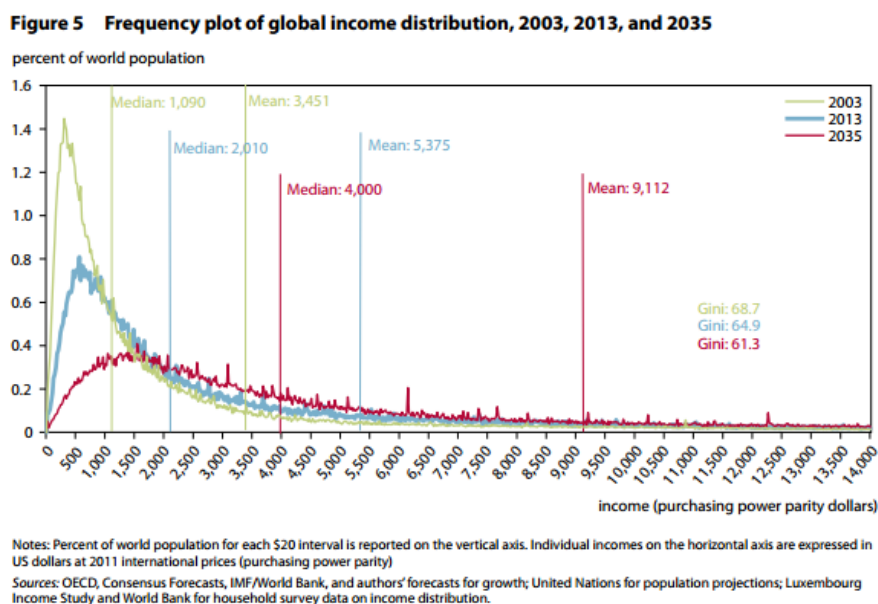
Forbes (2015) engaged in a study entitled *How Federal Reserve Quantitative Easing Expanded Wealth Inequality* in which it stated that QE “expanded wealth inequality through boosting prices of financial assets that are disproportionately owned by wealthier households“, while Ben Bernanke, Chairman of FED (2015), responded by saying “the distributional impact of monetary policy should not prevent the FED from pursuing its mandate to achieve maximum employment and price stability.” This effect is simply ignored as it isn’t part of FED’s main objectives.

Kevin Warsh (2015), former FED board member, stated that QE works through a, as he called it, “asset price channel” as it gets transferred to the 4 % of Americans that own stocks and other financial assets, while the remaining 96 % do not receive anything. We will later see

how this is indeed the major reason for increasing wealth inequality and it will later be proven so. However his statement is not entirely true as actually a substantial portion of this amount cascades over to the other 96 % percent of Americans mentioned, softening the redistribution effect.

A very interesting research performed by Tomas Hellbrandt and Paolo Mauro of the Bank of England (2014) and the IMF respectively showed how global inequality is falling (Gini coefficient fell from 69 in 2003 to 65 in 2013 and is projected to fall to 61 in 2035), due largely to the high economic growth in developing economies, as seen in graph. The notable thing is that developed countries which benefit from quantitative easing programmes are an exception from this rule, as wealth inequality continues to increase. We can see this in Graph 7 as shown below:

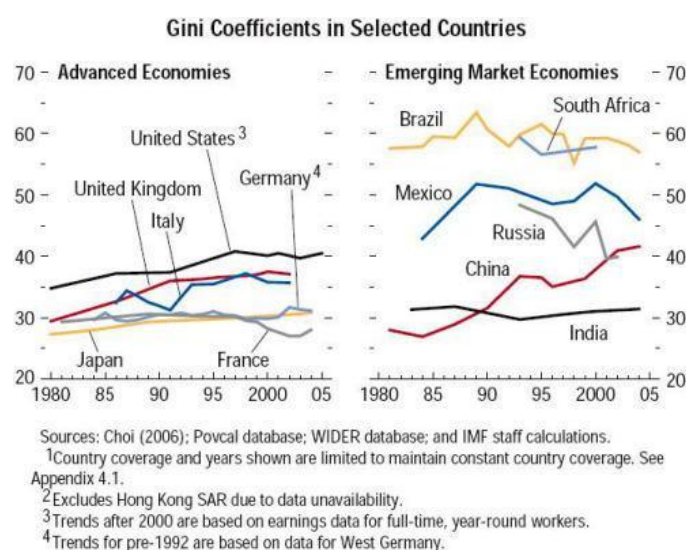
Graph 7: Frequency Plot of Global Income Distribution, 2003, 2013 and 2035



Source: Chris Weller, *This Chart should make you extremely hopeful about the future of income inequality*, Business insider (2015)

Graph 8 shows a comparison between Advanced Economies on the left side, which all implement or have implemented Quantitative Easing policies and Emerging Market Economies, on the right side in respect to Gini Coefficients. The former present a clear, steady slow increase in inequality over time while the latter feature a much more inconsistent measure of inequality but one which does sum up to a decreasing value over time.

Graph 8: Gini Coefficients in Selected Countries



Source: Laurence Parodi, *Economics and Business*, Gini Coefficients in Selected Countries (2016)

Let's take a look at QE's distributional impact on society. The Central Bank is purchasing securities from financial institutions instead of doing so from the government (i.e. open-market policies). The issue is that, as in the case of the US the Central Bank is purchasing high risk, toxic assets such as mortgage-backed securities, which financial institutions are more than content to get rid of, as soon as possible. This does nothing to aid the ones who are in difficulty paying for their house, the debt is simply transferred over to the central bank. According to William D Cohan (2014) from the New York Times "The traders benefit because they know – and have known for years, thanks to the Fed's telegraphing of its

quantitative easing program – that the Fed will be a continuing buyer of their risky securities at (ever-rising) market prices.”.

Moreover Quantitative Easing rounds are having a substantial impact on the stock market. Graph 9 shows a very clear boost to the S&P 500 every time a QE stimulus package was applied. For example Robert Schiller (2015), a Nobel laureate in economics is confident the US stock market is overvalued which may result in a burst characterised by falling prices and widespread pessimism. Many academics share his view and think the market is a bubble waiting to pop. Similar effects as shown in the graph have been experienced by other popular indexes: Dow Jones and NASDAQ. This is not to say that MBSs are responsible for this entire shift. According to the Job Economics Blog, the US Government has been engaged in \$16.6 trillion worth of Financial Bailouts, Buyouts and Stimuli since 2008 which is responsible for the prop-up that we can see. Knowing that QE totals \$4 trillion we can calculate that it represents roughly 24.09 % of the entire interventions over the period.

Because QE has such a large impact on inflating the price of the stock market it has a powerful impact on all segments of the population. While an increase in the price of the S&P 500 is good for the entire economy, it isn't equally good for all participants. This increase in share price of the top US companies is most beneficial to share owners which represent only a tiny fraction of the population. The rest of the population who don't own any shares are still better off because of the companies' performance. Higher employment and wages are just a few of the examples but this is a marginal gain compared to the people who benefit most from the high stock prices. While the S&P 500 does actually reflect the economic situation in the United States, it should perform due to indirect causes instead of being directly stimulated this way by the QE program. What this unconventional monetary policy does is that it directly targets the few large banks and other financial entities which do not continue to lend the funds over to the rest of the population, as they would normally do in the case of open market operations.

Graph 9: Effects of FED's Stimulating The S&P 500 Stock Market



Source: Job Economics Blog, *Stock Markets and the FED*

1.8. Solving the QE dilemma

We will mention some of the solutions that have been proposed to either counter the negative effects of Quantitative Easing or to replace it altogether. Upon completion of the final calculation we will base our solutions on these.

Many groups support the idea of **People's Quantitative Easing (PQE)**. This is a fairly spread concept and is characterised by a large number of supporters ranging from ordinary citizens to academics and even to government officials. According to Frank Van Lerven (2016)

“QE was a missed opportunity to promote growth in the non-financial sectors, the real economy. Consequently, a number of alternative monetary policy proposals have emerged – what we call Public Money Creation. [...] Public Money Creation proposals advocate using central bank money to directly stimulate the real economy.”

There are multiple proposed ways of achieving this and many are advocates of using 2 or even all 3 simultaneously:

- **By lending.** What this basically means is that through PQE the electronically created money will be diverted over to a *public intermediary* such as a private investment bank which would lend money only to businesses operating outside the financial sector (large businesses, SMEs, green enterprises, etc.). By using this method, debt will not be taken by households but rather by businesses, which will lead to increased wages and eventually increases in household incomes. Furthermore the new investments and activities these businesses engage in will stimulate growth and help the economy rise out of recession.
- **By spending.** The money could be directly injected into infrastructure, essentially benefiting everyone more or less. This bypasses debt creation altogether, but incomes will still rise due to the Government's injection of funds into goods and services, benefiting the economy as a whole.
- **By direct transfers to households.** These can take forms such as direct cash transfers or tax cuts. This would increase household incomes directly which facilitates consumer spending and uplifts the entire economy. For example taxes could be cut for productive purposes, effectively allowing businesses to produce easier. The increased number of goods also needs demand. This would be created by lowering personal income tax which leads to increasing disposable income and eventually demand. The 2 tax cuts work together towards increasing economic growth.

One of the main issues with PQE that most opponents are concerned about is the possibility of hyperinflation. This is because they are uncertain whether the production of goods and services is able to keep up with the introduction of the new funds in the system. If it is unable to, it will inevitably lead to high inflation, but supporters of PQE believe production is able to keep up, however it is hard to say which side is right so far.

A second issue is that how much money is created and its distribution have to be separated processes owned by different entities. Otherwise a conflict of interest could endanger the entire operation. One solution would be to split the responsibilities between the government and the Central Bank however we know how powerful lobbying is, especially in the US and it could be a major obstacle.

If we take a look as **Image 3** from the appendix we can see a compilation and comparison of QE and PQE's most important aspects:

Another suggestion as an alternative to QE would be **deficit spending**. Many governments are very careful to avoid having a deficit. However there are many people that support the theory that the Government could engage in infrastructure projects by creating a deficit. According to Management Study Guide (2015) Deficit spending has been widely used by governments around the world, but if gone array, it “creates the problem of huge interest burdens if the policy is not implemented carefully. Deficit spending programs gone awry have been the cause of many bailouts around the world.”

Moving on we arrive to the case of EU to what many believe is the real solution to the current economic recession, **austerity** (the reduction of Government spending). QE and the other alternatives listed above are regarded as nothing more than band-aids. Management Study Guide (2015) states that regardless of the chosen economic policy, whenever a system is stimulated, it only delays the effects of recession. Eventually the stimuli will offer decreasing marginal returns until they become ineffective and the only real solution is austerity. The problem, they say is that it is simply not being implemented because it is a very unpopular measure. If the public had to choose between spending more or spending less in the short run, with the opposite in the long run, it's pretty obvious what their choice would be. Decision makers act in the interest and will of the public and thus austerity measures get delayed in favour of others until absolutely necessary.

To go one step further there is another radical solution being proposed, also supported by a range of economists and some like Adair Turner see it as a “miraculous and pain free solution” according to Daniel Stelter (2015). The solution they are referring to is the **elimination of debt holdings** of the Central Bank. After purchasing bonds from the Government, interest payments would be transferred back to the Government, similar to reinvesting profits earned. This would effectively create debt-free funds to be used as public spending. Depreciation of currency coupled with high inflation are 2 of the major downsides of this operation, however Daniel argues that “In the end, when faced with a disastrous break-

up of the Eurozone or a political gamble with the ECB, future German leaders will likely end up supporting the gamble.”

2. Methodology

This chapter will deliver insight on how the calculation for the impact of quantitative easing on wealth inequality will be performed. Before continuing an important note has to be made about the period being used. Basically the main aim of the study is to look at how much the injection of funds from purchasing the mortgage-backed securities would change the Gini Coefficient. The QE policy took years to implement so it is best to look at the end of the period and that would be October 2014. An assumption will be made stating that the QE funds will be added on top of the M4 money supply from this same moment in time. Reasons for this are explained in more detail under the section Limitations.

Firstly we need to find or calculate the Gini Coefficient for this exact period. This is easier said than done as there is a lot of conflicting data regarding this. Each set of data from its corresponding source will be analysed and the Gini Index will be extrapolated. The most suitable will be used further as the base comparison against the final resulting Gini Index.

Secondly we need to find the entire money supply of the United States at the same point in time. We have an estimate on the value injected into the system via Quantitative Easing policy. In order to evaluate its impact it is imperative to know the entire size of the market (money supply). There is a slight challenge to this as there are multiple definitions (levels) of money supply and it can become a rather abstract concept. The following are a few of the difficulties when extracting such information:

- Incompatibility with set definitions of money supply. Some representations do not even state the level displayed (i.e. M2); others include only specific values pertaining to a different level, while ignoring others, etc.
- The higher the level the less common and, more importantly, less precise the information is. Due to the abstract nature of the higher levels of money supply it is difficult to represent and unanimously agree upon a value.
- Latest available official statistics only show data until January 2013 which means that the final values we are interested (for late 2014) will have to be predicted through technical analysis

In order to have an understanding of how much these amounts actually represent we should first take a look at the evolution of the entire money supply of the US. There are multiple ways of representing the money supply present within a system. Most economists use terms ranging from M0 to M4 (and some even talk about the existence of M5). We must first understand which of these values is applicable to the situation at hand. According to Investopedia “M0 is a measure of the money supply which combines any liquid or cash assets held within a Central Bank and the amount of currency circulating in the economy.” I will not go through all values but rather jump straight to the one which is applicable to this study and that is M4. According to Tejvan Pettinger (2014) from Economics Help, “Broad Money, e.g. m4 money supply is defined as a measure of notes and coins in circulation (M0) + bank accounts” and by *bank accounts* he refers to “private-sector retail bank and building society deposits + private sector wholesale bank and building society deposits and Certificate of deposit.” The reason for choosing M4 is that MBSs and the other securities purchased through QE are long term and are only included in M4 (and onwards, if we consider M5 as well).

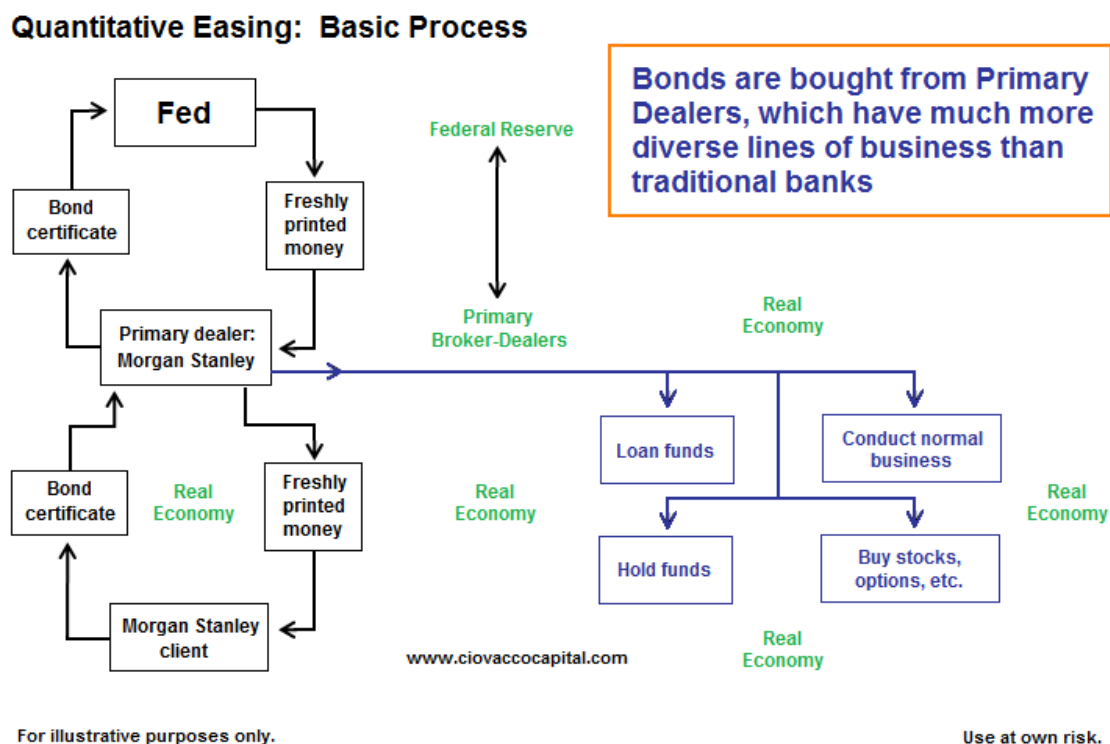
Thirdly the funds introduced into the system through QE must be discounted as their value decreased over time in order to accurately compare them to the entire amount of the money supply. The amounts will be discounted using the real interest rate according to the point in time at which they were injected into the system. Upon completion of this step we will know the value of the QE funds at 29th October 2014.

The initial aim of the thesis was to have 2 separate distributions for the amounts originating from the purchase of MBSs versus the ones stemming from Long Term Treasury Bonds. The reasoning for this is simple. The funds are introduced in separate parts of the market and have different destinations. Furthermore one of the hypotheses is that funds originating from the purchase of MBSs have more weight in increasing wealth inequality than the other. However there is insufficient publicly available data regarding this and it is impossible to extrapolate either using the information currently available. This would have provided a much more detailed insight on the destination and distribution of the QE funds and would have been a welcome addition to this study.

The next thing we have to look at is how these funds have been distributed. This is a required step for calculating the change in the Gini Index. Once we know the amount of funds introduced in the system and the size of the system we have to find out how they have been distributed across income households.

Chris Ciovacco (2015) explains that “Primary broker-dealers, not banks, are the primary recipients of the Fed’s newly printed money. [...] Hedge funds, sovereign wealth funds, and high net worth investors all over the globe can participate in the Fed’s QE 2.0 process.” The process can be seen in the following chart:

Chart 6: Quantitative Easing: Basic Process



Source Chris Ciovacco, *Quantitative Easing: How Does the Money Get Into The Real Economy?* Ciovacco Capital (2015)

The FED only deals with certain entities named *Primary Dealers*. According to its own sources (2016) “Primary Dealers serve as trading counterparties of the New York Fed in its implementation of monetary policy”.

These primary dealers have 3 obligations:

- “Participate consistently in open market operations to carry out U.S. monetary policy pursuant to the direction of the Federal Open Market Committee (FOMC)”
- “Provide the New York Fed’s trading desk with market information and analysis helpful in the formulation and implementation of monetary policy”

- “Participate in all auctions of U.S. Government Debt and to make reasonable markets for the New York Fed when it transacts on behalf of its foreign official account holders.”

The following is a list of all the primary dealers:

- Bank of Nova Scotia, New York Agency
- BMO Capital Markets Corp.
- **BNP Paribas Securities Corp.**
- **Barclays Capital Inc.**
- Cantor Fitzgerald & Co.
- **Citigroup Global Markets Inc.**
- Credit Suisse Securities (USA) LLC
- Daiwa Capital Markets America Inc.
- **Deutsche Bank Securities Inc.**
- Goldman, Sachs & Co.
- **HSBC Securities (USA) Inc.**
- Jefferies LLC
- **J.P. Morgan Securities LLC**
- Merrill Lynch, Pierce, Fenner & Smith Incorporated
- Mizuho Securities USA Inc.
- Morgan Stanley & Co. LLC
- Nomura Securities International, Inc.
- RBC Capital Markets, LLC
- RBS Securities Inc.
- Societe Generale, New York Branch
- TD Securities (USA) LLC
- UBS Securities LLC.
- Wells Fargo Securities, LLC

There are 3 types of dealers listed:

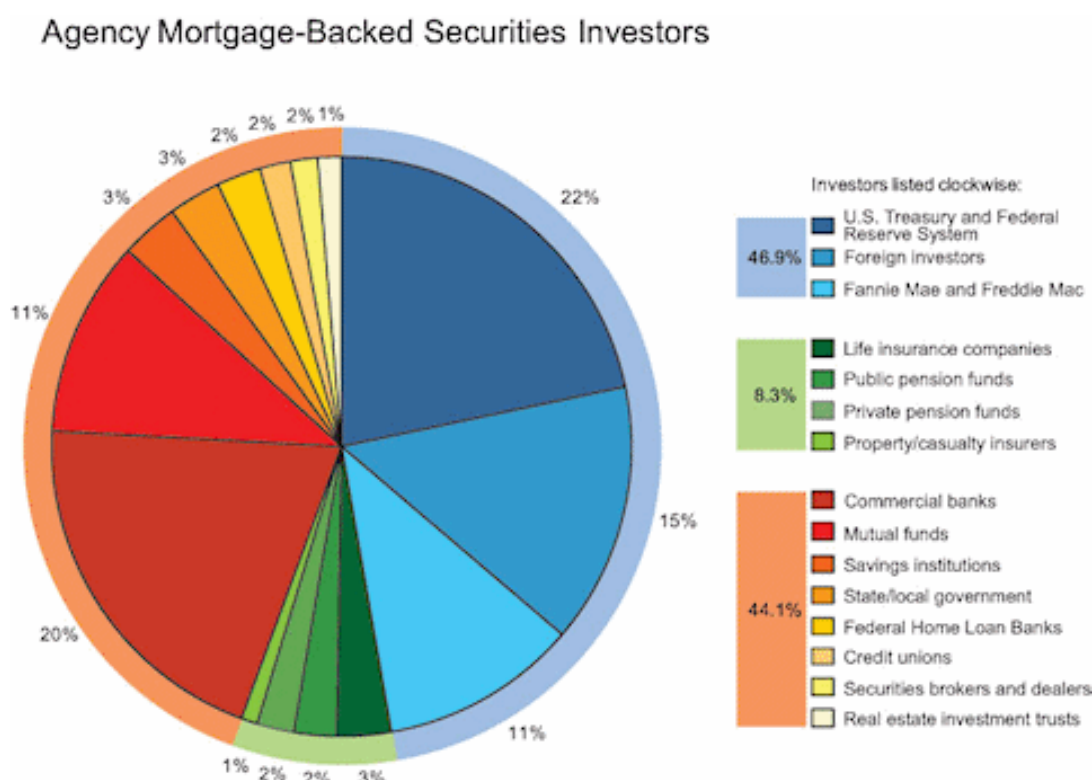
- The dealers with light blue background engage into commercial banking activities (5 out of 23)
- The dealers on yellow background engage do not engage in commercial banking activities but are specialised in other such as securities trading, private investment funds, etc. (18 out of 23)
- The dealers on yellow background but with **bold** letters are subsidiaries or other entities belonging to other large banks which do engage in banking activities among other activities. (6 out of 23)

The FED did not specify the exact details about the trades regarding either the MBS or the long term Treasury Bonds purchases and research didn't turn out any figures regarding this. This brings up the possibility of a large percentage of these funds ending up in hand which do not have any channels set up to lend them any further. This statement is also backed up by the Washington Blogs (2016) which states that "Although the Bernanke Fed has disbursed \$2.284 trillion in new money (the monetary base) since August 1, 2008, one month before the 2008 financial crisis, 81.5 percent now sits idle as excess reserves in private banks." Moreover only "approximately 18.5 percent (or \$15.72 billion) continues to circulate or is held as required reserves on banks' deposit accounts (unlike unrequired excess reserves)." This supports the statement that these funds have spread unequally among the population. Furthermore the FED engaged in buying MBSs at higher than market prices, effectively inflating the market for these assets. The following chart shows the holders of these securities.

Moreover we have seen how the entire stock market was inflated by the QE rounds, meaning that there is a much larger population affected by it.

The 81.5 % which are now sit idle as reserves in private banks and at the FED remain this way because the banks are offered a good rate from the FED (according to the Washington Blog 2016) and have no other incentive of circulating them. Basically these private banks are the ones shown in the chart below and the main beneficiaries of the QE programme as they are more or less the sole participants in the MBS market.

Chart 7: Agency Mortgage-Backed Securities Investors



Source: *Inside MBS & ABS*, 2010.

Note: The percentages for the individual pie segments have been rounded and therefore do not necessarily add up to the percentages reported in the three boxes on the right of the pie chart.

Source: Economists View, *Wealth Effects Revisited: 1975-2012*, (2013)

So we now know that only 18.5 percent have been passed on to the rest of the population (people not owning MBS stocks), while the 81.5 % have been retained by the MBS investors and listed above and other institutions targeted for the receipt of the QE funds. It is likely that the circulated funds first landed in the hands of commercial banks which have a good incentive of lending them onward, seeing as this is their primary activity.

The tricky part is determining which segment of population has invested in these entities which received the QE funds which remain uncirculated. This is quite difficult to calculate and at best it can only be estimated since statistics are vague and provide very little detail. This will require us to extrapolate the data once again, this time in an attempt to split the population into equal segments (percentiles).

The calculation will continue with setting distribution values for all funds between segments of the population. There will be a series of estimations based on statistics from various sources. The statistics don't match entirely and many will require some sort of processing in order to be usable / compatible with this study.

After the distributive percentages have been calculated, the data will be compiled and the respective amounts for each percentile will be calculated as well.

There is another very important bit of theory that should be explained before continuing with the study. The Gini Index as we have seen is not a very accurate description of inequality. It is just one of the least complex methods. A Gini Index simply shows the area between the Lorenz Curve and perfect equality. Two populations can have the same Gini Index but a different Lorenz Curve. This effectively means that the index represents only the relative difference between the Lorenz Curve and perfect equality. This means that the function of the Lorenz curve is irrelevant as long as it still displaces the same relative amount. This has an impact in the graphical representation of the Index. However this function must be as accurate as possible because the M4 amount will be distributed across the population using this function.

When calculating the changes in the Gini Index the study will follow the following steps:

- The function of the Lorenz Curve has to be determined. This is an important step because the function will determine the actual data to be plotted. The Gini Index calculated will determine how the function will approximately look like. One issue is that there are a lot of very different functions (in structure) that could determine a similar graph. Furthermore building a function from knowing just the Gini Index is strange because multiple functions could have the same index. There is an answer to this. Since the data used to plot the Lorenz Curve is cumulative, from lowest to highest we can tell that it follows an exponential trend. The easiest way to tackle this is to assume that the function is of the following format:

$$f(x) = x^y$$

It is a very simple function which also remains very representative of Lorenz Curves. So far though, I haven't found a way of directly determining the exponent (y) for a given Gini Index, but the Gini Index can be easily calculated by knowing "y". The

exponent will be calculated through trials and error by manually substituting “y” with values until we inch our way to the desired result.

- After knowing the function we will place a set of 21 data points which represent the 20 percentiles (5 % each) of household income and one which is (0, 0). The data points (represented by amounts) will be chosen randomly and then expressed as percentages. Once we know the distribution in percentages of a total we can already distribute the entire money supply (M4) according to the percentages.
- Once the previous step is completed the QE amounts can be added on top of the M4 distribution according to our calculation of the QE distribution.
- Once the new amounts have been calculated ($M4 + QE$ for each percentile) the new Gini Index can be calculated.

One of the goals of the study is to show how QE policy is deforming income distribution, over the effect of a conventional monetary policy such as Open Market Operations. If the QE policy will be replaced entirely by Open Market Operations by keeping the same amounts and holding onto the same assumptions we can calculate a new, second, Gini Index. We have already stated that calculating of the OMO effects are overly simplified, however the mechanism is still there and it serves to show the huge difference in change of the Gini Index if we compare the 2 monetary policies.

3. Calculation

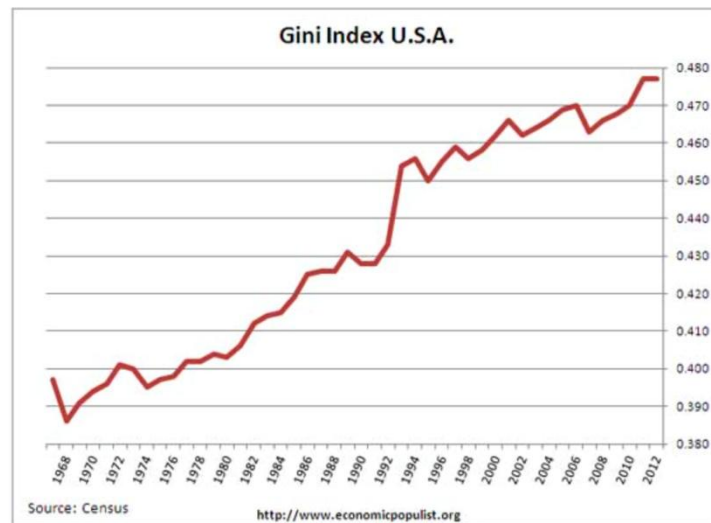
3.1. Base Gini Index

The first thing we need to calculate is the Gini Coefficient for October 2014. As stated before there are multiple sources that could be used for finding the coefficient. The first, as shown by Robert Oak from The Economic Populist (2012), is based on a Government Census, probably from 2012 seeing as that is where the data ends. In order to determine a trend the Graph will be plotted in Excel. There is a problem however: there is not data source for this graph that could be used to easily plot using Excel. In order to compare it to the one from the World Bank, and maintain objectivity, while also keeping the data as representative as possible the plotting of the new graph will follow the following rules:

- The period before 1986 will be cut out in order to correspond to the data provided by the World Bank
- The value for each year will be the average between the beginning and closing of the year. The reason is for simplification as this limits the number of measurements required and will correspond to the same plotting style as the set from the World Bank (one value at the half of each year). The disadvantage is that movements throughout any one year will not be 100 % accurate (i.e. spikes but they are very rare).
- The Gini Coefficient will be replaced with the Gini Index using the following formula in order to maintain compatibility with:

$$\text{Gini Index} = \text{Gini Coefficient} * 100$$

Graph 10: Gini Index US Government Census



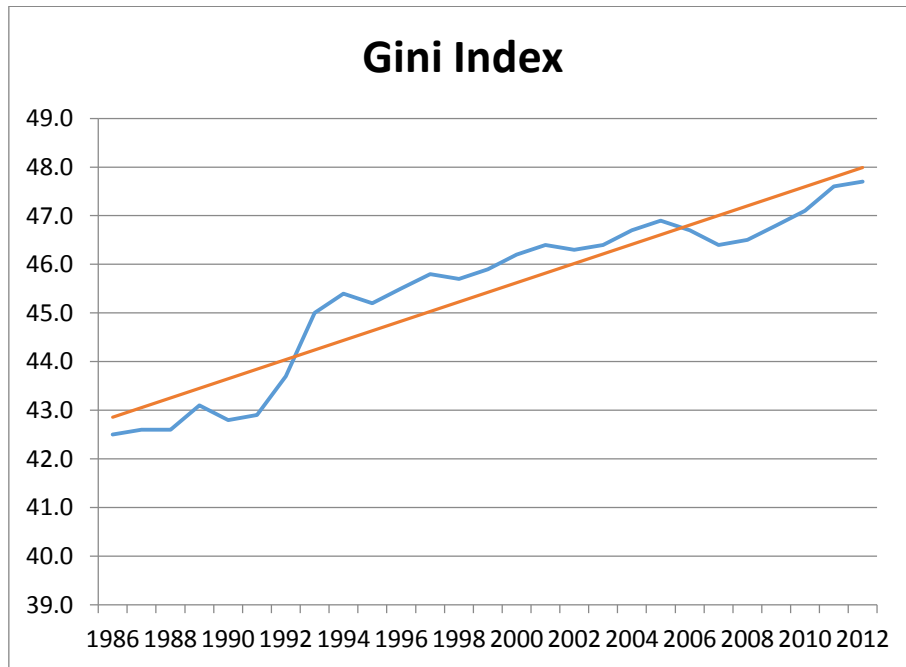
Source: US Government Census 2012

The following is the plotting of the Census graph. The red line is a Linear Trendline of the set of data. Linear seemed to be the best choice, as the data follows a very consistent path and is best represented by it. On the other hand this is an obvious limitation of the study as the decision is more or less subjective. The formula for the trend, as shown in Excel is the following:

$$y = 0.1973 x + 42.66$$

Where **x = years expressed in units – 1, 2, 3 ...** (i.e. unit x = 1 represents the 1st of July 1986 – due to the averaged values, as explained above)

Graph 11: Gini Index US Government Census Re-Plot



By replacing the “x” we can determine the value of the Gini Coefficient according to the Trendline. According to Appelbaum Binyamin (2014) from the New York Times the FED ended the QE program on 29th October 2014, or the 302nd day of the year. This is situated in unit 29 (the one that would correspond to 2014 in the graph). If “x” normally defines the half of the year (1st July) we can calculate that 29th October is the:

$$302 - 181 = 121^{\text{nd}} \text{ day after } 1^{\text{st}} \text{ of July.}$$

This means we replace “x” by:

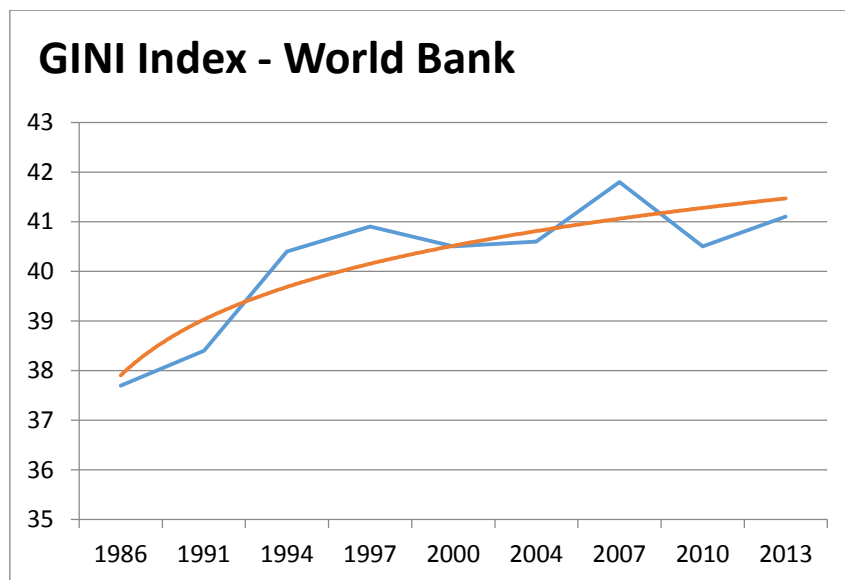
$$x = 29 + 121 / 365 = 29.3315$$

By substituting “x” with our value we get the Gini Index equal to:

$$y = 0.1973 * 29.3315 + 42.66 = \underline{\underline{48.4471}}$$

The graph for the World Bank, on the other hand, features the data source and re-plotting the graph didn't require any of the above mentioned extra steps. The graph can be seen below. The difference with this one is that the trend doesn't seem to follow a straight path and I chose to create a Logarithmic Trendline as it seems much more representative of the data set. The Gini Index is still increasing but by an increasingly lower margin.

Graph 12: Gini Index – World Bank



The formula below was extracted directly from Excel and following the same logic as for the Census data we can deduce using the Trendline the Gini Index from 29th of October 2014.

$$y = 1.6224 \ln(x) + 37.903$$

Whereas “x” now = 10.3315 units

$$y = 1.6224 \ln(10.3315) + 37.903 = 1.6224 * 2.3352 + 37.903$$

$$y = \underline{\underline{41.6916}}$$

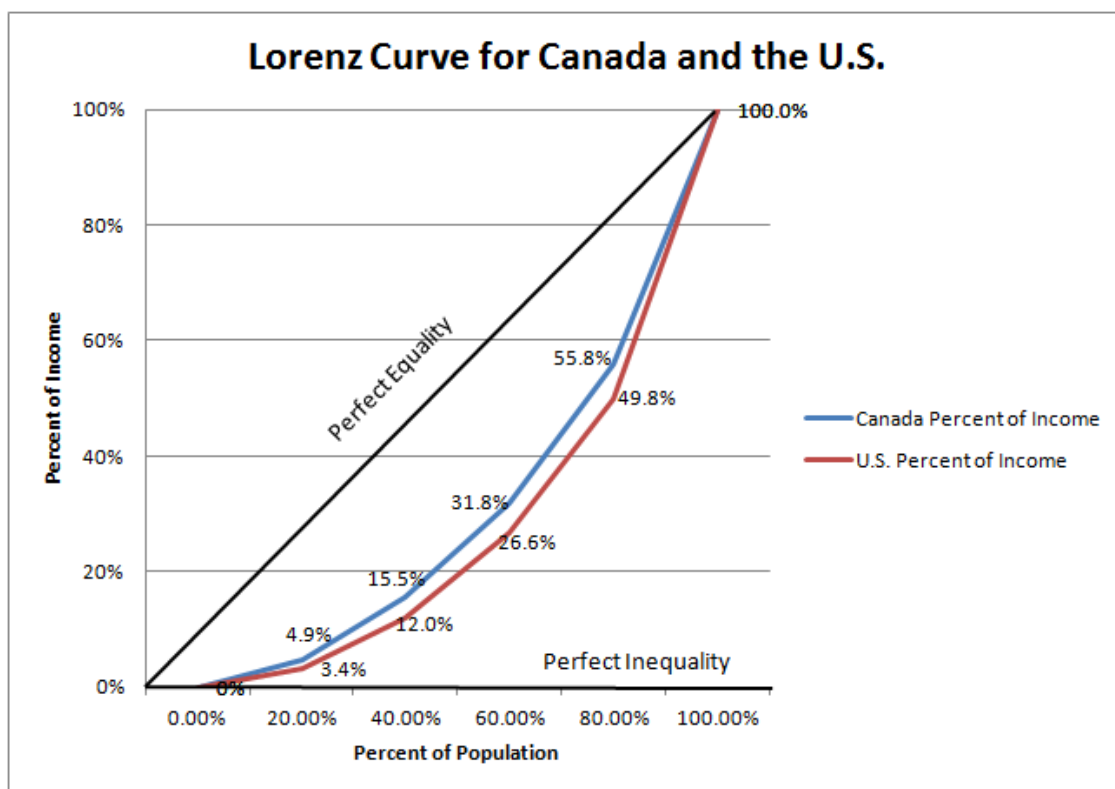
The numbers that we have are significantly different from each other. The bright side is that the changes in the Gini Index caused by the injection of the MBSs funds into the money supply should be a relative one as well. In other words the percentage change would be the same regardless of the Index's absolute value. However this thesis will provide a range of absolute values corresponding to the 2 Gini Indexes previously calculated. The Gini Index is not as accurate as other sources led to believe, especially since according to them, it is most accurate when describing developed economies. If we divide the indexes as below

$$48.4471 / 41.6916 = 1.162$$

We can see that the index extrapolated from the Official Government Census is roughly 16.2 % higher than the one featured in the data coming from the World Bank.

There is a third option however. The following graph was taken from Reasoning With Uncertainty (2015) and it shows the Lorenz Curve for percentage of income by percentage of population for US. They also provide the values for quintiles. This will make the Gini Index easy to calculate using the following procedure:

Graph 13: Lorenz Curve U.S. and Canada



Source: Reasoning With Uncertainty: *Canada's Voter Inequality and the Vote Swapping Economy* (2015)

n = number of incomes supplied

→ Lorenz Curve is described by n + 1 points

**The points are (x_1, y_1) , ..., (x_{n+1}, y_{n+1}) and are ordered lowest to highest and $(x_1, y_1) = (0, 0)$
 $(x_{n+1}, y_{n+1}) = (100, 100)$**

The next step is determining the cumulative totals which will be c_1 , ..., c_{n+1}

$$\rightarrow x_i = 100 (i-1) / n$$

$$\rightarrow Y_i = 100 (c_i / c_{n+1})$$

For $i = 1, \dots, n+1$

→ Gini Index = $100 + (100-2S) / n$ where $S = y_1 + \dots + y_{n+1}$

In our case, we get the following calculation (The cumulative incomes are already shown in our graph as the percentages on the Y axis):

$$G.I. = 100 + [100 - 2 (0 + 3.4 + 12 + 26.6 + 49.8 + 100)] / 6$$

$$G.I. = \underline{\underline{52.73}}$$

After later tracing the true origin of the data it doesn't show what it is based on and seems to be compiled by Dr Stephanie Powers in 2012 and this set of data cannot be used to extrapolate data for 2014. Moreover we don't know which period it represents and the value just seems a bit exaggerated. The most appropriate GINI Index for our study seems to be the one based on the US census identified as being approximately **48.4471**.

3.2. M4 Money Supply

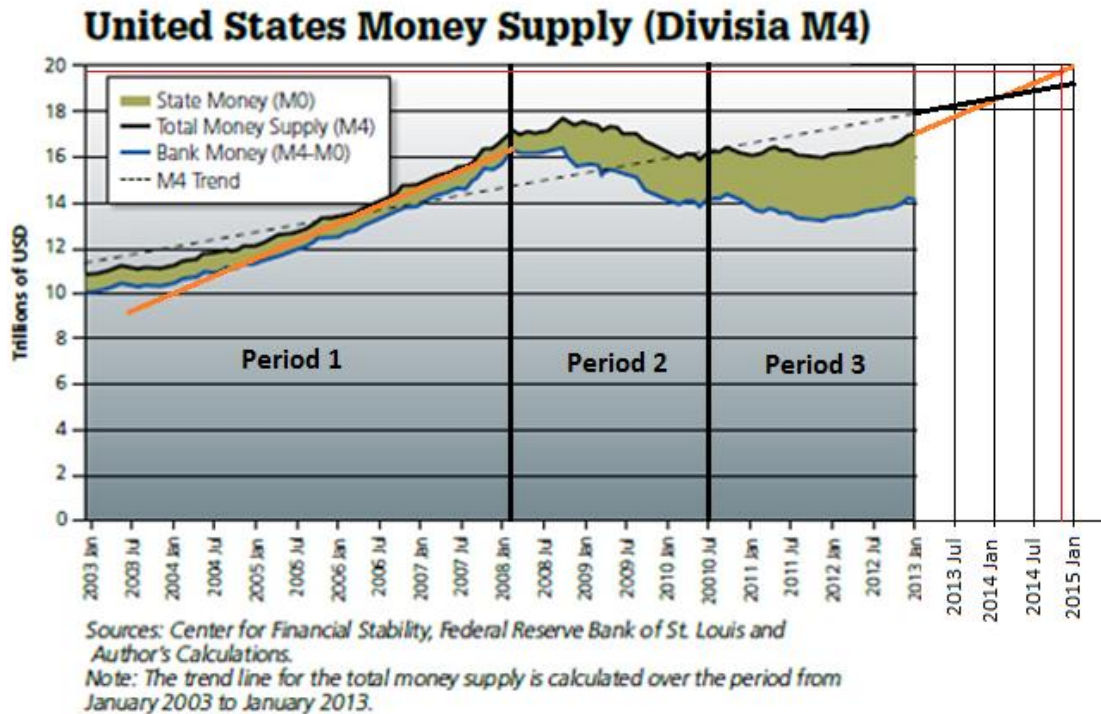
Moving on, a much more important aspect is extracting the value of the M4 money supply of the United States from the available sources.

The Following Graph is taken directly from the Centre of Financial Stability of the Federal Reserve (2013) and should provide the most accurate data currently available. As a note the value which is applicable is the “Total Money Supply” shown in black. Unfortunately a similar problem arises as before caused by the limited set of data which includes only pre-2013 period. Moreover the trend is rather volatile so the next step is trying to justify some of the movements in order to extrapolate the value that is needed. There are 3 noticeable periods:

- The first period, before January 2008 features a more or less stable growth rate and is the period before the Global Financial Crisis. We can see that the growth rate is significantly higher than the slope of the Trendline.
- The second period is from January 2008 and July 2010 which was most affected by the crisis featuring a strong negative growth rate
- The third and final period post July 2010 is characterised by a slow overall growth rate and is highly volatile. 29th October 2014 is very difficult to predict, so we have to make an assumption. Because the crisis has passed and the economy is starting to recover, coupled with the increasing growth rate seen at the very end of the period and knowing about the large money printing operation involving the Quantitative Easing Policy this study will assume that the money supply will follow a similar trend to the first period.

In the table we can see 2 orange lines: one in the first period and the other after the third period. They both have the same slope which is basically the growth rate of the second half of period 1 (second because it is the least volatile). 29th of October 2014 is basically marked with the thin red line perpendicular to the X axis. A corresponding thin red line perpendicular to the Y axis is the result of the intersection of the previous with the orange line post Period 3. We can basically see that according to the graph the extrapolated money supply for 29th of October 2014 is roughly **\$18.8 trillion dollars**.

Graph 14: United States M4 Money Supply



Source: FED, Centre for Financial Stability, *United States Money Supply (Divisia M4)* (2013)

3.3. Discounted QE funds

Moving on, the next step is the calculation of the discounted cash flows introduced by the QE program. One issue that immediately arises is that many of the amounts specified are bought over a period and not at a particular point in time and there is no way to know the distribution of all of these purchases. Some purchases are specified as being equally divided on a monthly basis (i.e. the long term Treasury Bonds from QE2). Thus another assumption has to be made. Perhaps it is the most objective and correct way of assuming that the entire amount

belonging to a certain period is equally divided into monthly payments. The data has been compiled and calculated in the **Table 3** from the appendix. The data has been placed according to the information available about the structure, timeline and activities of the QE programs as described before.

Note: The numbers are in billions of dollars. The following is an explanation of some of the columns for better understanding of the calculation:

Note: In QE1 there are \$100 billion marked as agency securities and are issued by the Federal National Mortgage Association (according to Investopedia -2016) and their characteristics resemble more those of MBSs (i.e. “Not backed by the full faith and credit of the US Government”). They would normally deserve a separate category of their own, however because they represent only a 2.5 % of the entire QE program, behave somewhat similarly to MBSs they will be categorized as MBSs. Research has shown that many articles and statistics present them as such as well.

- **MBS** represents the total payments for mortgage-backed securities during larger period. It basically equals the full packages announced by the FED at the beginning of a new round of QE or during an extension of one. They are separated by different colours in order to make it easier to identify.
- **MBS / t** represents the same amounts as mentioned above but equally divided by monthly periods.
- **LT TB** is an abbreviation for Long Term Treasury Bonds and this column follows the same rules as the MBS column
- **LT TB / t** same rules apply as for the MBS / t
- **IR** shows the real interest rate per month ($IR / 12$) which is taken directly from the World Bank’s website. The values are as follow (only one is provided for each separate year):
 - 2008 – 3.07 % p.a.
 - 2009 – 2.47 % p.a.
 - 2010 – 2 % p.a.
 - 2011 – 1.16 % p.a.
 - 2012 – 1.38 % p.a.

- 2013 – 1.59 % p.a.
- 2014 – 4.58 % p.a.
- **Disc Exp (DE)** basically describes the discount exponent used for calculating the discount rate. Its inclusion in the file is simply used for the calculation formula and presents no other relevance
- **Disc Rate** is the discount rate (DR) as calculated by the formula:

$$DR_{(DE)} = 1/(1+IR)^{DE}$$

- **Disc MBS** shows the discounted cash flows for MBS as calculated by the following formula:

$$\text{Disc MBS} = (\text{MBS} / t) * DR$$

- **Disc LT TB** illustrated the discounted cash flows for LT TB and are similarly calculated by the formula

$$\text{Disc LT TB} = (\text{LT TB} / t) * DR$$

- **TOTALS** are basically the sum of each of their respective columns
- **TOTAL** shows the 2 grand totals: before and after discounting

The 3 totals relevant to this study are the following amounts (as discounted for 29th October 2014):

- **\$2171.3039** billion worth of MBS purchased through QE policy
- **\$1531.9244** billion worth of long term Treasury Bonds acquired during rounds of QE
- **\$3703.2283** billion worth of total assets acquired during rounds QE

3.4. Distribution of QE funds

Next we are going to calculate the distribution of the QE funds.

There is a large number of Americans that hold stocks (according to Justin McCarthy – 2015 – over 55 % do) but it is the distribution that is important. According to *My Budget 360* (2015) the top 10 % of the population controls 81 % of the stock market wealth.

On the other hand the FED provides the following statement: “the top 5 percent own 60 percent of the nation’s individually held financial assets. They own 82 percent of the individually held stocks and more than 90 percent of the individually held bonds.” Basically the top 5 % of the population received between 82 and 90 percent of the 81.5 % of the funds created by QE. The FED is a more trusted source and provides a more detailed analysis so the study will focus on this.

This information brings an important change to the thesis and that is the ambiguous movement of the funds created through the purchase of long term Treasury Bonds by the FED. It was initially believed they don’t have a significantly higher wealth redistribution effect compared to the short term Treasury Bonds used in open-market operations. This doesn’t appear to be the case because it was true a lot fewer than 81.5 percent would be uncirculated. The following calculation shows the percentage of QE represented by MBSs.

$$\text{\$2380 billion} / \text{\$4000 billion} = 59.5 \%$$

Even if the entire amount of the MBS originating funds were entirely uncirculated, the percentage of uncirculated funds could not exceed 59.5 % although it is entirely possible that most of these remained uncirculated.

Because of the apparent high distribution of the long term Treasury Bonds and the lack of data regarding the proportions of MBS and Treasury Bonds in regards to how circulated / uncirculated they are, the thesis will resume the calculation while taking these two funds together and not separate. Otherwise it would involve highly fetched assumptions which could compromise the integrity of the thesis. While the strange behaviour of the long term Treasury

Bonds is unexpected, it should not have any impact on the final result. On the other hand it does debunk one of the early hypotheses and it makes the final result less relevant (not less accurate!) by constraining its level of detail.

So now I will define the final amount which shall be used for the calculation of the change in the Gini Index. From the data that is available there is no way to know how much many of the stocks and bonds the top 5 % of the population own because we do not know the weight of each percentage. Furthermore just because in regards to our amount, there are more funds originating from MBSs, there is no effect on the actual weight of the stocks and bonds owned by this segment. In this situation another assumption will be made: we will consider the top 5 percent of the population to own the average of the two:

$$(82 \% + 90 \%) / 2 = \underline{86 \%}$$

The amount of uncirculated funds represented as a percentage of the entire QE amount is the following

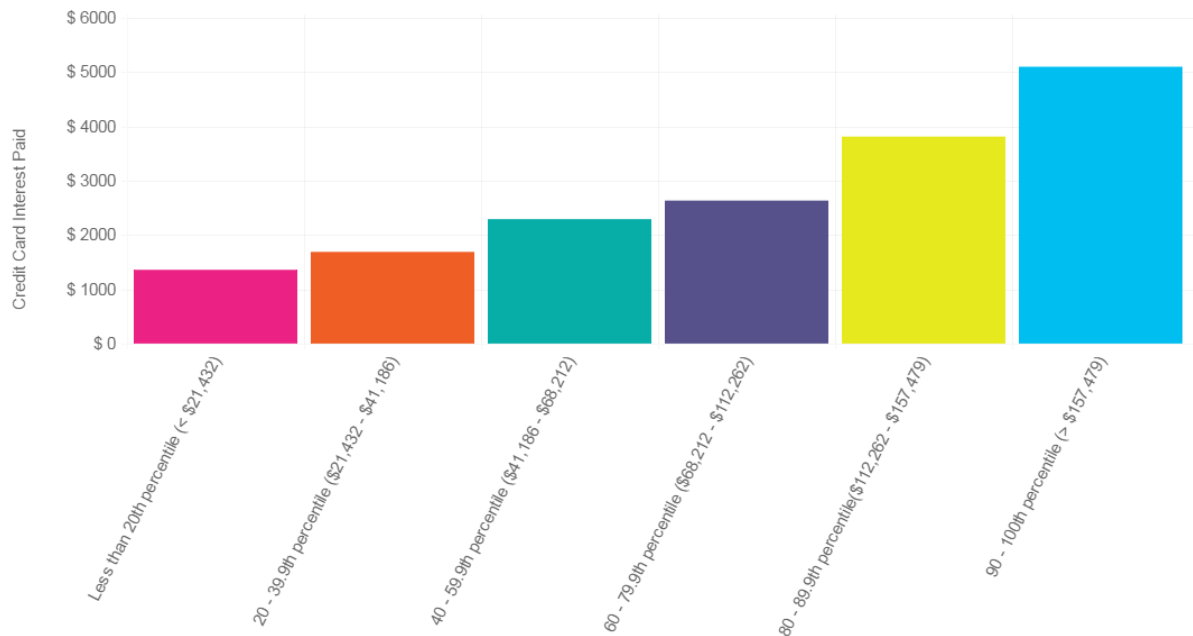
$$81.5 \% * 86 \% = \underline{70.09 \%}$$

The rest of the uncirculated funds are owned by the rest of the 95 % of the population and as a percentage from the total amount of QE funds they represent:

$$81.5 \% * (100 \% - 86 \%) = \underline{11.41 \%}$$

The rest of the 18.5 % of the total amount of QE funds are circulated mostly by commercial banks to all segments but we must again find how they are distributed within the population. We can see a distribution of the interest costs by 6 household income segments in the following graph:

Graph 15: Interest Costs by Household



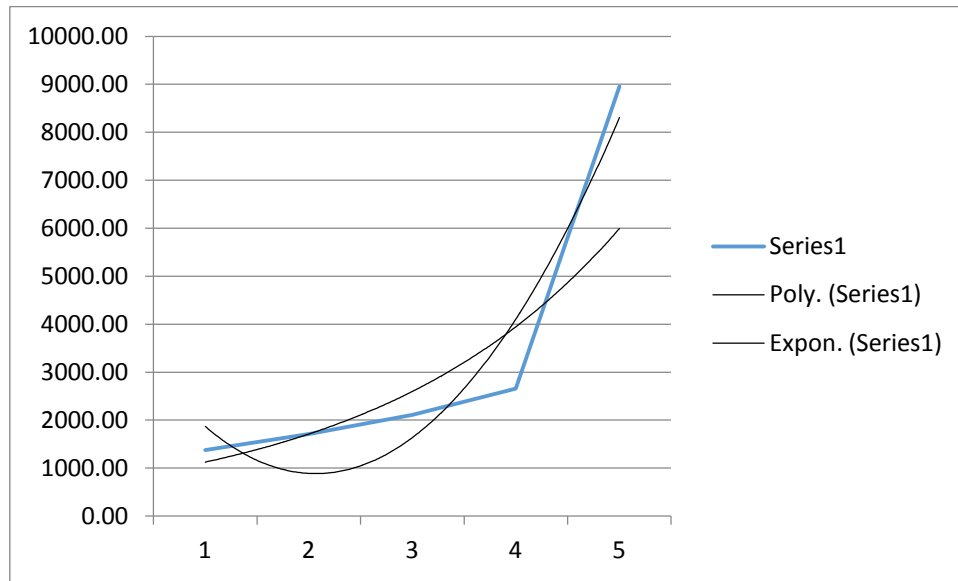
Source: Erin El Issa, *2015 American Household Credit Card Debt Study*, Nerd Wallet (2015)

The values from the graph are as follow:

- 0 – 20 % → \$1379.2
- 20 – 39 % → \$1709.36
- 40 – 59 % → \$2112.63
- 60 – 79 % → \$2654.35
- 80 – 89 % → \$3833.34
- 90 – 100 % → \$5120.47

Note that the last two household segments in fact represent the last quintile of the population (top 20%) and these combined are in fact just as large as any of the other quintiles. Taking this in mind, the graph would look completely different if the plotting was consistent. The following is on-scale representation of the graph above:

Graph 16: Interest Costs by household Re-Plot



The Graph also features both a polynomial and a exponential Trendline. My first choice was an exponential one, but the higher up the scale, the more it misrepresented the data (Trendline value was significantly below the series). While the polynomial Trendline misrepresents the early series of data it is more accurate for the values for the top 5 % (last half of the 5th quintile). The first formula is for the polynomial Trendline while the second is for the exponential one:

$$y = 862.65 x^2 - 3566.5 x + 4572.1$$

$$y = 741.11 e^{0.4181x}$$

What we will try to do is create a series divided into 20 household categories instead of quintiles, in order to be able to measure the distribution. Each equation will be used for its most representative part. The formulas intersect each other just before $x = 4$ and they will change from that value. We can see that around this value the numbers are slightly elevated due to the Trendlines, however the rest of the data seems to have a good representation. This is an obvious limitation of the study which will be logged. The following table shows the calculations:

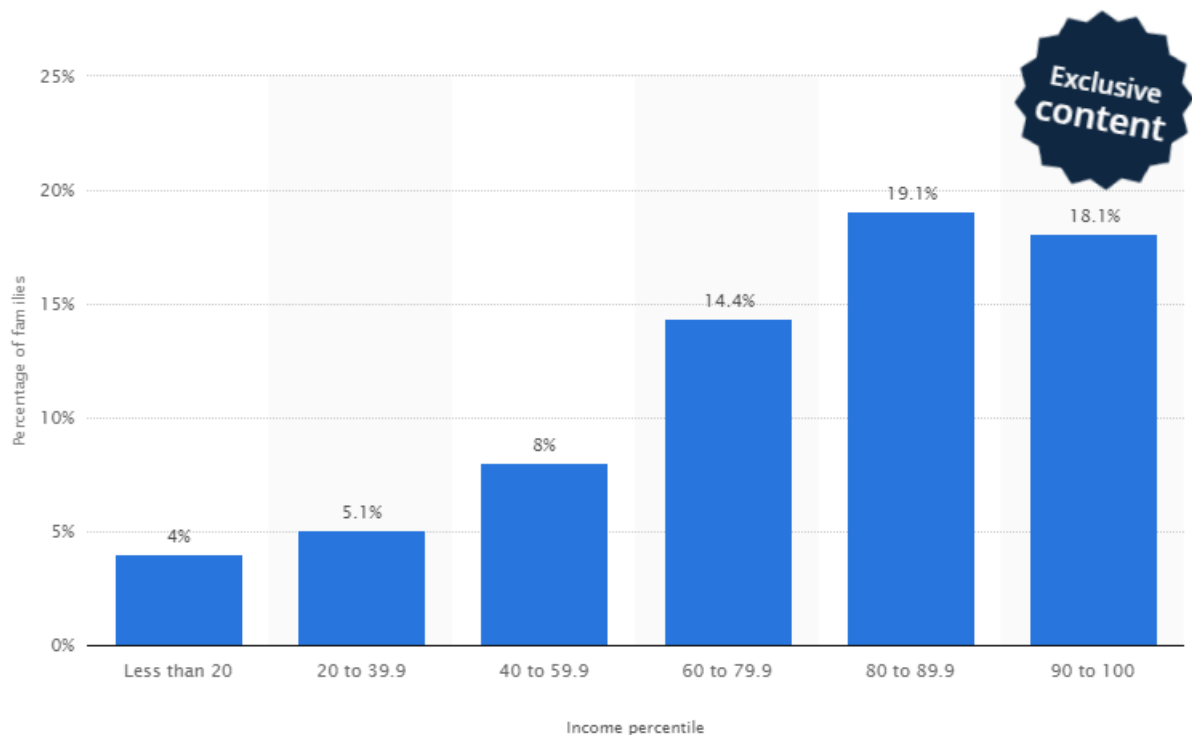
Table 4: Distribution of Circulated Funds

Percentile	x	Exponential	Polynomial	% of Total
5%	0.625	962.43		1.33
10%	0.875	1068.47		1.47
15%	1.125	1186.20		1.64
20%	1.375	1316.90		1.82
25%	1.625	1462.00		2.02
30%	1.875	1623.09		2.24
35%	2.125	1801.93		2.48
40%	2.375	2000.47		2.76
45%	2.625	2220.89		3.06
50%	2.875	2465.59		3.40
55%	3.125	2737.26		3.77
60%	3.375	3038.86		4.19
65%	3.625	3373.69		4.65
70%	3.875	3745.41		5.16
75%	4.125		4538.82	6.26
80%	4.375		5480.32	7.56
85%	4.625		6529.66	9.00
90%	4.875		7686.83	10.60
95%	5.125		8951.83	12.34
100%	5.375		10324.66	14.24
Totals		29003.18	43512.12	
Total			72515.30	

What has to be said about the table is that the Exponential and Polynomial columns define the calculations for the percentiles and that the percentiles are ordered from lowest to highest income. This shows how the circulated (loaned) QE funds are distributed.

We still need to determine the distribution of the 14 % of the uncirculated QE funds which consist mainly of stocks and bonds. There is a survey conducted by Statista, The Statistics Portal which shows the following distribution:

Graph 17: Savings Bonds Ownership Distribution

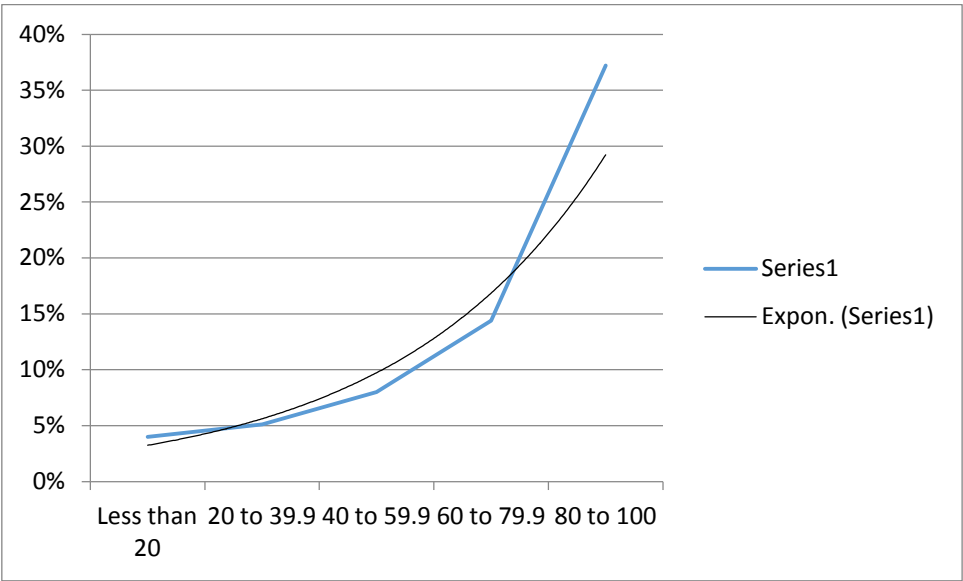


Source: Statista, *Percentage of U.S. Families owning savings bonds in 2013, by income percentile* (2016).

Although these are saving bonds, they are still the closest statistic to what we are looking for. Still it must be said that there is a obvious downward trend featured between the last 2 percentiles which will remain ignored for now. There is not enough data to take this into consideration for a trend and will be ignored. This of course is another slight limitation of the study but considering the rest of the data is consistent and that we are looking for the distribution of the rest of the 95 %, the data is sufficient and valid.

By combining the last 2 bars, in order to create a quintile we get the following graph:

Graph 18: Savings Bonds Ownership Distribution Re-Plot



An exponential Trendline was selected to represent the series of data with the following formula extracted from Excel:

$$y = 0.0187^{e0.5498x}$$

Following the same principle as before, we will transform the quintiles into 5 % intervals, representative of 20 household categories. The table below shows the distribution:

Table 5: Distribution of Uncirculated Funds among the Bottom 95 % of the Population

Percentiles	x	y (%)	y adjusted	Y Adjusted * 14 %
5%	0.625	2.64	1.17	0.16
10%	0.875	3.03	1.34	0.19
15%	1.125	3.47	1.54	0.22
20%	1.375	3.98	1.76	0.25
25%	1.625	4.57	2.02	0.28
30%	1.875	5.24	2.32	0.32
35%	2.125	6.02	2.66	0.37
40%	2.375	6.90	3.06	0.43
45%	2.625	7.92	3.51	0.49
50%	2.875	9.08	4.02	0.56
55%	3.125	10.42	4.62	0.65
60%	3.375	11.96	5.30	0.74
65%	3.625	13.72	6.08	0.85
70%	3.875	15.74	6.97	0.98
75%	4.125	18.06	8.00	1.12
80%	4.375	20.72	9.18	1.28
85%	4.625	23.78	10.53	1.47
90%	4.875	27.28	12.08	1.69
95%	5.125	31.30	13.86	1.94
100%			0.00	0.00
Total		225.84	100.00	14.00

We can see that after the calculation, the values add up to a total of **225.84 %** which is impossible for a population. This doesn't mean the method is wrong however since we basically introduced a large number of data points into a graph that defines percentages. This simply requires an adjustment. Y adjusted has the following formula:

$$y_{\text{adjusted}} = y / \text{Total} * 100$$

They now total 100 % and we get a good measurement of the distribution.

The **Y adjusted * 14%** shows what percentage of the total uncirculated funds each segment of the population will receive.

The following table shows a compilation of the calculations which will be used further to determine the change in the Gini Index. The percentages have been transferred from the

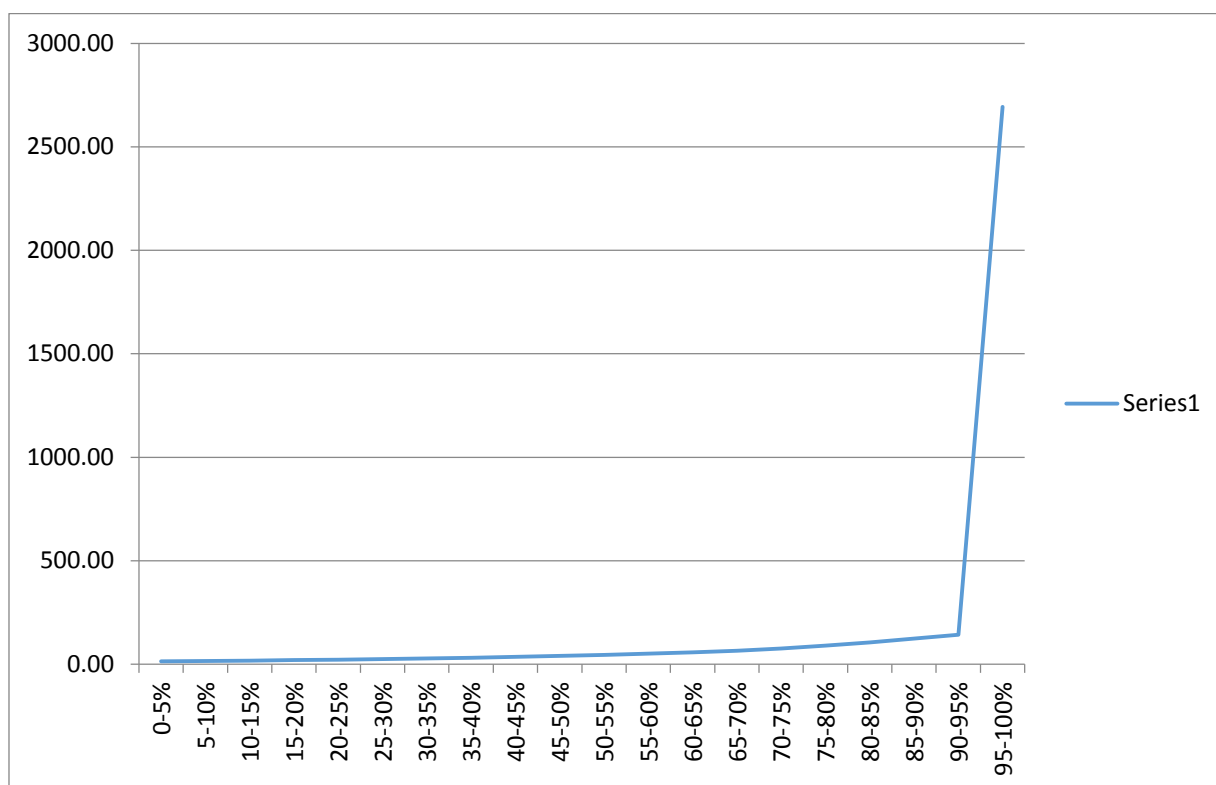
previous tables and the mounts have been calculated for all percentiles (uncirculated, circulated and total). The amounts are in billions of dollars.

Table 6: Distribution Compilation

Total QE Funds = \$3703.2283							
Uncirculated funds 81.5%				Circulated Funds 18.5%			
	% of Uncirc Funds	% of QE Funds	Amounts	% of Circ Funds	% of QE Funds	Amounts	Total
Percentile	100%	81.50%	3018.1311	100%	18.50%	685.0972	3703.2283
0-5%	0.16	0.13	4.93	1.33	0.25	9.09	14.03
5-10%	0.19	0.15	5.66	1.47	0.27	10.09	15.75
10-15%	0.22	0.18	6.49	1.64	0.30	11.21	17.70
15-20%	0.25	0.20	7.45	1.82	0.34	12.44	19.89
20-25%	0.28	0.23	8.55	2.02	0.37	13.81	22.36
25-30%	0.32	0.26	9.81	2.24	0.41	15.33	25.14
30-35%	0.37	0.30	11.25	2.48	0.46	17.02	28.28
35-40%	0.43	0.35	12.91	2.76	0.51	18.90	31.81
40-45%	0.49	0.40	14.81	3.06	0.57	20.98	35.80
45-50%	0.56	0.46	17.00	3.40	0.63	23.29	40.29
50-55%	0.65	0.53	19.50	3.77	0.70	25.86	45.36
55-60%	0.74	0.60	22.38	4.19	0.78	28.71	51.09
60-65%	0.85	0.69	25.67	4.65	0.86	31.87	57.55
65-70%	0.98	0.80	29.46	5.16	0.96	35.39	64.84
70-75%	1.12	0.91	33.80	6.26	1.16	42.88	76.68
75-80%	1.28	1.05	38.77	7.56	1.40	51.78	90.55
80-85%	1.47	1.20	44.49	9.00	1.67	61.69	106.18
85-90%	1.69	1.38	51.04	10.60	1.96	72.62	123.67
90-95%	1.94	1.58	58.56	12.34	2.28	84.57	143.14
95-100%	86.00	70.09	2595.59	14.24	2.63	97.54	2693.14

We can summarize the distribution of the Quantitative Easing monetary policy over percentiles in the following graph:

Graph 19: QE Funds Distribution



It is obvious who benefited from the QE policy, although the increase in inequality will not be as extreme. When calculating the Gini Index we will see how much of an impact this has on the distribution of wealth.

3.5. Distribution of M4 Money Supply

It is now time to calculate the function that most accurately depicts our Gini Index of **48.4471**. The formula to be used for calculating it for the function $f(x) = x^y$ is the following (same as in the previous 3rd attempt of calculating the Gini Index:

$$\text{Gini Index} = 100 + (100-2S) / n \text{ where } S = y_1 + \dots + y_{n+1}$$

After multiple attempts the function was identified as having a Gini Index of **48.41** which is remarkably close to **48.4471**. If we divide the indexes we can see how similar they really are:

$$48.4471 / 48.41 = 1.0007$$

The relative difference between them is only 0.07 % which is low enough to be able to continue. The function used is the following.

$$f(x) = x^{2.7}$$

3.6. Total Money Supply

The following table shows the data used to calculate the base Gini Index (**48.41**). All amounts are in billions of dollars. The following columns and the calculations are explained below:

- **Percentile.** What needs to be explained here is that 0 is introduced as a base value as a starting point for the graph. Each graph depicting the Lorenz Curve has to have a base of 0 and an end of 100 %.
- **The X column** represents the arbitrary values used for calculating the base Gini Index. They have to be equally distanced between themselves in order to provide an accurate representation of the percentiles. For simplicity reasons they start from 0 and are exactly 1 unit of measure apart.
- **Y Cum** is basically the Y axis which is calculated through the above function.
- **M4 Cum** is determined using the Y Cum column. Each value from the Y axis is divided by the total cumulated amount (3256.7243) and then multiplied by the entire M4 amount (\$18.8 trillion) that we previously calculated. This basically shows the cumulated distribution of M4 over the percentiles.

- **M4 Amounts** represents the actual distributed amounts of the M4 money supply over the percentiles
- **QE Amounts.** These are simply transferred over from the previous excel file where their distribution was calculated
- **Total Amounts** are obtained simply by adding the previous 2 columns together and are the ones used to create the new Lorenz Curve.

Table 7: Total Money Supply Distribution

Percentile	X	Y Cum	M4 Cum	M4 Amounts	QE Amounts	Total Amounts
0	0	0.0000	0.00	0.00	0	0.00
0-5%	1	1.0000	5.77	5.77	14.03	19.80
5-10%	2	6.4980	37.51	31.74	15.75	47.49
10-15%	3	19.4190	112.10	74.59	17.70	92.29
15-20%	4	42.2243	166.7243*18	131.65	19.89	151.54
20-25%	5	77.1292	445.24	201.49	22.36	223.85
25-30%	6	126.1852	728.43	283.18	25.14	308.32
30-35%	7	191.3219	1104.44	376.01	28.28	404.29
35-40%	8	274.3740	1583.87	479.43	31.81	511.24
40-45%	9	377.0985	2176.87	592.99	35.80	628.79
45-50%	10	501.1872	2893.19	716.32	40.29	756.61
50-55%	11	648.2765	3742.29	849.10	45.36	894.46
55-60%	12	819.9538	4733.32	991.04	51.09	1042.13
60-65%	13	1017.7639	5875.22	1141.89	57.55	1199.44
65-70%	14	1243.2134	7176.66	1301.45	64.84	1366.29
70-75%	15	1497.7744	8646.16	1469.50	76.68	1546.18
75-80%	16	1782.8876	10292.02	1645.86	90.55	1736.41
80-85%	17	2099.9652	12122.41	1830.38	106.18	1936.56
85-90%	18	2450.3931	14145.31	2022.91	123.67	2146.58
90-95%	19	2835.5331	16368.60	2223.29	143.14	2366.43
95-100%	20	3256.7243	18800.00	2431.40	2693.14	5124.54
100%				18800.00	3703.25	22503.25

3.7. Change in Gini Index

With these final amounts we can calculate the new Gini using the same formula as before. This way we get to the new Gini Coefficient of **53.38**. By dividing the new index to the base one we can see the percentage relative change before and after the period.

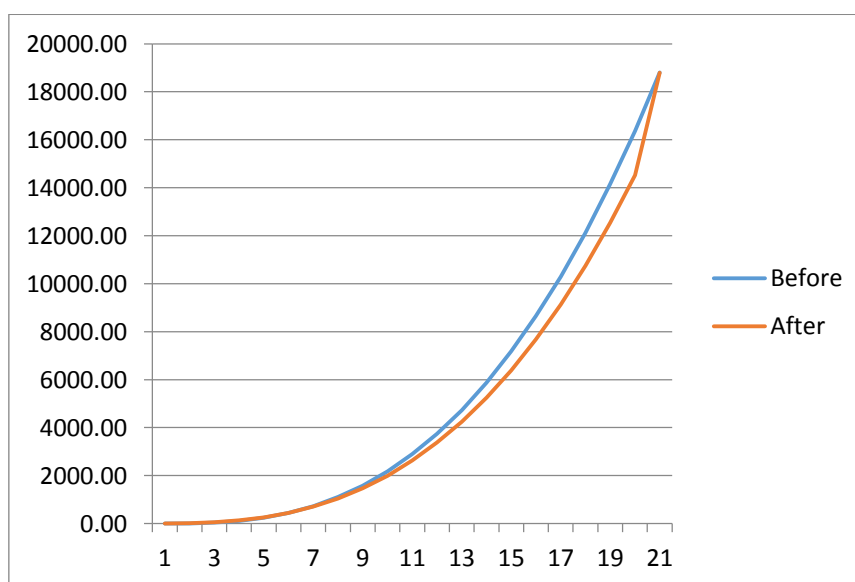
$$53.38 / 48.41 = \underline{10.27 \%}$$

Perhaps just as important is the absolute shift as well. We can find it below:

$$53.38 - 48.41 = \underline{4.97}$$

We can also view this graphically to get a better understanding of the effects. The two Lorenz Curves will be displayed in the following graph:

Graph 20: Change in Gini Coefficient



3.8. Change in Gini Index Using OMO

What we will do now is showing the effects by replacing QE policy with Open Market Operations. **Table 8** from featured in the appendix shows the data, created in a very similar fashion to the table above. Again all values are in billions of dollars except the distribution column which represents percentages. All calculations we conducted in a similar fashion as before.

This time, by calculating the Gini Index we get 47.4, which is actually lower than the base one, effectively reducing income inequality. To compare them we see the following relative and absolute values:

$$1 - 47.4 / 48.41 = \underline{2.086 \%}$$

$$48.41 - 47.4 = \underline{1.01}$$

There is no point in showing this in a graph together with the others as it almost entirely overlaps the basis graph but on the other hand it will be discussed in the next chapter.

This is basically the final result. We can clearly see that after the QE funds injection income inequality significantly. The results will be discussed in the next part.

4. Discussion

4.1. Analysis

Although it doesn't seem like much of a change, it actually is very significant. What we see in the graph is the 10.27 % relative shift and 4.97 absolute increase of the Gini Index which translates into a large increase in income inequality. This is represented by the small movement seen in the graph. One more thing that is noticeable is the spike at the end of the red line. It shows how most of the funds were directed towards the top segment of the population by income. While conventional monetary policies would have circulated those funds, distributing them in a relatively even fashion, QE policy simply acts different.

This can be seen in the results. If the funds originated purely through Open-Market Operations their influence on the Gini Index would be very low and, according to this study, it would actually decrease income inequality.

According to our study the total amount of QE funds that were delivered to the wealthiest 5 % are \$2693.14 billion out of the total \$3703.25, or $2693.14 / 3703.25 = 72.7$ % of the entire amount. While the rest of the amount was distributed among all segments of the population, it simply isn't enough to offset the imbalance that has been created by the incirculated funds that never departed from the investment funds and other institutions that were the beneficiaries of this stimulus package.

This injection of funds effectively increases the money supply within the system which leads to a overall depreciation of the currency. While the lower and middle class should own more than before in absolute terms, in relative terms their possessions are worth less, while the exact opposite is true for the top income / wealth households.

The following graph shows the percentage distribution of wealth over the 20 percentiles. The plot is based on the data featured in the table below:

Graph 21 Total Money Supply Distribution

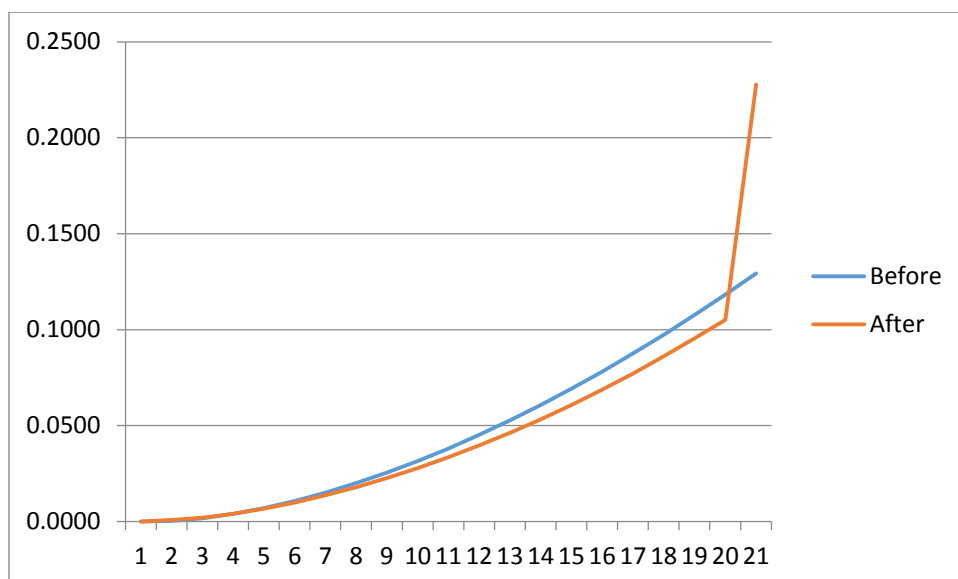
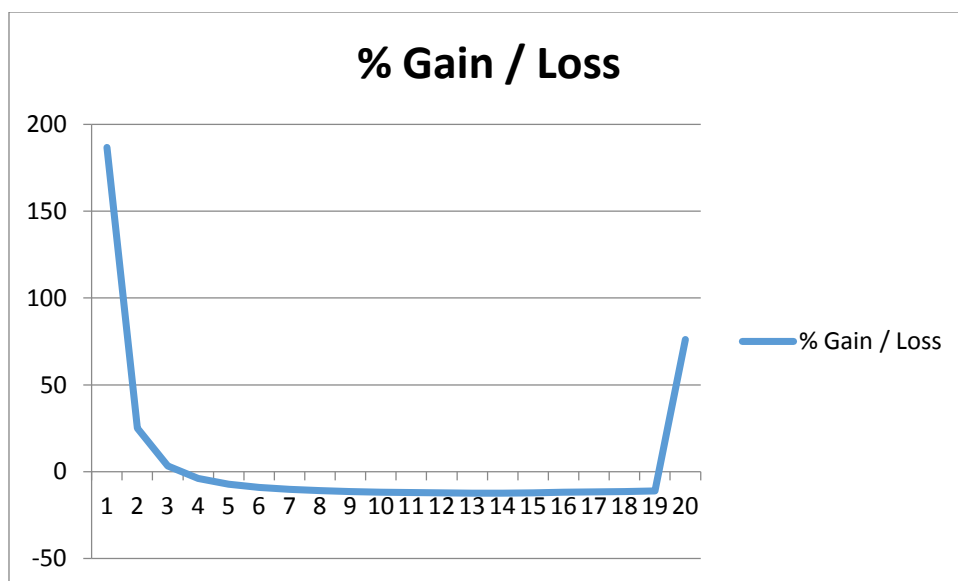


Table 9: Gains / Losses by Household Income Percentiles

Percentile	M4 Amounts	% of Total	Total Amounts	% of Total	Net % Gain
0	0.00	0.0000	0.00	0.0000	0.0000
0-5%	5.77	0.0003	19.80	0.0009	1.8659
5-10%	31.74	0.0017	47.49	0.0021	0.2500
10-15%	74.59	0.0040	92.29	0.0041	0.0337
15-20%	131.65	0.0070	151.54	0.0067	-0.0383
20-25%	201.49	0.0107	223.85	0.0099	-0.0719
25-30%	283.18	0.0151	308.32	0.0137	-0.0904
30-35%	376.01	0.0200	404.29	0.0180	-0.1017
35-40%	479.43	0.0255	511.24	0.0227	-0.1091
40-45%	592.99	0.0315	628.79	0.0279	-0.1141
45-50%	716.32	0.0381	756.61	0.0336	-0.1176
50-55%	849.10	0.0452	894.46	0.0397	-0.1199
55-60%	991.04	0.0527	1042.13	0.0463	-0.1215
60-65%	1141.89	0.0607	1199.44	0.0533	-0.1225
65-70%	1301.45	0.0692	1366.29	0.0607	-0.1229
70-75%	1469.50	0.0782	1546.18	0.0687	-0.1210
75-80%	1645.86	0.0875	1736.41	0.0772	-0.1186
80-85%	1830.38	0.0974	1936.56	0.0861	-0.1161
85-90%	2022.91	0.1076	2146.58	0.0954	-0.1135
90-95%	2223.29	0.1183	2366.43	0.1052	-0.1108
95-100%	2431.40	0.1293	5124.54	0.2277	0.7608
100%	18800.00	1.00	22503.25	1.00	1.20

We can see that the first 3 lowest income percentiles (excluding 0) actually own a higher percentage of the total money supply. This may actually be true since at such low interest rates unemployment is at an all-time low and the very poor who are in need fo borrowing, will be able to get a loan easier by paying less for it in the long run. On the other this result is probably obtained accidentally as the distribution is more or less determined by deduction based on certain sources instead of being based on hard data which could not be obtained. Thus whatever the confidence level is, it can be more distorting for such small percentages (and amounts) for the bottom 3 households. The net percentage gain / loss has been plotted in the following graph:

Graph 22: % Gains / Losses by Household Income Percentiles



The percentage gain for the first household percentile is so extreme that it can only be attributed to the error mentioned above. There is no evidence to suggest that they have benefited this much.

The importing thing is that we take a look at the rest of the graph. While the spike at the end for the 20th percentile may be exaggerated (it would normally have occurred in a more fluent, exponential function) the value should not be far from reality. Many academics believe that the QE program effectively transferred wealth from the middle class over to the powerful elite. The poor were not affected as much, because of their increased benefits of low interest rates, although it is unclear whether these benefits are able to overcome the losses incurred during QE in reality or not. The middle class doesn't perform nearly as well in periods of low interest rates because they are effectively losing a good part of their savings. Combine this with the fact that QE funds never actually reached these households and / or small businesses we see consistent losses over the entirety of the middle class. Exactly how far up the income percentiles this happened in reality isn't clear and there is little data to back it up. Somewhere between 10 and 20 percent of stock and bond owners are not located in the top 5 % income households, but, would their gains on the stock and bond market be able to offset their savings and relative wealth losses that have struck the middle class? This is something that again, this study is not able to explain.

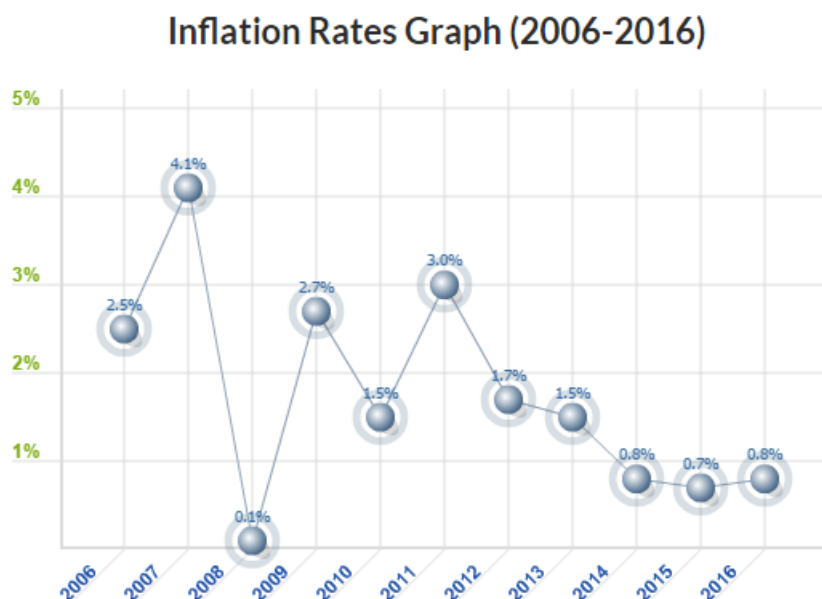
Let's take a look at the losses. We are to average the percentage losses of households between the 20 % and 95 % of the population we reach a value of 10.69 %. This is quite a large value and most of it went to the top 5 % income households who see an increase of 76 %. Any economic policy which has this as a side effect is not sound. This may not be the real world result, but the mechanism is there, it exists and it has a redistribution effect when it comes to income and wealth.

So has Quantitative easing failed? As we stated earlier the FED has the following objectives when it comes to implementing its monetary policy:

- Neutrality of money
- Stability of exchange rates
- Price stability
- Full employment
- Economic Growth
- Equilibrium in Balance of Payments

The main metric used to evaluate the achievement of these objectives is the US inflation rate. This was the main goal of the entire QE program: to pull the economy out of inflation. Unfortunately if we look at the graph below we can see the exact opposite.

Graph 23: Inflation Rates US



Source: US Inflation Calculator: *Current US Inflation Rates: 2006 – 2016* (2016)

We can see 2 spikes at the beginning of 2010 and 2012 but the overall trend is quite obviously downward sloping. FED's Quantitative Easing goal was to keep inflation at 2 %, which it succeeded for a while, until 2012 that is. By the 3rd QE stimulus package inflation was tumbling down. Professor Scott Fullwiler (2010) explains that:

“Banks can't “do” anything with all the extra reserve balances. Loans create deposits—reserve balances don't finance lending or add any “fuel” to the economy. Banks don't lend reserve balances except in the federal funds market, and in that case the Fed always provides sufficient quantities to keep the federal funds rate at its . . . interest rate target. Widespread belief that reserve balances add “fuel” to bank lending is flawed”

Furthermore GDP growth rate has been sluggish, being centered around an average of 2 %
The following graph best describes the trend:

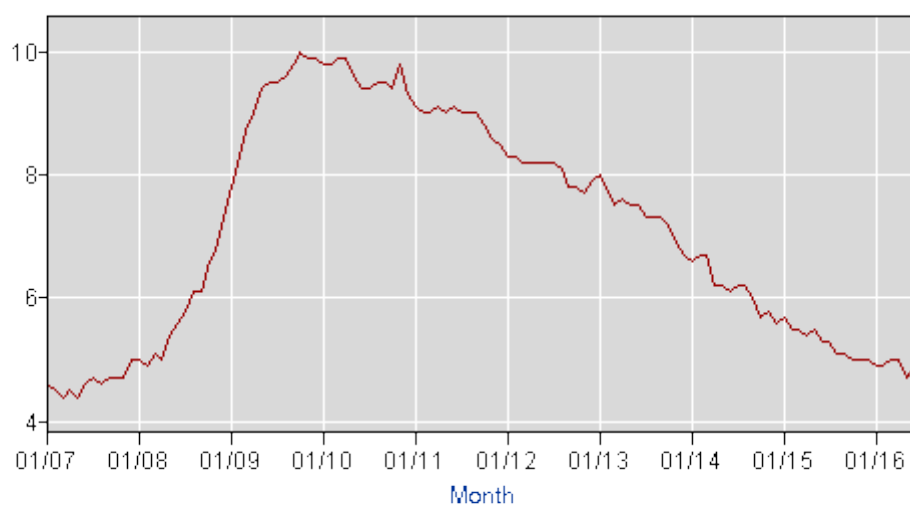
Graph 24: GDP Growth Rate US



Source: Trading Economics, *United States GDP Growth Rate* (2016)

On the other hand, other FED objectives were more successful. For example the unemployment rate decreased at a steady rate since 2010. We can see this in the following graph:

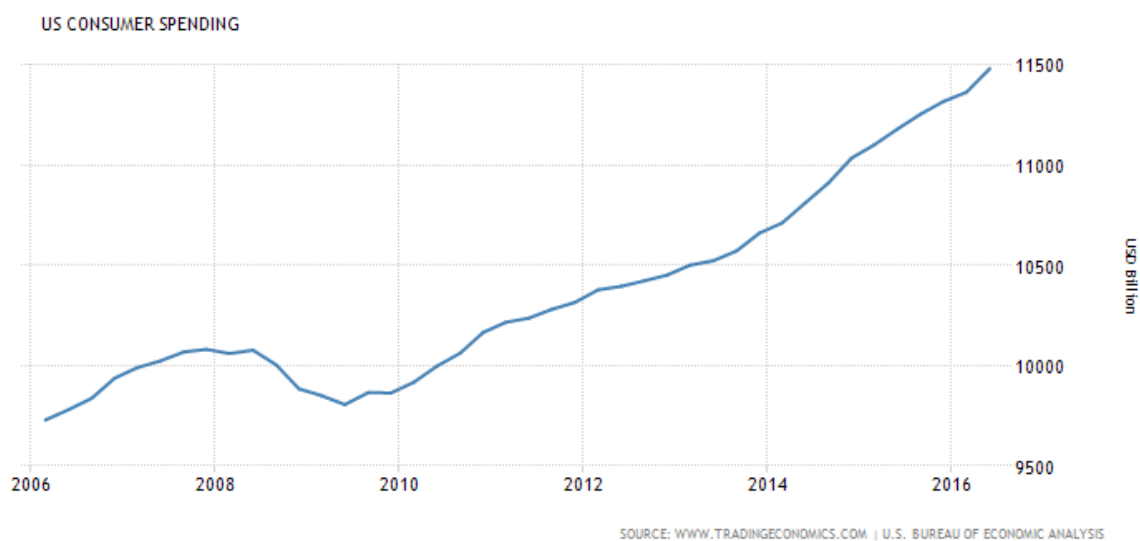
Graph 25: Unemployment Rate US



Source: Bureau of Labor Statistics: *Labor Force Statistics from the Current Population Survey* (2016).

Moreover consumer spending has gone up steadily since 2010 as well. We can verify this in the following graph:

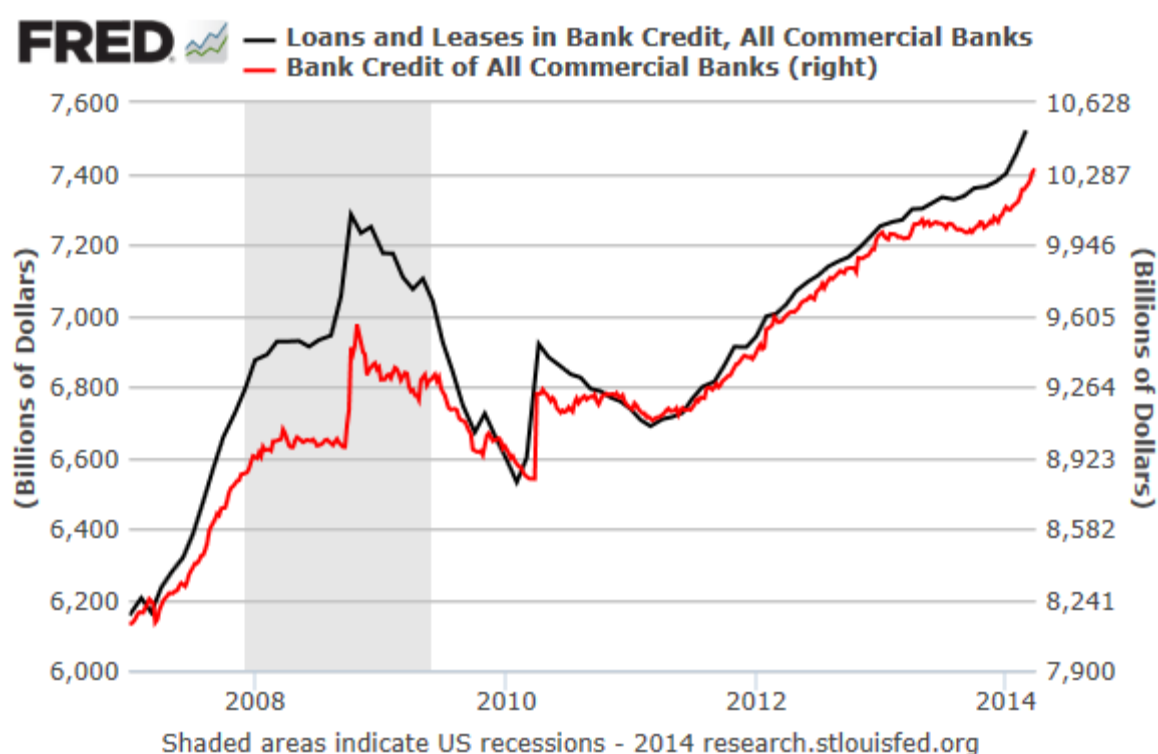
Graph 26: Consumer Spending US



Source: Trading Economics, *United States Consumer Spending* (2016)

Finally, to my surprise, Loans and Leases in Bank Credit have gone up, rather consistently by mid 2011, so much so that some say it has created a bubble.

Graph 27: Loans and Leases in Bank Credit for All Commercial Banks US



Source FRED (Federal Reserve Economic Data), *Loans and Leases in Bank Credit, All Commercial Banks* (2014)

Answering the question whether QE was successful or not depends on the perspective but most are not happy with the results. While it did accomplish most of FED's objectives, it failed at the most important one which was to raise inflation and while it did indirectly help the population one way or another, it is very clear that some benefited a lot more than others and that the funds didn't circulate the way they were intended to. And while managing income and wealth inequality isn't the FED's concern it perhaps should be considered

because it is clear that the QE policy has a much larger effect on this than conventional monetary policy.

QE's effects still haven't completely surfaced. There are simply not enough case studies to accurately say whether it works or not and not enough time passed to be able to judge the final results of its implementation.

Other nations didn't experience much improvement either. Andrew Cave (2015) from the Federation of Small Businesses placed the following arguments for and against QE in UK:

- Previous rounds have not led the money into the right hands (i.e. small businesses and households)
- We do not know how much worse the economy would have been without QE
- There is no evidence that it worked either

The Guardian states a very similar statement to what our study found and that is that "Britain's richest 5% gained most from quantitative easing" coming from a statement issued by the Bank of England.

The value of shares and bonds raised by 26 % equating to 600 billion pounds, 40 % of which are owned by the top 5 %. The Bank insists though that it saved the economy from a deep slump and that the overall economy did benefit with a boost to jobs. Note however that inflation went to as low as 0.5 %.

In Japan however the BOJ (Bank of Japan) applied a much more drastic QE package. According to Chris Sheridan (2016) the BOJ has injected the "roughly equivalent to Canada's entire economy" into their financial system. Their inflation target was also set at 2 % which, according to forecasts it will fail to achieve and the BOJ is now running out of steam. Relative to the size of the economy the BOJ was spending a lot more than the US on QE injections. Amounts reached \$70 billion a month.

4.2. Applications

There are a number of applications for this thesis:

- It serves as a basis for future research. This study is more theoretical because it is based on loose, unstructured data which limit its potential. However there are a lot of things that can be improved upon and by providing a framework of the mechanism involved in connecting QE and an increase in wealth inequality it will be easy in time to build on this work when the data required gradually surfaces. This is even encouraged as this thesis is a gateway into the discovery of new knowledge regarding this subject.
- It spreads awareness on something that is all too willingly and blindly being accepted by an increasing number of societies without having a proper understanding of how detrimental it can be from an inequality standpoint.
- It provides insight on the data that should be considered when deciding on the right course of monetary and fiscal policy. The purpose of the thesis is to have an influence on our political and economic structure by revealing the problems associated with the adoption of Quantitative Easing and ultimately attempt to reform the system.
- The mechanism shows the flow of money and this would allow the entities responsible to make better decisions in regards to these policies or at least empower stakeholders to influence them into doing so.
- It shows the importance of taking income and wealth inequality into consideration when formulating such policies, with the hope that it would be included into the primary objectives of Central Banks. This objective could be pursued exactly the same as the others.

4.3. Proposed Solutions

QE has had mixed results. It works in some economies but not in others, it reaches some monetary objectives while failing in others and it leads to a significant increase in wealth inequality. There is some evidence that it helped overcome a potentially larger recession but it is unknown how large and thus there is no indicator as to how much it actually helped. If one of the goal of the funds injected into the financial markets is to trickle down to the rest of the economy why not do this using a different method? It is clear that these funds are not cascading down nearly enough to be considered efficient. On the contrary, if only 18.5 % of the funds in the US and only 10 % in UK circulate this way it doesn't a lot of thinking to know that this is completely inefficient. There are so many downsides to QE that it is surprising that it is still knowingly being used today. Open-Market Operations are not perfect either but they're not nearly as disruptive and their effects are proven to be effective. Unfortunately they are only effective in times of higher interest rates, so an unconventional / alternative monetary policy will still need to be used.

Why not start from QE and improve on it? People's QE as described by Jeremy Corbin could be the solution to this problem. Austerity simply seems to have the opposite effect and that's why it is not being considered as an alternative. If it is true that in the long run austerity measures will be applied after QE or other policies have been exhausted, then it is not being considered here as a solution. The current solution that this study aims at providing is a similar policy to QE with similar desired end state. Austerity simply doesn't provide that.

Moving on, the final proposed solution would be Jeremy Corbin's of **PQE** but with a twist. We noted there are 3 kinds of PQE: lending, spending and direct fund injections. The third kind is not recommended because it instantly creates higher demand due to the extra disposable income. This is quite dangerous as it could too easily lead to hyperinflation: the additional goods and services available would never be able to keep because of how fast demand increases. Thus it would be a choice between lending and spending. Each affects different segments of the population in different ways but I would say that this is one of those situations where using multiple channels is a good idea because it is less susceptible to corruption or mishandling (accidental or otherwise) of the funds. Furthermore they should get

distributed in a much more equal manner. The twist that I mentioned is not ignoring the financial system, contrary to Corbin's PQE model. Perhaps it is not part of the so called "productive sector" but it is an integral and crucial part of the economy without which it would not stay afloat. So that leaves 3 channels for the distributions of the funds:

- Lending
- Spending
- Financial

Inflation would still be kept under control because there is no sudden increase in demand versus the production of new goods and services, on the contrary it would increase as a result of it.

The funds would reach both large and small businesses, public investments would help the economy as a whole and create jobs, production of goods and services will rise, increasing demand and leading to economic growth. On top of this it should not increase wealth inequality, at least in theory.

Perhaps the biggest 2 questions to be asked if implementing PQE are how much and how the distribution should be organised. These are very tricky topics which require a lot of surveys to answer correctly. The distribution requires special attention however, especially considering the 3 entirely different channels. **One of the main proposals of the thesis would be to include wealth inequality as an objective of monetary policy.** However should the objective be maintaining or reducing wealth inequality? Surely a small portion of the population doesn't desire either of these variants but we should consider the approach which brings benefits to most people. By following this rule, the objective of monetary policy would be to reduce it and it seems rightfully so. We have reached a limit as to how much wealth a handful of individuals can amass. Oxfam (2016) states that the top wealthiest 62 people own as much as the bottom 50 % of the population. It would, subjectively, perhaps be enough to strive for decrease in wealth inequality if the top 1% owned that much. Clearly **policies must** start targeting this aspect flaw of our society and **aim at reducing wealth inequality**, instead of ignoring it and even contributing to it.

So would this be feasible? That is a question which has no concrete answer and there are people on both sides of the fence, and it isn't only people we are talking about but proven academics as well. It's hard to say but current QE programs are riddled with toxic side-effects and they hardly seem to be working, considering the extent of the funds involved in the process. While some are convinced that PQE will not work, objective views state that there is no way to know for sure until trying it out. On paper it seems to make sense and considering the alternative, to be honest, it seems like there isn't much to lose by doing so.

So why doesn't it get implemented at least somewhere, considering it already received a lot of attention? This comes down to our political, economic system and human nature in itself. Lobbying is at an all-time high and there are a lot of very important interests for such policies not to be adopted. It is the way that we construct our policies, the actual process that is the issue. Same goes for wealth inequality as an objective of policy making. One would think that it should have eventually found its way in but still it hasn't happened and one can only speculate whether it will ever be taken into consideration.

Inequality is at an all time high and Joseph E. Stiglitz (2015) the former Vice President and Chief Economist of the United States Federal Reserve believes that Quantitative Easing has been a complete failure. He argues that if an economic policy of such a massive scope (roughly 4 trillion dollars) has only helped a tiny fraction of the population and barely managed to inch out of depression, it is an ineffective policy. He has written many works explaining the phenomenon that links monetary policies to income inequality and he believes that it is not only dangerous for the progression of our society but we are already so deeply rooted in a systemic cycle which perpetually increases wealth inequality that the only way of changing the course of our path is to radically reform many aspects of the world we live in. He blames many of the causes of inequality on failed economic models and on the fact that we relied so much on the idea that unregulated capitalism is the factor for economic growth.

I completely agree that inequality must be reduced and the only way to do so is to radically reform the system that. However none of that seems to happen any time soon, and right now what we need is an alternative to Quantitative Easing. One which has the capability to lift an economy out of depression but one that is also able to help the society as a whole. The fact that people accept the Government's and FED's idea of pumping in such a large amount of money with little to no positive effect on most the population, on the contrary, making most

people worse off, is outrageous. Simply the fact that an operation of this scale is shrouded in so much controversy is unacceptable. If, other than austerity, the most reasonable solution seems to be **People's Quantitative Easing**. The most extreme forms of this concept such as helicopter drops (direct transfers to households) should be avoided for the reasons explained but some mild form of PQE combined with a light injection of funds into the financial sector seems like a reasonable choice.

On the other hand such policies could simply be just another patch that delays the actual problem and we may be running out of patches. The stock markets kept getting overinflated but there is only so far that this can go and the bubble has not only been already created but it continues to expand. Moreover economists believe that the debt the private sector can amass is reaching critical levels. These 2 factors will lead to an eventual crisis, whether we like it or not and patching it up simply makes it worse in the long run. Some just hope we never run out of steam, but judging by the effectiveness of QE which has seen diminishing marginal returns, it doesn't seem to be the case. In face of all of this, **Austerity** should be considered as the only solution when other unconventional monetary policies stop working, considering they ever worked in the first place.

4.4. Conclusion

The question we first asked ourselves was whether the Quantitative Easing monetary policy of the United States had contributed to increasing wealth inequality. By calculating the distribution of current money supply and adding the QE funds on top of that with their respective distribution we can say that: yes, the QE program did increase wealth inequality. The Gini Index, if unaffected by other variables, would have increased by 10 % with a nominal increase of roughly 5 units. In order to have a reference for comparison the same calculation was performed by replacing Quantitative Easing with Open/Market Operations by using the same amount of funds to be injected, this variant yielded a result of a reduction in the Gini Index of 2 %, or 1 unit. While there is a general consensus that conventional monetary policy would not be effective anymore due to the extremely low interest rates present in the market, the difference in the two effects (conventional Vs unconventional) is the focus here. There are other channels affected by the introduction of the QE funds in the system, such as the employment channel. To be exact, QE was supposed to reduce unemployment and it was successful, which has a role in reducing wealth inequality. This effect was not included in this thesis as it is an entirely separate channel, governed by forces unrelated to the asset pricing channel used in this work. An inclusion of this channel would soften the impact of Quantitative Easing on wealth inequality and there are studies conducted on this aspect as well. Regardless the same study which was conducted by Gerald Epstein (2015) states that the employment channel's effects are overshadowed by the asset pricing channel. Thus we note that our thesis doesn't consider the entirety of the QE effects and instead focuses simply on the one channel that is responsible for increasing inequality. While this study is more focused on the theoretical mechanism rather than analysis of brute data and it features multiple shortcomings, it shows a real trend that has to be addressed. There are many effects which still remain unknown and considering QE policy has just been initiated in the EU this study aims at spreading awareness of one of the most important and overlooked aspects of this unconventional monetary policy.

Limitations

This study was built on a lot of assumptions and is therefore constrained by just as many limitations. They will be listed in the order in which they featured:

- Income vs Wealth Inequality. This issue was explained over at the beginning of the study however an exact correlation has not been identified. What is known is that income affects wealth to a large degree. My estimates would be a correlation of positive 0.8 or more but it is difficult to say exactly.
- The choice of using the Gini Index to present the data. The Gini Index is not the most accurate depiction of Income Inequality however it was chosen to simplify the calculation. There are much more descriptive inequality metrics available.
- The QE amounts and the period of purchase. These are mostly accurate but I would not guarantee it to be at 100 %. These have been quite a few conflicting sources in regards to this. Furthermore an assumption was made about the purchases being split on monthly basis. While it would be consistent with most other QE purchases, there is no guarantee that all have followed this trend.
- The Money Supply. A big assumption has been made, again for the sake of simplifying the analysis and the calculation: the QE funds are not considered as part of the M4 by the end of 2014 but rather was added on top of it. A couple of sources mentioned the existence of the M5 money supply which was not used but led to the belief that M4 doesn't define the entire money supply of a system. The assumption was made to compensate for this fact.
- Calculation of the money supply. The calculation was performed using technical analysis. As we know there is no best way of doing this, although I provided strong arguments for why it was done the way that it was.
- Lack of data regarding MBSs and Long Term Treasury distributions. There is very little to no data that can show the difference of distributions and destinations between these 2 types of funds. There is a complete lack of transparency when it comes to this and it is quite a shame since it limits the level of detail this thesis is able to provide. The accuracy of the end result will not be affected but it would have been a big step ahead if we were able to tell how much of the change in the Gini Index is attributable each portion of the funds.

- The 81.5 % of funds which remained uncirculated. They were basically provided to banks and other institutions but who actually owns them, or how can they be attributed to any 1 segment of the population? This forced usage of the assumption that they are mostly owned by the top 5 % of the population.
- Gini Index for US income inequality. There is no consistency regarding sources for the Gini Index and thus an arbitrary one was selected. This has a bit of an effect on the data, but much more on an absolute level while the study is more aimed at providing a relative view.
- The distribution of circulated and uncirculated funds. This is the second big limitation, after the choice of money supply. The data was extrapolated from sources which are either incomplete, with differing layout and / or representing similar but not identical sets of data, limiting accuracy. Compatible distributions were impossible to find and there was no way to continue the study without these extrapolations. This thesis states multiple times how *The effects of QE are not fully known*. This is a prime example of that. Such statistics are simply not yet available. To justify the methodology, these extrapolations are carefully explained so that the reader can choose whether he / she agrees or not.
- The isolation of the framework. This point is very important. This thesis ignores many of the variables affecting income inequality, even ones which are an indirect influence of QE policy (i.e. unemployment), and treats the system as if isolated from them. This is done again in order to simplify the calculation. Juan Antonio Montecino and Gerald Epstein (2015) studied the issue of QE vs income inequality as well and agree that there are 2 other channels which reduce income inequality: the employment channel and the mortgage refinancing channel. However they also state that they are not powerful enough to offset the asset appreciation and return channel (what our study is focused on). Because much of the data needed is unavailable, overcomplicating the study by including additional variables will subtract from the validity of the thesis by forcing additional assumptions and extrapolations.
- The function of the Gini Index. While most Lorenz Curves follow a similar pattern (exponential function) it is impossible to say what it actually looks like in the case of US without access to hard data. The function was simplified to simplify the process of calculating once again. However whatever function should have been chosen, it is

unlikely that it is too different from this. Because of the cumulative nature of the data composing a Lorenz Curve it is often very similar to a $f(x) = x^y$ function. This is a rather important assumption because it depicts the distribution of the M4 money supply but considering that whatever function we choose, inequality should still shift by the same amount, the end result will be just as accurate.

As a final note, while this study tries to be as accurate as possible, there are too many assumptions and data processing operations which could quite distort the final results, but the effect of QE (through the asset appreciation and retrain channel) on income and wealth inequality is undeniable and is consistent throughout the thesis. I'm positive that by analysing the other variables, this effect would be diminished, but never eliminated.

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