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The Consequences of Ultra-low and Negative Interest Rates on the Real Economy

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Abstract

This research aims at analysing the consequences of ultra-low and negative interest rates on the real economy in three economic blocs: the United States, Japan, and the Eurozone. We give an extensive account of the most relevant central bank tools with a focus on money and interest rates. The consequences expected by central banks and academics when implementing expansionary policies are then reviewed. Subsequently, through a data-based verification, we show that monetary policy close to or below the zero lower bound is partly ineffective. Even though consumption rates are on the increase and there is a decline in the unemployment rate, actual data does not clearly back an increase of the inflation rate or a depreciation of the currency. Based on our results, we come to question the effectiveness of current monetary policies, as well as their alignment with a new economic reality.

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Introduction

The effects of the 2007-2009 financial crisis that turned global economies upside down are still being felt today. Both financiers and economists still get the blame for the events that unfolded during that period. The former group for causing it and the latter for not predicting it. The response of central banks has shaped an economy unlike anything that has been previously studied, with short-term rates and bond yields at negative levels and markets hanging on to every statement made by central banks.

Ultra-low interest rates have become the new normal (Pesek, 2015). More recently, one of the most basic economic concepts of the last century, the time value of money, has been negated by central banks. As in the Eurozone and several other countries, commercial banks must pay in order to deposit money in the central banks' vaults. This logic has also spread to other segments of the economy. In some European countries, (e.g. Denmark, Switzerland, Luxembourg) companies are now being charged by commercial banks to deposit their extra funds (Campbell & Levring, 2016).

In light of these developments, our study aims, in a first step at developing an understanding of the consequences central banks expect to materialise as a result of their policies; and in a second step, to analyse whether the wanted effects have been achieved and to which extent they have changed conditions in the real economy. Throughout our preliminary readings, we found that the majority of studies adopted a forward-looking perspective by creating and adapting economic models to predict what the consequences of these policies will be. However, to the best of our knowledge, there has not been a comprehensive account on the change in economic indicators, *à posteriori,* in a country let alone a comparative study between major monetary systems. As such, this work can be seen as an attempt to fill a gap in the literature.

For the reader to become acquainted with the intricacies and complexities of macro-economic developments and in order for country-specific factors to average out, we choose

to study the three major economic blocks, Eurozone, United States and Japan currently applying ultra-low or negative interest rates. The paper has been divided in three main chapters completing and accompanying each other as the reader follows us in our analysis.

- The first chapter consists of the literature review where we have exposed the theories on money and interest rates as well as the state of the literature regarding the different configurations and tool sets central banks' have at their disposal when drafting monetary policies. Consequently, we introduced our main topic by looking at what history had to tell us about the very first implementations of negative interest rates.

- The second chapter starts with an account of the triggers (crises and developments) that have led central banks to the inevitable implementation of ultra-low and negative interest rates. The rest of the chapter lays the foundation to our final analysis by providing a complete account of what are the reported reasons (i.e. the expected effects) of central banks' in implementing such policies.

- The third chapter concludes our work by performing a data-based verification of the expected consequences that were laid down in chapter 2 thanks to the gathering and the analysis of data coming from all the major intergovernmental organisations and central banks.

Methodology

In order to give the reader the tools to fully grasp the particularities studied in our work, we choose to perform an exhaustive literature review of the notions studied namely money and interest rates, which are two indivisible concepts as well as monetary policy which regulates them.

While reading through the literature and selecting what to include in the core of our work, we followed a two-step method: first, we wanted to help the reader get a complete understanding of what had been published regarding the topic studied, second, we exert our critical thinking in exhibiting what the strengths and weaknesses of those ideas and concepts might be. However, we gave a preference to being partial to the facts as exposed in the literature reserving our full appreciation and remarks to Chapter 3 when we delved into the data-based verification of the expected consequences of ultra-low and negative interest rates.

Given the breadth of the literature analysed as well as its technicality, we decided to create tables at the beginning of each Part, summarizing the main takeaways of the section and giving a succinct picture of the authors cited. The presence of these tables is a way to guide the lecture of the chapter and to allow the reader to jump back to the main concepts when needed with the aim of enhancing the overall comprehension of the text.

As the title of our work suggests, the reader is about to be exposed several times to the word “interest rate”. Therefore, it is paramount that we define to what it refers in the context of our research. When speaking of a central bank’s monetary policy, the interest rate that is referred to in the literature as well as in most newspapers is the overnight deposit rate, also called policy rate. In the Eurozone, it is officially called the deposit facility, in the United States it is named the Federal funds rate while in Japan it is dubbed the overnight call rate.

Chapter I.Literature Review

1. Money and interest rates

This part of the literature review will concentrate on casting some light on what is and has been the role of money in society and in the economic system of our modern democracies. Some common macro-economic measures of money will also be presented. We will then shift the focus on the mechanism that is used to regulate the supply of money and attribute it its time value, namely the interest rate. Our definition of interest rates will have for aim to be as broad as possible and to include all the relevant forms of interest rates founded in our economic sphere. After having presented some theories on interest rates, we will close this part by exploring what is called the lower bound on interest rates.

Even though the subject will be developed in more depth in the third point of the literature review, when discussing the characteristics of money and interest rates, it is paramount to also touch upon the institutions in charge to manage them, namely, the central banks. For the past several years, an increasing attention focus has been casted on central bankers. In the aftermath of the financial crisis their actions, as The Economist puts it, had the same aim: preventing a shock from becoming a depression. Their main lever to achieve such an objective was to cut central banks' deposit rates (i.e. the premium central banks pay to private banks in order to compensate them for the time value of money, while it is in the central banks' vaults).

When it comes to controlling the supply of money in the economy through the central bank deposit facility rate, heads of central banks must act independently and comply with the central bank mandates. The objectives and key benchmarks that are included in a central bank's mandate differ across jurisdictions. The Fed's role is defined by the Federal Reserve Act and aims at maximising employment, securing price stability and moderating long-term interest rates (Federal Reserve, 2017a). The European Central Bank (ECB) has set as its primary mandate to achieve price stability. As a benchmark, the ECB has decided to target an annual headline inflation rate of *close to but below 2 percent* (European Central Bank, 2017a). Münchau (2017) argues that central bank independence is under threat and that it is easier

to preserve it when mandates are defined narrowly and there's no space for trade-offs. Comparing the ECB's mandate to the Fed one reveals that in the US, the presence of several policy goals implies that at some point trade-offs would need to be made. In turn, for the Fed this broader definition might imply a deviation from an independent task to what constitutes the essence of a political task. (Münchau, 2017).

In order to guide the reader through this dense part of the literature review, we have created a table below, summarising the most important takeaways of each point as well as the authors cited.

Table 1.1. Money and interest rates

Parts	**Authors**	**Takeaways**
Theory on Money	Ostroy and Starr (1990); Walras (1900); Keynes (1936)	- Money plays three roles: unit of account, store of value and medium of exchange. - Transactions role of money cannot be separated from its function as a store of value. - Economic theories motivating certain policy decisions take the store of value function as the predominant view.
Measures of Money	Johnson and Kamerschen (1970); Taylor (2009); Federal Reserve (2017a); European Central Bank (2017); Bank of Japan (2014)	- M1 is the most liquid form of money in represents the currency in circulation and short-term deposits. - M2 encompasses M1 and, also includes medium to long-term deposits. - M3 is the broadest measure of money including the two previous ones, money market funds and deposits with financial institutions.
Theory on Interest Rates	Brealey, Myers, and Allen (2009); Snowdon and Vane (2005); Aglietta and Valla (2016)	- In addition to its face value, money has a time when it is not spent directly. - The interest rate is the price of money to be saved, or to be borrowed and repaid at a later date. - Interest rate determined by the liquidity preference (demand) and the supply of money. - Central banks monitor the equilibrium between savings and investments, thanks to an equilibrium interest rate.

Parts	Authors	Takeaways
Types of Interest Rates	Lubik and Matthes (2015); Duprat (2015); (European Central Bank, 2017b); Hou and Skeie (2014);	- Natural rate of interest: policy rate that equates savings and investments at full employment, guaranteeing price stability - Policy rate: central bank's deposit facility rate - Short-term interest rate: approximated by the LIBOR which serves as reference rate for debt instruments. - Long-term interest rate: rates of government bonds maturing in 10 years; closest determinant to business environment.

Source: Personal Production

1.1. Theory on money

Following Ostroy and Starr (1990), money plays three commonly acknowledged roles: unit of account, store of value and medium of exchange. Money, as an object, comes first to our attention thanks to the role it assumes as a facilitator of transactions. However, it is also important to note that the transactions role of money cannot be separated from its function as a store of value. Even though a medium of exchange must necessarily be a store of value, the inductive logic stating that all stores of value are necessarily money does not hold.

Ostroy and Starr (1990) postulate that what gives the unique character to money and distinguishes it from other stores of value is its liquidity. The liquidity characteristic that money holds derives from the fact that money is the common medium through which other commodities are exchanged. It is also worth noting what we mean by liquidity and that is *the ready convertibility through trade to other commodities* (Ostroy and Starr ,1990, p.28) which is not *a property of the commodity itself but something that is established through the trading arrangement* (Ostroy and Starr ,1990, p. 28).

Further research conducted by the same authors found out that among the three main roles of money outlined above, the transactions one would be at the top of the hierarchy. As we will debate exhaustively monetary policy theories and their effect on economic variables, it is paramount to note that some of the prevailing economic theories (i.e. the general equilibrium theory of Walras (1900)) on which certain policy decisions are based have taken

the store of value function as the predominant view when incorporating money in their hypotheses.

Consistent with this view of money as a store of value are Keynes (1936) theories. The author advances that rational agents may choose to hoard money without the explicit purpose of making transactions, but simply as a way of preserving and storing economic value. However, where both Ostroy and Starr (1990) and Keynes (1936) theories meet is as to why economic agents desire to hoard money and that is because of its intrinsic liquidity characteristic.

1.2. Measures of money

To give a holistic definition of money as a concept and touch upon the ways it is referred to in economic theories, we will briefly present the three main measures of money. The different measures of money supply can also be linked to the different functions money can hold which was the main focus of the previous point. As Johnson and Kamerschen (1970) state in their book about Macroeconomics, there's not a unique measure of money supply as such. Instead, we can find several measures of money that range in a continuum going from narrow to broad monetary aggregates.

The types of money are called "M's" and they range in the same order as the numbers, M0 being the narrowest definition of money while M3 is the broadest. As category numbers of the money measure increase so do their maturities. Given that we will give a predominant focus in our thesis to a cross-country analysis including the Eurozone (i.e. the European Union countries that are part of the Economic and Monetary Union and share the euro as a common currency), the United States and Japan, it is essential that we also define what are the differences in the measures of money of those different economic systems.

Taylor (2009) found that the European Central Bank defines the Eurozone money aggregates as follows:

- *M1* is made of the currency in circulation (i.e. euro bills and coins) and the overnight deposits.

- *M2* encompasses *M1* in addition to deposits with an agreed maturity up to 2 years and deposits redeemable at a period of notice up to 3 months.
- *M3* consists of *M2,* repurchase agreements, money market funds and debt securities up to 2 years.

The Federal Reserve webpage sheds exhaustive light on the measures of money in practice in the United States. The Federal Reserve makes a distinction between central bank money (called MB or M0) and commercial bank money (ranging from M1 to M3).

- *M0* is made of the coins and notes in circulation whether they are held inside or outside the private banking system as reserves (i.e. the total of physical currency).
- *M1* comprises *M0* outside the private banking system, the demand deposits, travellers' checks and other checkable deposits.
- *M2* includes *M1* plus most savings accounts, money market accounts, retail money market mutual funds, and small denomination time deposits (under $100 000).
- *M3* encompasses *M2* in addition to all other certificates of deposits (e.g. large time deposits), deposits of Eurodollars and repurchase agreements.

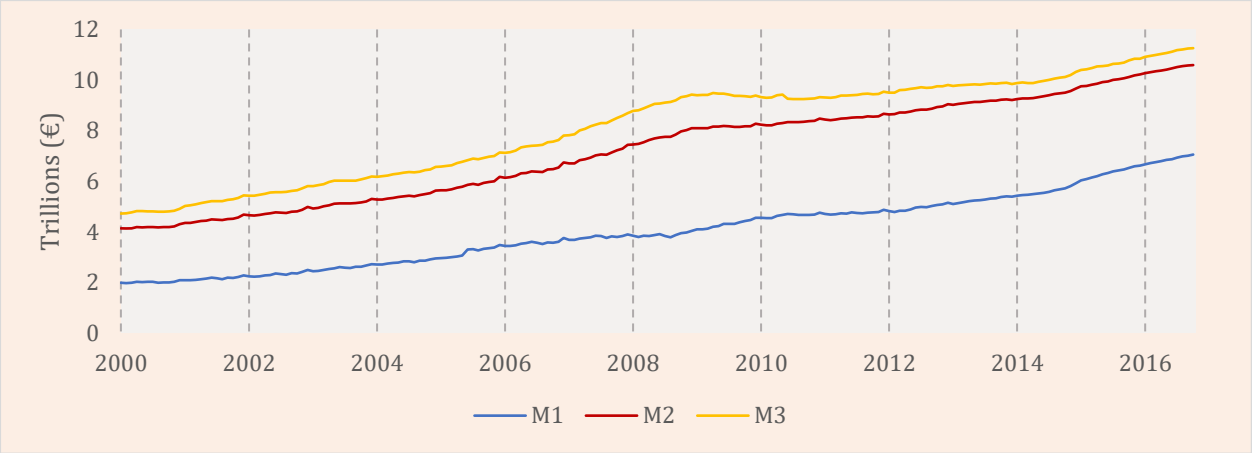
It is worth noting for the remaining of our work, that the Federal Reserve has also a unique money aggregate which happens to be its most famous and that is: *MZM* (i.e. Money Zero Maturity), as the Federal Reserve website mentions, this aggregate is used because of its velocity and has been the best predictor of inflation. It includes *M2,* time deposits and money market funds.

The Bank of Japan defines the money aggregates as follows:

- *M1* consists of cash currency in circulation and deposit money.
- *M2* includes *M1* in addition to what is define as "quasi-money" (e.g. savings accounts, money funds, time deposits) as well as certificates of deposit.
- *M3* encompasses *M2* plus deposits of post offices, savings and deposits with financial institutions and money trusts.

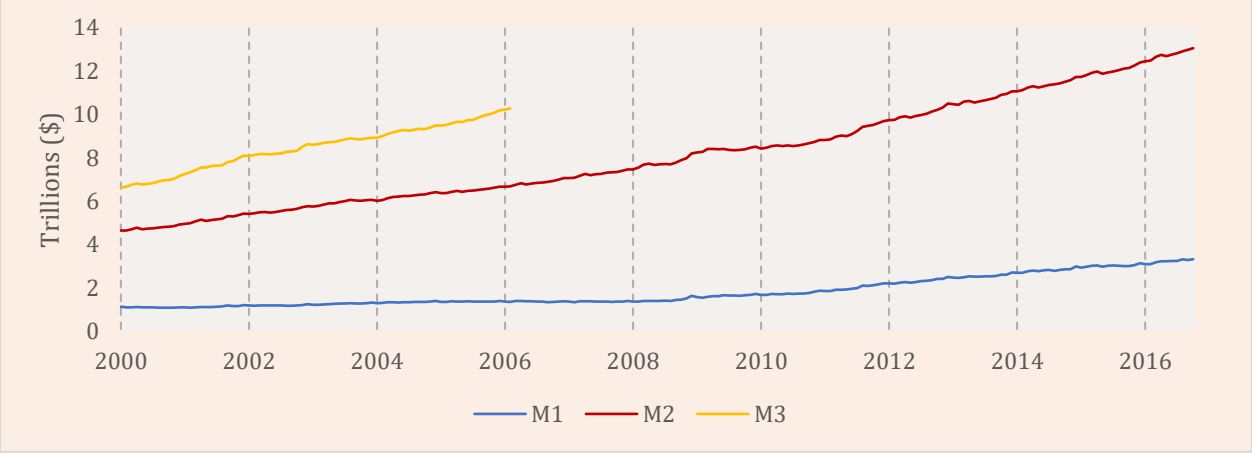
This cross-system analysis reveals that the measures of money used by the predominant Central Banks are fairly similar ranging from the narrowest definition (i.e. cash in circulation) to the broadest one including all forms of money including time deposits and money funds. In order to give the reader an order of size for the measures of money we have just discussed above, we have gathered monthly, not seasonally adjusted data, from the St. Louis Federal Reserve for each money aggregate in the three economic regions studied in our work. It is worth mentioning that the Federal Reserve has stopped the disclosure and measurement of M3 as of the 23rd of March, 2006.

Figure 1.1. Eurozone Money Stock



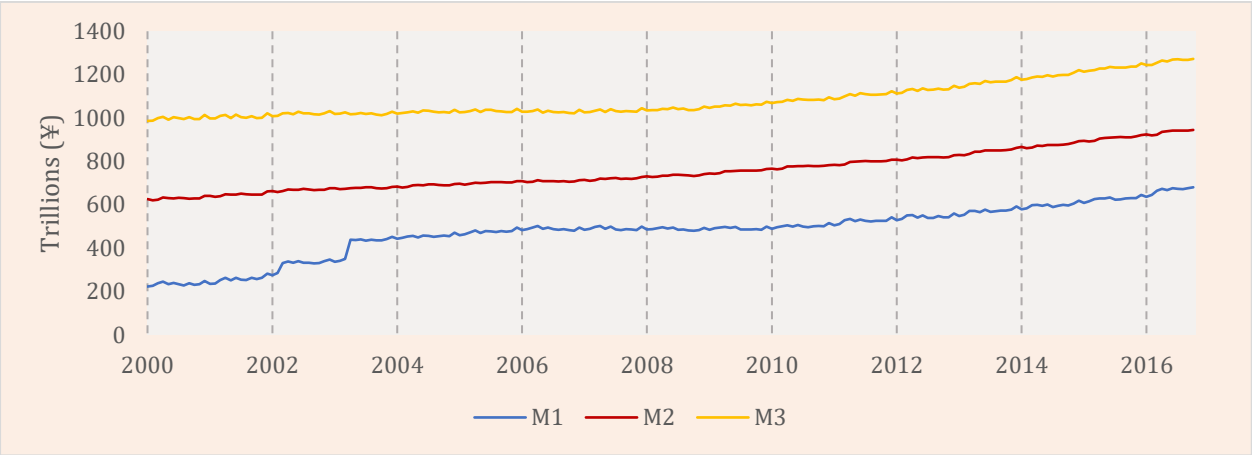
Source: St. Louis Fed; Personal Design

Figure 1.2. United States Money Stock



Source: St. Louis Fed; Personal Design

Figure 1.3. Japan Money Stock



Source: St. Louis Fed; Personal Design

1.3. Theory on interest rates

Having exposed the concept of money and the ways to quantify it, we can now delve into the tool that is used to regulate its supply: the interest rate. The most basic definition of the interest rate has been echoed by Brealey, Myers, and Allen (2009), which posit that *a dollar today is worth more than a dollar tomorrow*. This widely accepted notion, gives money more than its face value, it adds a time value when money is not spent directly, but saved to be spent at a later time. The way to quantify the time value is the interest rate, which is the price of money that is hoarded to be spent later, in case of saving, or that it is spent before possessing it in case of borrowing.

Snowdon and Vane (2005) report that in Keynes's General Theory, the interest rate is conceived purely as a monetary phenomenon. Keynes further advances that the level of interest rate is determined by two variables: the liquidity preference (i.e. demand for money) and the supply of money which is determined by the authorities. Aglietta and Valla (2016) give an interesting perspective on the use of interest rates by Central Banks. Nowadays, macroeconomists recognize the existence of financial cycles of great magnitude and long duration and how they impact the economic cycles inherent to them. The authors further advance than in presence of this "super-cycles", central bankers have drop the direct control

of the money supply in favour of controlling the equilibrium between savings and investments, thanks to the usage of a principal interest rate, the natural interest rate. This is the level of interest rate that equates the desired level of savings to the expected investment yield when the GDP is at its potential level.

Following Aglietta and Valla (2016), the monetary authority ought to fix their nominal policy interest rate at a level equal to the natural interest rate if they want to keep price stability. The real interest rate is constructed by adding to this nominal policy interest rate, the expected level of inflation (i.e. the erosion in the value of money), determined by financial markets actors. Moreover, when the expected growth rate of the economy is constant, the inflation expectations are aligned on the inflation target determined by the Central Bank.
It is worth noting for the rest of the analysis that if the level of the real natural interest rate would be known by the Central Bank, monetary adjustments would be easy to conduct. It would, indeed, suffice to make the real policy interest rate converge towards the real natural interest rate in order to achieve the targeted level of inflation.

The important question at this point is how these mechanisms adapt or are disturbed by the use of negative interest rates?
While we will discuss the precedence and relevance of negative interest rates in point 3 of our literature review, it convenes, in light of what has been discussed before, to explain the logic behind negative interest rates.
The Fisher equation tells us that:

$$(r_r = r_n - \pi_e)$$

- the real interest rate (r_r) is made of two components:
- the nominal interest rate (r_n) minus
- the expected inflation rate (π_e).

As we can see, for individuals, the real interest rate acts as a better predictor of the cost or remuneration of funds as it includes a correction for the erosion of money that inflation causes.

Therefore, when the level of inflation is close to zero, as it has happened for the past years in the Eurozone and the United States, keeping the nominal interest rate positive will result in a real rate that is too high to entice money demand and by that stimulate the economy.
As a consequence, when inflation expectations are this low and especially if we are confronted with a period of deflation (i.e. a negative inflation rate), the monetary authority has no other choice but to decrease the nominal interest below its zero-lower bound.

1.4. Lower bounds on interest rates

There's a widespread rationale, first formulated by Hicks (1937), stating that interest rates have a "natural" zero lower bound, implying that they could never by negative. The author further advances that *if the costs of holding money can be neglected, it will always be profitable to hold money rather than to lend it, if the rate of interest is not greater than zero. Consequently, the rate of interest must always be positive*. (Hicks ,1937, p. 150)

Later on, Friedman (1969) formalized a variant of Hicks assumption in what is called the *Friedman rule.* The author postulates that the optimal level of nominal interest rates is zero, which means that there is neither a tax nor a subsidy on cash. da Costa and Werning (2008) have found out that, thanks to the complementarity of money and work effort, negative interest rates may be efficient, while they view the Friedman rule as a corner solution, under the assumption that negative interest rates are not practicable.

However, Rognlie (2015), through his various demonstrations, argues that this claim is false as the cost of holding cash would always be positive and can, therefore, not be neglected. On the other side, the author argues that, from the monetary authority perspective, negative interest rates are not without costs as they, effectively, subsidize fiduciary currency. The rationale behind is that, paper currency now receives a nominal return (zero) that exceeds

the return (negative) on other short-term assets (i.e. deposits). The author has found that with negative interest rates as a tool, it is more feasible to come close to the optimal level of output, however, the urge to avoid a loss from subsidizing cash, mitigates the effect.

In conclusion, the assumption backing a natural zero lower bound on interest rates comes from the fact that a return on paper currency equal to zero is preferable to a bond or deposit returning less than that. Therefore, any attempt to push interest rates below zero will inevitably conduct to an explosion in the demand for cash. However, the author delves into different theoretical situations where negative interest rates might be applicable and breach the basic assumptions. These scenarios and other views regarding the effect of the zero lower bound are beyond the scope and objective of the present work.

1.5. The different types of interest rates

At this point, it is paramount that we define some of the types of interest rates we will be discussing the most during the rest of our work. Without the aim of being comprehensive, the rationale behind this list is to showcase what is under the name "interest rates" and how the concept is used and defined throughout the literature. As the difference between nominal and real interest rate has already been defined above, in *point 1.3*, I will assume the reader is familiar with this difference.

- *The Wicksellian Natural Rate of Interest* is a relationship that was discovered by the Swedish economist, Knut Wicksell. Lubik and Matthes (2015) define it as the interest rate that is compatible with a stable price level. It follows from this definition, that if the monetary authority sets as policy rate a value that is above the natural rate, the economic activity will contract leading to lower prices. Whereas a decline relative to the natural rate has the opposite effect. Echoing Wicksell's view, Lubik and Matthes (2015) affirm that the equality of the market interest rate with the natural one, guarantees price and economic stability. However, the authors don't fail to mention that the natural rate is unobservable as it is a hypothetical construct that cannot be measured directly. Duprat (2015) gives a complementary definition of the natural rate

of interest as the policy rate that equates savings and investment at full employment.

- *The policy rate, also called deposit facility* can be defined as the Central Bank's deposit rate. The European Central Bank defines it on its website as *the rate on the deposit facility, which banks may use to make overnight deposits with the Eurosystem*. (European Central Bank, 2017b)

- *The short-term interest rate* is best approximated by taking the London Interbank Offered Rate (LIBOR), which, following Hou and Skeie (2014), is the most renowned benchmark for short-term interest rates. It indicates banks that participate in the determination of the LIBOR, the average rate at which they can obtain short-term loans in the London interbank market. The primary function of LIBOR is to serve as the benchmark reference rate for debt instruments, including government and corporate bonds. The rate also serves to assess the current state of the world's banking system and acts as a proxy to evaluate expectations for future central bank interest rates. The most common rate used is the U.S. Dollar 3-month LIBOR rate.

- *The long-term interest rate* refers to government bonds maturing in ten years. The OECD further mentions that long-term interest rates are determined by *the price charged by the lender, the risk from the borrower and the fall in the capital value*.

The value of these rates is not determined by the governments but implied by the prices at which bonds are traded on financial markets, which may very well vary from the interest rates at which bonds were initially issued. In all cases, long-term interest rates refer to bonds whose capital repayment is, in principle, guaranteed by governments. That is why some refer to it as the risk-free rate for a given country. This interest rate is the closet determinant of business environment, the OECD mentions that *low long-term interest rates encourage investment in new equipment and high interest rates discourage it* (OECD, 2017a).

2. Monetary policy

Conducting negative interest rates policies, implicitly signals, among other things, that Central Banks are at the end of their means over how to spur growth and fight deflation. Before getting into such extreme forms of intervention, we will analyse what are the "traditional" tools and policy means Central Banks have at their disposal to direct the economy.

Central Banks do not only give guidance and aim at stirring the economy in one particular direction, they are also the "Bank of Banks" and as such assume the role of lender of last resort (Fleming, 2015). This function allows them, mainly through their monopoly on issuing liquidity, in playing a preventive and corrective role assuring the financial system's stability (Wolf, 2014).

There is another variable that impacts Central Banks' reach, and that is, their credibility, or as Kydland and Prescott (1977) put it, their time consistency. The authors found that for a policy to be fully efficient, it has to be credible over time. This point will also be developed below as in order to reach that objective, Central Banks now use forward guidance.

To guide the reader and give a summary of what is about to be discussed, we have compiled a table with crucial takeaways from all the parts to follow. This table also includes a comprehensive view of the cited authors.

Table 2.1. Monetary policies

Part	Authors	Takeaways
Types of monetary policies	Borio and Zabai (2016); Borio and Disyatat (2010); Taylor (1999); Christiano, Eichenbaum, and Evans (1994); Johnson and Kamerschen (1970); Wolf (2014); Smaghi (2009); Viñals, Blanchard, and Bayoumi (2013); Moghadam and Teja (2014); Ugai (2007); Kapetanios, Mumtaz, Stevens, and Theodoridis (2012); Bech, & Malkhozov (2016); Jensen and Spange (2015)	- A tight monetary stance refers to the situation when a central bank raises short-term interest rates in order to decrease the money supply and increase the cost of borrowing, with the aim of decreasing inflation. - An easy monetary policy corresponds to the opposite, when the central bank decreases the reference rate. - A central bank is said to be pursuing a conventional policy when it uses either its policy rate or adjust the supply of money without engaging in outright purchases of debt instruments. - Unconventional tools comprise: Balance sheet policies (i.e. QE) (altering the availability of certain assets); Forward guidance (influencing public expectations about the future path of policy rates); Negative interest rates (when policy rates are set below the zero lower bound).
Role(s) of monetary policies	Mishkin (1999); Federal Reserve (2017a); Federal Reserve (2017b); European Union (2017); European Central Bank (2017c); European Central Bank (2017a); Bank of Japan (2013)	- US: maximum employment, stable prices, and moderate long-term interest rates. - EU: maintain price stability, supporting the economic policies of the Union - Japan: achieving price stability and contributing to the sound development of the national economy
Fiscal and/or Monetary policy	Nakata (2016); Eggertsson (2011); Woodford (2011); Davig and Leeper (2011)	- When the policy rate hits its lower bound, it becomes optimal to increase government spending. - Interactions between monetary and fiscal policy are essential in achieving the central bank's objectives, separating them prevents from reaping those benefits.

Source: Personal Production

2.1. The different types of monetary policies

First of all, let us introduce how monetary policy can be conducted. Interest rate policy and balance sheet policy are the two ways a central bank has to influence monetary conditions. Under the first set of measures, a central bank controls a short-term rate and guides expectations about its level in the near future. To increase its impact on monetary conditions, the central bank can also decide to alter the size or the composition of its balance sheet through open market operations (Borio, & Zabai, 2016).

The intended effects (easing or tightening) of these tools as well as their range and ingenuity (unconventional or conventional) will be discussed below. A policy which won't be discussed into further details in this work, is the exchange rate policy whereby the central bank conducts operations in the foreign exchange market altering the exposure of the private sector to foreign currencies (Borio, & Disyatat, 2010).

- *Easy or tight monetary policy?*

We will take the US as an example to explain the main difference between what is considered a tight or easy monetary stance. The Federal Reserve uses as its main policy tool, the Federal funds rate level. Tightening occurs when the rate is raised whereas easing corresponds to a decrease of the reference rate (Taylor, 1999).

As defined previously, one of the main policy objectives included in the FED mandate is to maintain stable prices. Therefore, when inflation (as a proxy for the level of prices) is rising too fast, the Federal Reserve will make money "scarce" by raising short-term interest rates thanks to the Federal funds rate which is also used as the discount rate (Taylor, 1999). As the cost of borrowing increases in relation with the interest rate level, it becomes less attractive to borrow funds which has the, expected, effect to push prices down.

As Christiano, Eichenbaum, and Evans (1994) further advance, with higher Federal funds rates come higher savings, as individuals are paid more to park their extra cash within the

bank, further decreasing the quantity of money flowing into the real economy and acting as a further drag on prices.

If the natural increase in savings from individuals is not enough for the Federal Reserve to achieve its aim, another tool commonly used is to sell treasuries on the open market. As the Federal Reserve, through the sale of treasuries, promises investors a return on top of their principal for them to give up immediate liquidity, this tool helps reducing the money supply which prevents the domestic currency from appreciating (Johnson, & Kamerschen, 1970).

An easy monetary policy environment follows an inverse rationale to the one described above. When there is sluggish growth in the economy and the money supply is too slow compared to the targeted objectives. The Central Bank effectively lower its key rate which impacts borrowing rates leading consumers to borrow more, thereby, increasing the money supply (Taylor, 1999).

- *Conventional or unconventional (QE) tools?*

As Wolf (2014) rightly points out, the main justification behind the recourse of Central Banks around the world to unconventional monetary policies has been the natural limit of conventional central bank intervention rates to the zero lower bound. Smaghi (2009) further asserts that non-standard tools, in some situations, might be needed before policy rates have touched their lower bound. When interest rates are approaching the zero lower bound, asset purchases (i.e. quantitative easing) still have the power to make monetary policy effective.

Let us first define what falls into the category of conventional monetary policies. Smaghi (2009) asserts that, after having set a target for the overnight interest rate in the interbank money market, Central Banks adjust the supply of central bank money, through open market operations, to that target, in order to achieve their monetary policy objectives. He further emphasizes that, in normal times, the central bank is not involved in direct lending to the private or public sector, nor in outright purchases of any types of debt instruments. By setting a key interest rate, the central bank effectively manages the liquidity conditions in money

markets which help it to achieve its primary objective of maintaining price stability in the medium-term.

However, abnormal times call for exceptional measures, and providing:

- the economic shock suffered by the economy is so severe that rates need to be brought down to their zero lower bound or;
- the key interest rate is above zero but the monetary policy transmission process is impaired;

Central banks might have to resort to unconventional policies in order to achieve their objectives.

Therefore, whenever rates cannot go lower (even if in practice we will demonstrate they can) or the transmission channel of monetary policy (i.e. interbank money market rates) is notably impaired, conventional policies are largely ineffective. Smaghi (2009) also notes that when implementing unconventional policies, an issue that is common to all Central Banks is the risk of hindering the functioning of markets by substituting or interfering with them.

Unconventional tools will be further developed below but we can already disclose that they comprise tools as balance sheet policies (i.e. quantitative easing), forward guidance and negative interest rates.

2.2. The role of monetary policy

The goals of monetary policy vary per region and Central Bank. As the bulk of our study will be concentrated on three economic systems, namely the U.S., the E.U. and Japan, we will look at the monetary objectives of each of those global poles. Mishkin (1999) points out that the political, cultural and economic institutions of a country as well as its past history, play a role in assessing what is the best policy strategy.

- *In the United States*

The objectives of the Federal Reserve (Fed), the country's central bank, were set by Congress, the main national legislative body, in the Federal Reserve Act. As per this legislation, the monetary policy conducted by the FED has for objectives: *maximum employment, stable prices, and moderate long-term interest rates* (Federal Reserve, 2017a).

In respect to the stable prices target, the Federal Open Market Committee (FOMC) issued a statement in January 2012 asserting that an inflation rate of 2 percent (measured by the annual change in the price index for personal consumption expenditures) was the most consistent metric to target in line with its statutory mandate. The implicit role of quantifying and communicating such a specific target is that it keeps long-term inflation expectations anchored which in turn helps to foster price stability, keeping moderate long-term rates and supporting maximum employment.

In respect to maximum employment, the FOMC admits that employment levels are also strongly influenced by nonmonetary factors affecting the dynamic of the job market. Therefore, the FOMC has choose not to pursue or publicly communicate a specific target level of maximum employment. However, in the FOMC's March 2017 Summary of Economic Projections, the participants disclosed what they believe to be longer-run normal rate of unemployment which ranges from 4.5 to 5.0 percent, with a median value of 4.7 percent (Federal Reserve, 2017b).

Finally, the FOMC also believes that pursuing their assessed maximum level of unemployment and keeping inflation at 2 percent are two complimentary objectives.

- *In the Eurozone*

The Article 127 of the Treaty on the Functioning of the European Union (European Union, 2017) establishes that the primary objective of the Eurosystem (i.e. monetary authority of the Eurozone) and of the single monetary policy is *to maintain price stability* (European Central Bank, 2017c). However, it is also stated that the Eurosystem shall contribute to the objectives of the European Union by supporting the economic policies of the Union. The

European Central Bank (ECB) further asserts that among the objectives of the European Union are "full employment" and "balanced economic growth" (European Central Bank, 2017c).

However, the ECB does not fail to remind that the Treaty gives a dominating importance to price stability as the way to achieve both a high level of employment and a positive economic climate. The strong focus on price stability has two implications in the way monetary policy is interpreted and conducted in the Eurozone.

First, it emphasises the importance of price stability benefits, as a controlled level of inflation increases the economic welfare and the growth potential of the economy. The second implication, and the most important one in the context of our research, is that the ECB's interpretation of monetary policy assumes it can affect real activity only in the short-term. Indeed, as the only role given to the ECB is to maintain price stability, in the longer run, all the central bank can do is influence the price level in the economy, leaving little room for tools with the potential to have a greater impact on the real activity.

Quantifying their primary objective, the European Central Bank has enforced that they aim at maintaining *inflation rates below, but close to, 2% over the medium term* (European Central Bank, 2017a). The Bank refers to inflation as a general increase in consumer prices which are measured thanks to a harmonised index across all EU Member States: The Harmonised Index of Consumer Prices (HICP). This measure is used by the Governing Council (i.e. the executive body of the ECB) in order to measure price stability in the euro area as a whole.

- *In Japan*

In a public announcement on January 22, 2013, the Bank of Japan (BoJ), explained that their aim in conducting monetary policy is *achieving price stability, thereby contributing to the sound development of the national economy* (Bank of Japan, 2013a, p.2). In order to monitor and measure their target, the bank, in the same statement, defined its price stability target as an inflation rate consistent with a sustainable evolution and level of prices.

The BoJ judges that a 2 percent year-on-year rate of change in the Consumer Price Index (CPI) guarantees price stability. In the past, the BoJ had defined a monetary policy *goal* one percent below the actual *target*. The change in wording (from goal to target) emphasizes, following the BoJ, the importance of flexibility in the conduct of monetary policy in Japan. The bank affirms that, since changes in monetary policy need a considerable and often variable time lag in affecting prices and thereby economic activity, the change in the wording reflects that reality (Bank of Japan, 2013a).

2.3. Unconventional monetary policies

The IMF has noted about the Central Bank's reactions to the credit crisis of 2008 that: *central banks in advanced economies responded with unconventional tools to address two broad objectives: first, to restore the proper functioning of financial markets and intermediation, and second to provide further monetary policy accommodation… The two objectives, while conceptually distinct, are closely related*. (Viñals, Blanchard, & Bayoumi, 2013, p.1)

In the wake of the financial crisis of 2008, Borio, & Zabai (2016) affirm that there's evidence backing the fact that unconventional measures manage to influence economic conditions. However, the authors remind us that the precise effect of these policies on output and inflation is hard to point out.

- *Quantitative easing*

The very first bank to have used Quantitative Easing (QE) (i.e. balance sheet policies) as a policy tool, however in a limited way, was the Bank of Japan in 2001 (Wolf, 2014). In the aftermath of the 2008 crisis, all major central banks (i.e. the FED, the Bank of England, the Bank of Japan, and the European Central Bank), start to insistently incorporate quantitative easing into their tool set.

The categorisation of QE as an unconventional policy comes from the fact that the Central Bank, goes beyond using the short-term rate to influence economic conditions, and uses its

balance sheet to alter the availability of certain assets (Viñals, Blanchard, & Bayoumi, 2013). Because investors have to find substitutable assets given the scarcity of the ones the Central Bank decides to purchase, this leads to an aggregate rise in prices and pushes up yields (Wolf, 2014).

Easing credit conditions is one of the main objectives and effects of QE. The president of the Federal Reserve Bank of San Francisco, John Williams, found out that $6000bn of asset purchases by the bank led to a reduction of between 15 to 25 basis point on the 10-year Treasuries (Wolf, 2014). This is roughly equivalent to a reduction in the short-term rate of around one percent.

A list of economists surveyed by Wolf (2014) have found that, all in all, QE has increased asset prices, including equities, and has had a positive effect on economies. Further proof of the efficiency of such measures has been the backing of QE efficiency by two IMF economists (Moghadam, & Teja, 2014) and their recommendation of this policy tool, including purchases of government bonds, for the Eurozone.

However, other authors (Ugai, 2007; Kapetanios, Mumtaz, Stevens, & Theodoridis, 2012)) do not fail to pin point some of the risks of these measures, namely a distortion in asset prices, particularly in those with long maturities.

- *Forward guidance*

Managing public expectations about the future path of policy rates in order to provide additional stimulus when rates reach their lower bound, is what Borio and Zabai (2016) define as forward guidance.

Before the Great financial crisis of 2008, forward guidance, in the way it was performed, was not considered an unconventional policy tool. However, after the crisis, and as short-term rates reached their lower bound in several economic areas, there has been a shift in the way of disclosing expectations. Nowadays, several authors among which Borio and Zabai (2016) and (Wolf, 2014) consider forward guidance an unconventional tool.

Borio and Zabai (2016) further develop that there are two dimensions that distinguish forward guidance. When it relates to a certain period of time, the guidance is said to be "calendar-based". Whereas when it is derived from economic conditions, it is labelled "state-contingent". On the second dimension, the guidance can be qualitative, when it is expressed in vague terms or quantitative when there are numerical values attached to it. One last comment is that forward guidance acts through what is called the central bank's signalling channel, as the bank *seeks to influence market expectations about the future policy rate path* (Borio, & Zabai, 2016, p. 24).

The authors also advance that there are some factors hindering the efficiency of forward guidance as a monetary policy tool. For instance, the public may not fully understand a complex statement about monetary policy, or if it is understood, they may not totally believe it, diminishing the potential result of such policy. That is why consistency and commitment to pre-announce monetary policy developments are key for central banks in reaping the benefits of forward guidance.

- *Negative policy rates*

Bech and Malkhozov (2016) affirm that there is a broad set of reasons to implement negative interest rates (NIR) policies. When the central banks of the Eurozone, Sweden, Denmark and Switzerland started implementing NIR policies as of mid-2014 (for the Eurozone), they had in common the fact that they were struggling with difficult macroeconomic conditions. However, while some of the bank's motivations were to defeat a sluggish inflationary context, others used NIR as a tool to contain currency appreciation pressures, sometimes caused by the ultra-loose policies implemented by neighbouring central banks.

Jensen and Spange (2015) argue that there are no differences in how negative or positive interest rates are transmitted to money markets. However, the question Bech and Malkhozov ask and one that resonates with our thesis problematic is: *whether negative policy rates are transmitted to the wider economy through low lending rates for firms and households, especially in rates associated with bank intermediation* (Bech, & Malkhozov, 2016, p. 37).

The authors further assert that institutional or contractual factors may impede the transmission of NIR beyond money markets. Bech and Malkhozov (2016) have also found that in order for this policy to keep its rationale, NIR have to be incorporated into the lending rates for firms and households. However, when they do, the detrimental effect on commercial bank's profitability can be unsustainable in the long-run. Policy trade-offs and transmission as well as implementation mechanisms will be further developed in the remaining sections.

2.4. Central bank's tools

The table below adapted from Borio and Zabia (2016) is a comprehensive summary of the different mechanisms that are available for central banks to direct the economy. While some of the tools have been discussed in great detail, such as balance sheet policies (in the form of quasi-debt management and credit policy), negative interest rates and forward guidance; other tools have not been further examined due to their limited impact on our specific research. However, in order to give a comprehensive account of all central bank tools we included them in the following table.

Table 2.2. Central bank's tools

Policy	Description	Examples
Interest rate policy	Setting the policy rate and influencing expectations about its future path	
➢ Forward guidance on interest rates	Communication about the future policy rate path	The central bank *expects the key [...] interest rates to remain at present or lower levels for an extended period* (European Central Bank, 2013, p.1)
➢ Negative interest rates	Setting the policy rate below zero	Negative deposit interest rate at the ECB and at the BOJ (European Central Bank, 2014) and (Bank of Japan, 2016)

Policy	Description	Examples
Balance sheet policies	Adjusting the size/composition of the central bank balance sheet and influencing expectations about its future path to influence financial conditions beyond the policy rate	
➢ Exchange rate policy	Interventions in the foreign exchange market	
➢ Quasi-debt management policy	Operations that target the market for public sector debt	Purchases of government debt
➢ Credit policy	Operations that target private debt and securities markets (including banks)	- Modifying the discount window facility - Adjusting the maturity/collateral/counterparties for central bank operations - Commercial paper, ABS and corporate bond funding/purchase
➢ Bank reserves policy	Operations that target bank reserves	The central bank conducts *money market operations so that the monetary base will increase at an annual pace of about 60-70 trillion yen* (Bank of Japan, 2013b)
➢ Forward guidance on the balance sheet	Communication about the future balance sheet path (composition/size)	*The [BOJ] will purchase JGBs so that their amount outstanding will increase at an annual pace of about 50 trillion yen... as long as it is necessary for maintaining [the 2% price stability] target in a stable manne*r (Bank of Japan, 2016a, p.2)

Source: Personal Production

2.5. Interactions between fiscal and monetary policy

The IS/LM model which depicts the investment/saving as a demand proxy (IS) and the liquidity preference/money supply as proxy for the money available (LM) helps explain decisions made by economic agents in relation to investments taking into account the money available and the interest they will received if saved (King, 2000). This model helps study the interactions between fiscal policy which influences the goods market (through higher government spending), and monetary policy influencing the assets market (through a variation of interest rates).

Kirsanova, Leith and Wren-Lewis (2009) argue that the current consensus in the literature is that monetary policy should focus on business cycle stabilisation and inflation control, while fiscal policy should aim at controlling government debts or deficits.

Particularly in the United States, we can pinpoint certain interactions between the monetary and fiscal policy, as the same government, notwithstanding the political independence of the central bank, is responsible for both. The same study is more difficult for Eurozone countries, as the fiscal policy falls under the responsibility of each member states while the monetary policy is coordinated by the European Central Bank for all the EU member states that have adopted the euro as their currency.

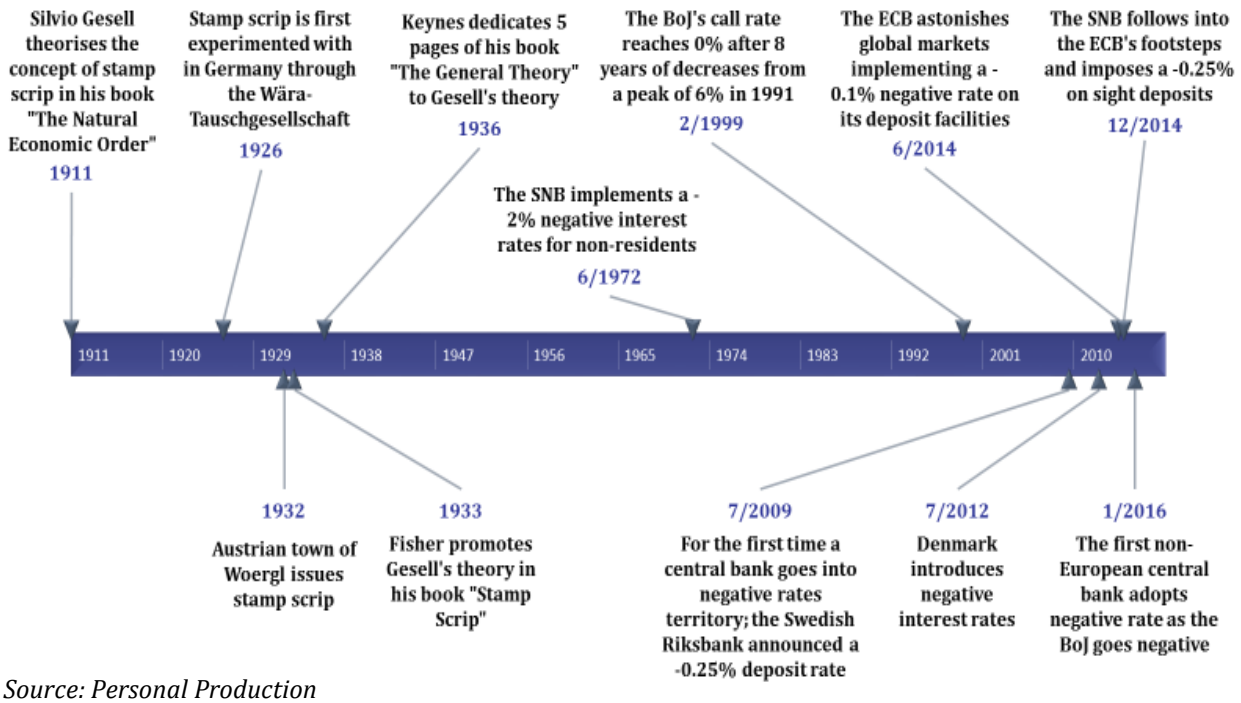
Nakata (2016) affirms that after the Great Recession of 2008, and as the short-term rate of the FED was constrained at the zero lower bound, the US government decided to use fiscal policy to further stimulate a sluggish economy. Eggertsson (2011) and Woodford (2011), to name a few, have found that when the policy rate hits its lower bound, it becomes optimal to increase government spending which links to Kirsanova, Leith and Wren-Lewis (2009) assertion that fiscal policy should, by definition, should be used in situations where monetary policy is constrained in some way. Davig and Leeper (2011) report that a long line of studies found that separating monetary from fiscal policy prevents from reaping the benefits of policy interactions that are essential in achieving the central bank's targeted macroeconomic equilibrium (i.e. price stability).

3. History of Low and Negative Interest Rates

Negative numbers were labelled as impossible by early mathematicians, just like negative nominal interest rates were by many experts until 2008. After the financial crisis of 2008, most economists expected interest rates to increase again towards their pre-crisis levels. Nearly 9 years after the onset of the crisis, many central bank nominal base rates are now even lower with most rates even closer to zero and what was deemed impossible occurred; rates have gone beyond the zero boundary in countries such as Switzerland, Sweden or Japan (Arteta, Kose, Stocker, & Taskin, 2016). Popular attention was accorded to negative nominal interest rates only recently when the Swedish Central Bank decreased its deposit rate to -0.25% in 2009 (Riksbank, 2009) and the Danish Central Bank as well as the European Central Bank followed suit in respectively 2012 and 2014.

In order to facilitate the reading and understanding of the history discussed we designed a graphic timeline summarising the latter.

Figure 3.1. Timeline of ultra-low and negative interest rates



Source: Personal Production

3.1. Early Conception

Negative nominal interest rates are closely related to the concept of "taxing money" as both aim to penalise possession of liquidity. The academic debate on "taxing money" dates back to the late nineteenth century with Gesell Silvio as a pioneer, described by Keynes (1936, p.353) as *a strange unduly neglected monetary theorist.*

- *Gesell Silvio*

Several authors have studied the concept of tax on money to overcome the zero lower bound, a largely forgotten German scholar of the late nineteenth century, Gesell Silvio, is at the concept's origin. He provided a visionary view on monetary theory of interest by proposing a periodic tax on money through 'stamp scrip'. The idea of stamp scrip is similar to a negative nominal interest rate on liquidity as these stamps would have had to be purchased from authorities and affixed to banknotes for the currency to remain legal tender (Ilgmann, 2015).

Therefore, is Gesell considered by many as at the origin of the concept to tax money. Two prominent economists of the Great Depression era, John Maynard Keynes and Irving Fisher referred to Gesell's literature. Fisher even endorsed the idea of stamp scrip to reduce the real interest rate on liquidity to reflate the economy in times of emergency such as the Great Depression (Fisher et al., 1933). In his famous book, *The General Theory,* Keynes dedicated five pages to Gesell's theory. However, he did not believe in the concept of stamp scrip as described in Gesell's literature. Nevertheless, Keynes stated that the idea behind stamped money is sound (Keynes, 1936). After these mentions of a negative nominal interest rate on money by some of the greatest economist, a few local communities and regions experimented with the concept in the mid-twentieth century.

- *The concept*

Even though the way Gesell theorised the concept of tax on money and the modern depreciative currency policies it led to are profoundly different, it is still interesting and worthwhile to uncover the very origin of the current unconventional monetary policies.

Gesell's theory was founded on the fact that money had negligible storage costs whereas commodities have higher storage costs and many are also perishable. This perishability of commodities, according to Gesell & Pye (1958), allowed money holders to delay their purchases and so force owners of perishable commodities to either pay a fee in the form of price reduction or let their goods perish. It is important here to consider the time at which Gesell lived and wrote; end of the nineteenth century, a time at which only one third of German exports were finished goods (Bairoch, 1972).

Nevertheless, even for non-perishables Gesell also conceived interest rates as a mere fee passed on from the producer to the consumer given that the producer's retail price includes production costs and the cost of capital. Gesell argued that all investment in real capital, such as machinery, factories, and equipment would necessarily have to produce at least the same return on investment as the interest on money. Therefore, he considered that basic interest on money is an equilibrium which includes interest rates on all types of real capital and commodities. (Gesell & Pye, 1958).

Gesell's theories led to the conclusion that basic interest on money causes distortions in regards with wealth distribution and income for the capitalists owning money. A parallel conclusion to the paper is that for Gesell, basic interest artificially limits the productivity of the real economy due to the laws of supply and demand. In his research, interest on money is designated as the reason why supply of real capital (e.g. houses, ships and jobs for example) always falls short of demand (e.g. tenants, freights and workers) as marginal productivity of real capital must always be at least equal or superior to the basic rate of interest in order to attract investment. (Gesell & Pye, 1958). By taxing money through stamp scrip, Gesell aims to push down the basic interest to an optimal level of zero. Consequently, the minimum marginal productivity of capital would then also be lowered to zero.

Parts of this theory such as a constant under-supply of real capital have been proven wrong by twenty-first century financial events, for example, when housing was clearly in over supply on the American real estate market in 2007. Nevertheless, Gesell's theory remains relevant to our work as striking similarities are found between his research conclusions for

taxing money and the objectives of current negative interest rate policies such as the increase of investments (European Central Bank, 2017c).

- *Early experimentations of Gesell's concept*

As hypothesised by several economists (Levring, 2017; Wallace, 2005), the witch-hunt on cash is real, as is the possibility of implementing cashless economies. If cash was eliminated and only electronic money prevailed, then negative interest rates would simply be a tax on money. Therefore, given this striking similarity between Gesell's concept of tax on money and contemporary negative interest rates it is interesting to observe the initial experimentation of Gesell's proposal in countries such as Germany, Austria and the United States.

Stamp scrip was first experimented within Germany through local initiatives. For instance, the Wära-Tauschgesellschaft was founded in 1926 in which over 1,000 corporate members could acquire the depreciative currency, named Wära, by exchanging domestic or foreign currency or even the equivalent in any other type of asset (Ilgmann, 2015). Through depreciation policies such as a monthly fee of 1 percent of the nominal value, the Wära currency was encouraged to be spent or to be deposited at the Tauschgesellschäft so it could be lent to other corporate members. In a depression-ridden Germany, the Wära was a large economic success as all possessors of the currency did not hoard it to battle the difficult times ahead but instead spent most of it. It made the news in the rest of Europe, and even in some financial papers in the United States. It was said that during the 1930-1931, two and a half million people handled Wära currency, which helped many individuals in depression-ridden Germany. The currency was eventually accepted in a few thousand stores across Germany and a few small banks even opened Wära accounts. These banks had also an incentive in lending the Wära money to individuals asking for credit in order not to pay the monthly fee of 1 percent. (Fisher et al., 1933).

This sounds a lot like one of the main reasons why most central banks currently implement negative interest rate policies. Nevertheless, the Wära initiative was privately organised, and due to biased fears that the currency would lead to harmful inflation, the German government eventually interfered and forbade Wära through an emergency law on November 1931.

Another interesting example of stamp scrip experimentation in the early twentieth century is in Austrian town of Woergl. In this case however, the stamp scrip was issued by the local authorities themselves to riposte to the important unemployment of 35 per cent within the community. Once the consent of workmen, merchants and the local savings bank was obtained, the city of Woergl issued the stamp scrip in 1932. There was a holding fee of 1 per cent per month, and if currency holders were to request a redemption at the town's treasury, there was a 2 per cent fee on the nominal value. The objectives of the local policy were to provide jobs while improving infrastructure and re-establish tax payments in due time. All objectives were met; 30-50 new jobs were created, infrastructure was considerably improved, and from the first month of implementation taxes paid increased by 38 per cent. (Fisher, 1933). As in the Wära case, the local currency of Woergl was eventually forbidden by the central government to assert the control of the central bank over the national currency (Onken, 1977).

Moving on to the United States, according to Fisher (1933) there were approximately 450 U.S. municipalities in the early 1930' considering the option of issuing stamp scrip and in 1933 more than twenty towns had already introduced stamp scrip. Furthermore, in 1932, the Bankhead-Pettengill Bill aimed to introduce $1 billion stamp scrip for similar reasons the smaller communities did. The state of Oregon wanted to issue $80 million in stamp scrip in 1933. Both plans were blocked by the Treasury who accepted stamp scrip on a local scale but did not want to endorse a general monetary reform (Cohrssen, 1991). The American initiatives which were actually implemented at that time were however less prominent than the two European ones mentioned above.

- *Current initiatives similar to stamp scrip; Local Exchange Trading Systems*

Contemporary initiatives most similar to the stamp scrip examples above are Local Exchange Trading Systems (LETS) also known as community currencies. These systems still exist in many parts of the world, more prominently in North America and Europe. They are locally organised economic organisations which allow members to exchange goods and services amongst each other using a currency specifically created for the LETS. One of the

fundamental principles of such an organisation is that its currency is non-interest bearing. There is generally a membership fee which can be considered as a tax on the LETS currency. However, the striking difference between LETS and the two European examples discussed above is that adequate collateral was accepted to create Wära currency while in the Austrian case the currency scheme was initiated by local authorities, unlike any LETS.

These differences show that stamp scrip, as previously mentioned, has many similarities to contemporary negative interest rates while Local Exchange Trading Systems share less of those similarities. Therefore, the next two parts will re-focus the discussion on low and negative interest rates.

3.2. First implementations of low and negative interest rates

While low interest rates went mainstream during the financial crisis of 2008 and negative interest rates are common since Denmark's Central Bank's initiative in 2012, there are a few examples of low and negative interest rates before these eras.

Through its monetary tools aiming at deterring capital inflows, the Swiss National Bank (SNB) was the first implementer of nominal negative interest rates in the 1970s, these interest rates only applied to non-residents (Gillian, 2011). In the meantime, the Central Bank of Japan decreased its call rate on overnight deposits to 50 basis points in 1996 and kept this rate between 0 and 50 basis points until 2016 (Figure 3.2.). In this part focus is upon interest rates set by central banks, which is why the low short-term interest rates of Treasury Bills during the Great Depression in the U.S (Orphanides, 2004) are omitted.

A closer look at these two early adopters of ultra-low and negative interest rates is appropriate. Firstly, Switzerland's forerunning implementation of reversed economics; meaning finance concepts turned upside down through nominal negative interest rates for a specific set of stakeholders. Secondly, the economy which led the way to general ultra-low and negative interest rates through its policies in the 1990s, is Japan.

- *The negative interest rate precursor; Switzerland in the 1970s*

In the first half of 1970, headline inflation in Switzerland rose above 10 percent (Figure 3.2.). This was partly due to a worldwide rise in inflation levels fuelled by expansionary US monetary policies in connection with its Vietnam war. The Swiss inflation level was intensified by the explosive growth of Switzerland's monetary base which grew by nearly 60 percent at the end of 1971. The SNB had no other choice but to dramatically increase its monetary base as it was still obliged to defend the then still fixed exchange rate of the Swiss franc which was under speculative pressure. (Kugler & Rich 2001).

Even in the early 1970s, Switzerland had already since long been battling with an inconveniently strong exchange rate. To fight the inflow of capital and so, its strong exchange rate, Switzerland introduced negative interest rates of -2.0 percent per quarter on CHF deposits from non-residents in June 1972. In November 1973, the rate on CHF deposits from non-residents decreased to -3.0 percent per quarter, and eventually decreased to -10.0 percent per quarter in February 1978. In 1978, net interest rates were pushed to -40 percent through these policies and did not manage to stop the CHF from appreciating. Between November 1972 and February 1978, the Swiss franc appreciated by a nominal 62 percent (29 percent in real terms). Eventually, by the end of 1978 negative interest rates were abandoned and replaced by an explicit exchange rate target which required the SNB's intervention, money supply expansion, and eventually led to inflation. (Meggyesi, 2010).

Two main lessons can be drawn from the early experimentation with negative interest rates in Switzerland. First, negative interest rates do not seem to prevent a strong currency from appreciating, or at least does not seem to be enough by itself to do so. Second, as David Blanchflower, who at the time was a member of the Bank of England, stated in 2009 there is a "one-tool one-target" rule to Monetary Policy (Fincher, 2009).

A central bank can attempt to weaken its currency's exchange rate or aim to have stable price levels, but both objectives are rarely attainable simultaneously. Even through negative rates this fundamental rule cannot be bent. As illustrated in Figure 3.2. below, this is particularly true in the 1970s Swiss case as the SNB seems to have merely slowed the pace of appreciation

of the domestic currency while inflation was maintained between 1 and 2 percent between 1975 and 1978. Once it abandoned its negative interest rate policy, and implemented money supply expansion to aim at an explicit exchange rate target in late 1978, Swiss inflation increased considerably.

Figure 3.2. Consumer Price Inflation in Switzerland

Source: OECD Statistics; personal Design

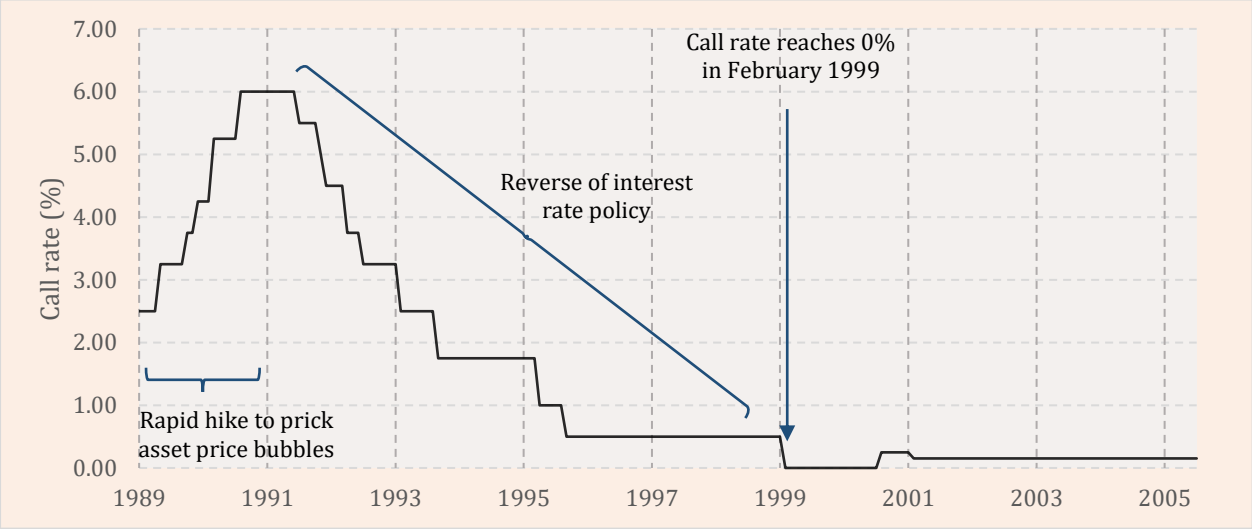
After the Swiss experimentation, it was not until 2009 that nominal interest rates were once again set below the zero lower bound, this time in Sweden. However, before moving on to those more recent cases it is worth reminding that the Bank of Japan's overnight call rate consistently stayed below 50 basis points since 1996, the BoJ even committed to a zero percent policy from February 1999 to July 2000. (Figure 3.3.). Hence, the following discussion.

- *Leading the way down; Japan in the 1990s*

Japan experienced slow growth between 1975 and 1990, money expansion was generous and M2 expanded much faster than domestic GDP while Consumer Price Inflation (CPI) did not respond proportionally. Instead, two bubbles surfaced, both in the stock market and the real estate market. Stock prices multiplied fivefold in the 1980s and land prices almost increased by 100 percent. (Sato, 2008). The BoJ responded by rapidly rising interest rates in

order to 'prick' the asset price bubbles which it considered, would be beneficial in the long run (Figure 3.3.). What followed was the collapse of both bubbles in a stagnant economy during the 1990s with falling consumer prices and rising unemployment (Corbett, 2012). The decade started with the Heisei Recession from 1991 to 1993, the second longest recession in post-war Japan (Sato, 2008). Furthermore, the yen steadily appreciated in real terms despite poor economic conditions, adding difficulties to the entire recovery process.

Figure 3.3. Bank of Japan call rate



Source: Federal Reserve Bank of St. Louis; Factset; Personal Design

Note: The Bank of Japan implemented the Mutan rate in April 1996, also called the overnight uncollateralized overnight call rate as its new main tool to transmit its monetary policies. Prior to April 1996, the BoJ's main transmission tool was the Discount rate (Parker, 2013). Hence, the graph above illustrates the discount rate up until April 1996, and the BoJ's objective for its overnight uncollateralized overnight call rate from then onwards.

The poor economic performance, conjuncture and set of problems in the 1990s led to the Bank of Japan (BOJ) using the call rate (overnight rate) as its primary policy tool. As illustrated in Figure 3.3., the BoJ reversed its interest rate policy and steadily decreased the rate from its 6 percent peak in 1991 to zero percent in February 1999 in the hope of stimulating growth through increased corporate capital investment, aggregate demand, and inflation. It combined its zero-rate policy with aggressive money expansion; money supply M1 expanded much faster than nominal GDP growth (Sato, 2008). This was the first time in recent history that a central bank went as low as zero percent on any of its main rates, which

at the time was believed to be the lower bound. The latter has however been proven wrong in the last decade.

All measures implemented in Japan failed to have any considerable positive effects on its macroeconomic context. To summarise the outcomes:

- Unemployment rose from 2.0 percent to 5.5 percent between December 1990 and December 2001
- By 2002, the Nikkei Stock stood at less than 25 percent of its 1989 peak and the land price index stood at 57.3 percent of its September 1991 peak
- There were deflationary periods between 1994 and 1997
- Annual GDP growth averaged 0.97% between 1992 and 2002. (Worldbank, 2017).

By many experts, the 1990s in Japan are called 'the lost decade' (Corbett, 2012). There are many lessons to be learned from the Japanese failed experimentation with ultra-low interest rates. Its failure can be partly explained through Keynes's concept of the 'liquidity trap'. The Keynesian liquidity trap *is a situation in which low short-term interest rates engineered with monetary policy prove to be ineffective in stimulating an economy in a deep depression* (Sutch, 2014, p.2) while Svensson (2000, p.2) defines a liquidity trap as a *situation with zero [nominal] interest rates, persistent deflation and persistent deflation expectations*.

By lowering its interest rate to zero, and increasing the supply of its domestic currency while simultaneously deflationary trends persisted, the BoJ found itself entangled in a liquidity trap. It could not apply the usual remedy: lower short-term nominal interest rates (Eggertsson & Woodford, 2003). As to how to escape such a liquidity trap, according to Fujiwara et al. (2006), the central bank should increase expected inflation and lower expected future interest rates. However, this might be an important challenge in practice. Several solutions to address the challenge are proposed; first, the central bank should commit to low future rates through variations on its price-level targeting, second, a central bank can produce further easing effects by a policy commitment such as an explicit commitment to hold short-term interest rates at a specific level (Fujiwara et al., 2006).

In addition, Eggertson and Woodford (2003) stress the importance for a central bank to commit to a form of inflation level targeting during a liquidity trap while Svensson (2003) encourages the use of alternative measures for monetary stimulus such as quantitative easing. Fiscal policies should of course be aligned and support monetary policies. Unfortunately, this was not always the case in Japan; the Ministry of Finance (MoF) did not want to use fiscal stimulus unless the BoJ committed to an inflation target while the BoJ would not relax monetary policies as it encouraged and advised fiscal stimulus (Corbett, 2012).

The consensus in the literature regarding Japan's failure to efficiently address its economic set of problems is that it did pick the right solutions but not always at the right moment and mostly not to the correct extent. To exemplify, Bernanke (2003) argues that Japan's expansionary monetary policies were not applied in a sufficient scale as these policies, if executed with more courage and robustness, would eventually have affected price levels and expectations.

The Great Depression (1929/9-1933/5) was a striking example of a liquidity trap (after which were executed the stamp scrip cases in the US to fight poor economic conditions). Japan was a second case of such a trap and now as some major economies such as the Euro area are currently running the risk of getting stuck in liquidity traps, the lessons learned from past experiences are even more relevant. The recent development of ultra-low and negative interest rates is essential to the understanding of the current risks.

3.3. Developments in the past decade

During the financial crisis of 2008, major economies' central banks dramatically decreased their overnight interest rates until the point where they hit the zero boundary, which was then believed to be the lowest boundary. However, as most of these economies remained stagnant and were looking for stimulus, the zero boundary was breached and interest rates went negative and still are today. The objective here is to give a short overview of recent developments.

In July 2009, the Swedish national bank, the Riksbank, announced a measure even the BoJ did not dare applying at the deepest of its crisis; negative interest rates on bank deposits with rates on one of its deposit facilities at -0.25 percent (Ward & Oakley, 2009). Most central banks would implement such a policy to, for example, avoid a liquidity trap. However, the main reason why the Riksbank implemented the negative deposit rate is simply because it was forced to. It consistently keeps its deposit rate 50 basis points below its repo rate to regulate liquidity in the market, so when the repo rate was lowered to 25 basis points the negative rate was a simple logical consequence (Ward & Oakley, 2009).

However, the Riksbank has two different overnight deposit facilities; the one at –0.25 percent and another one which at that time had a 0.15 percent interest rate. Naturally, all commercial banks parked their money in the latter deposit facility. To illustrate, 90 billion Swedish kroner were deposited at 0.15 percent while only 12 million Swedish kroner were deposited at -0.25 percent (Dougherty, 2009). Nonetheless, at the time, by using this unusual measure, the Riksbank did eliminate some of the stigma surrounding negative rates.

The first time negative interest rates were truly implemented and affected a national economy was in Denmark. In 2012, the remnants of the euro area's sovereign crisis led considerable capital inflow into Denmark. To protects its peg to the euro, deter speculators and reduce capital inflow, the Danmarks Nationalbank (DN) cut rates on its Certificates of Deposit (CD) to -0.2 percent in July 2012. In January 2015, when the Swiss National Bank (SNB) announced its decision to cease its peg to the euro, the DN made a statement to the markets that it would not do as the SNB and kept its peg to the euro. It did so by further reducing its interest rate on CD to -0.5 percent and -0.75 percent soon after. It combined the negative rate policy with large foreign exchange rate purchases amounting to 13 percent of the Danish GDP. (International Monetary Fund, 2016).

The European Central Bank (ECB) introduced negative interest rates on the 5th June 2014 when Mario Draghi announced that the ECB will cut its interest rates on its deposit facility to a negative -0.10% (European Central Bank, 2014). At the time, and still today, the negative interest rate cut was part of a combination of measures designed to increase inflation levels

towards its objective of 2% over the medium term, thus ensure price stability, which is part of the essential building blocks for sustainable growth in the euro area (European Central Bank, 2014).

In December 2014, the SNB followed the ECB's footsteps; imposing a negative interest rate of -0.25% on sight deposit account balances (above a given exemption threshold of CHF 10 million) and lowered its 3-month Libor target rate to negative levels between -0.75% and 0.25% (International Monetary Fund, 2016). As the SNB has often struggled with massive capital inflows in time of economic uncertainty and a dangerously appreciative Swiss franc, by lowering one of its key interest rates, the SNB's main objective was to make it less attractive to hold Swiss francs. It combined these rates with a readiness to purchase foreign currency in unlimited quantities in order to respect its commitment to the minimum exchange rate of CHF 1.20 per euro. (Swiss National Bank, 2014).

The next Central Bank to follow suit, in early 2015, was the Sweden's Riksbank (RB). It did so for similar reasons as the ECB, to fight low inflation and boost sustainable growth (Gibas, Juks, & Söderberg, 2015). Given that many other banks had introduced negative interest rates, the RB was inclined to lower its interest rates too as the repo rate level in relation to other Central Banks, in an open economy such as Sweden, is extremely important (Riksbank, 2016).

In January 2016, in what constituted a surprise to the economic world, the Bank of Japan (BoJ) adopted negative interest rates in order to revive growth in what is the world's third-largest economy (Bank of Japan, 2016a). Also, European Central Banks, outside the Eurozone, have introduced negative interest rates to follow trends of their larger European counterparts. The Bulgarian National Bank imposed negative interest rates on banks' excess reserves in January 2016 and the National Bank of Hungary cut its overnight deposit rate to -0.05% in March 2016 (International Monetary Funds, 2016).

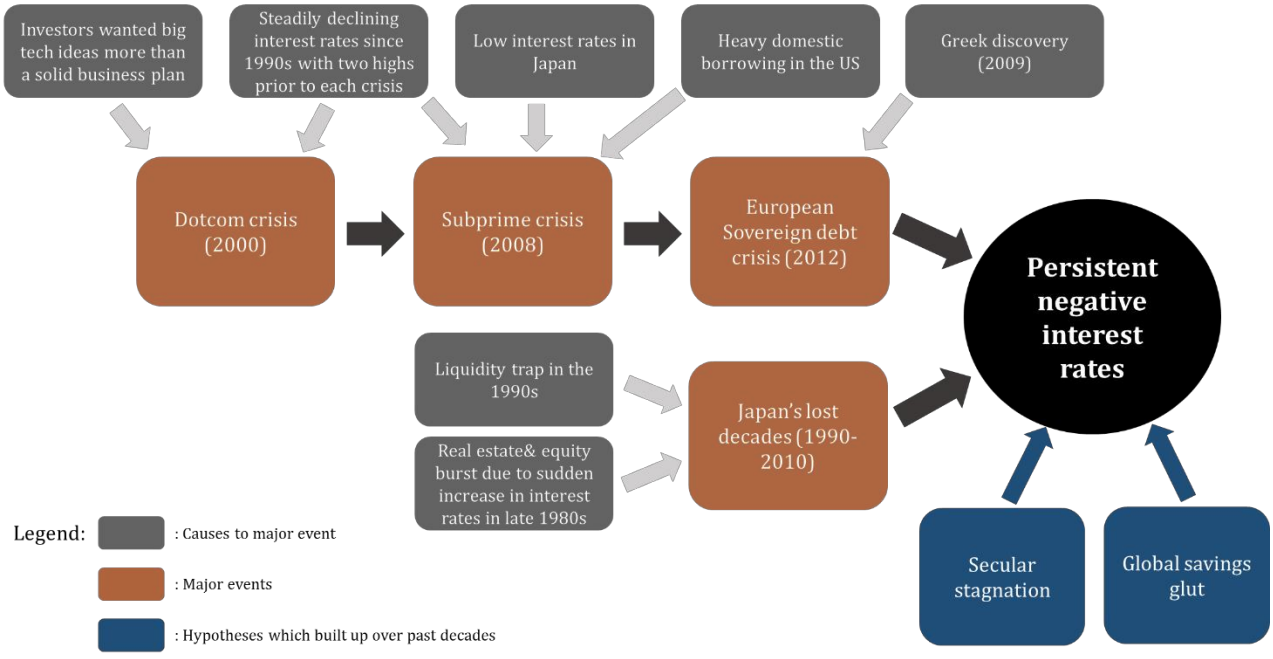
Chapter II. Causes and expected consequences of low and negative interest rates

4. Origins of low and negative interest rates

The Figure below gives the reader a clear and quick snapshot of the developments having set the ground for the negative interest rates policies to surface and which will be discussed in this part. After examining the two most recent crises in the United States, we will delve into the European Sovereign debt crisis as well as into Japan's two lost decades.

While the global economy was under heavy turmoil, the academia put forward some hypothesis (global savings glut and secular stagnation) explaining the origins of these unfavourable events.

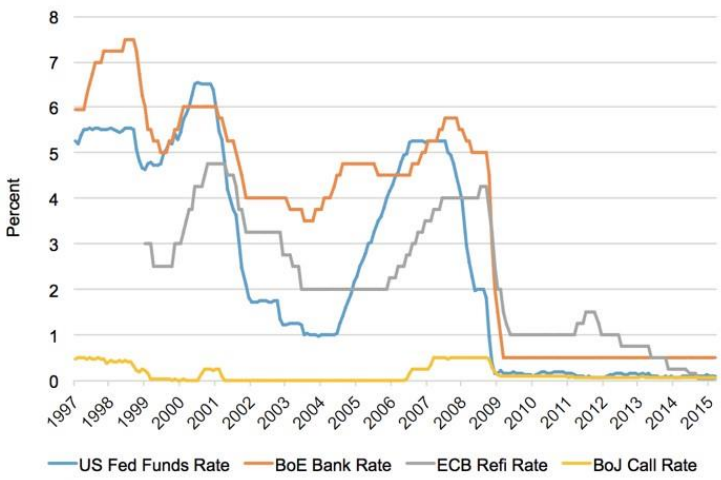
Figure 4.1. Graphic representation of the causes of negative interest rates



Source: Personal Production

4.1. Global events having led to ultra-low rates

Figure 4.2. Central bank policy rates



Source: Central bank websites

When analysing interest rates evolutions across major economies, we can clearly detect two tops, related to the aftermath of the two crises that have shaped the 2000s, namely the "*dotcom bubble"* of 2000 and the "*subprime crisis"* of 2008. Figure 4.1. also shows that there has been an almost steady declining trend in interest rates from the late 90s, and that since the 2007-2008 financial burst, they have remained near their lower bound (Bean, Broda, Ito, & Kroszner, 2015).

Holt (2009) comes back to the causes of the housing bubble that drew the global financial system into a crisis that is still being felt today. Following him, there were four primary causes to the build-up of the unsustainable financial situation that culminated with the Lehman Brothers' implosion in September 2008 (Wigglesworth, 2017). A mix of low mortgage and short-term interest rates, combined with relaxed standards for mortgage loans and an irrational exuberance (i.e. *a heightened state of speculative fervour* (Shiller, 2005)) is what Holt (2009) believes led to the implosion of the so-called credit bubble.

Brian and Patrick (2010) describe the context that influenced the economic events of 2007 in what they define as a global liquidity bubble. Following the authors, low interest rates in major economies such as the US and Japan accompanied by Asian investments in US Treasury securities capped the mortgage rates to low levels, thereby, encouraging buyers to enter the market and fuel the housing bubble. Brian and Patrick (2010) argue that by prompting US interest rates cuts, the crash that followed the dotcom bubble in the early 2000s, laid the ground for the financial crisis. The authors argue that the combination of the three following factors were toxic for the American economy:

- Low US interest rates which encouraged consumers and businesses to borrow;
- Low Japanese interest rates which spur demand for US bonds, via the yen carry trade, further depressing yields;
- The impact of sovereign wealth funds, led by China and Middle East countries which invested significant amounts of national wealth into US Treasury securities.

From these developments, we get a sense of how two of the most recent crises that have originated in the US, namely the "*dotcom bubble"* and the *"subprime crisis"* have been responsible, in combination to other elements, for an overall economic context made of depressed interest rates and close to zero sovereign yields.

A collateral event to the Great Recession that developed in the US, is the European Union's sovereign debt crisis. De Santis (2012) argues that the starting point of the economic events that would lead the ECB to adopt negative interest rates as a policy measure is the revelation, by the Greek prime minister in October 2009, of a deficit double the one disclosed to the international economic bodies. As an immediate consequence, sovereign spreads rose remarkably for most E.U. countries, posing the first major challenge to the stability and continuity of the European Monetary Union.

The author points out as an incoherent development the fact that, even if the assessment of the credit risk of some countries (i.e. Austria, Finland and the Netherlands) remained unchanged, the spreads vis-à-vis the German bund, nonetheless, rose. Building on the previous argument, De Santis (2012) points to an often-overlooked subtlety in the way central banks can correct economic developments. He argues that an intervention by central banks is only effective if financial markets face technical or liquidity problems. On the contrary, if the rise in spreads is due to aggregate factors like it has been the case after Greece's disclosure (as proved by rising spreads in sound economies), then the Central Bank's influence is limited.

In July 2012, all these developments led Mario Draghi, President of the ECB, to reassure the international community by stating *within our mandate, the ECB is ready to do whatever it*

takes to preserve the euro (Draghi, 2012). A report made by Khan (2016), an Oxford economist, looks at what has been implemented by the ECB over the last four years since the 2012's economic lows which also helps explain the trajectory of interest rates since then.

- First, Outright Monetary Transactions coupled with the Quantitative Easing programme has strongly reduced sovereign yields across the monetary union. For instance, in those four years, Spain's 10-year yield has fallen more than 6 percent.

- Second, ECB's balance sheet has considerably expanded since January 2015, when the bank announced that it will be buying €60bn worth of government and covered bonds per month (Kahn, 2016), which as of March 2016, reached €80bn per month and includes some corporate bonds (European Central Bank, 2016a).

- Third, with sovereign yields under control, the ECB has focused its efforts on tackling the low growth/weak inflation environment Eurozone countries' have been exposed to. However, the results fall short of the expectations, with average consumer prices hitting all-time lows in 2015, persistent low inflation is deemed to be a risk factor for economies with high debt burdens (Kahn, 2016).

- Fourth, as it can be expected from traditional economic models (Sanchez, 2008), negative interest rates and quantitative easing have pushed the euro down in trade weighted terms (Kahn, 2016). A weaker exchange rate, although not explicitly mentioned as a policy target by the ECB, should help the bank achieve its objectives by boosting export competitiveness and igniting inflationary pressures in the economy (Kahn, 2016).

Since the economic world has become more and more intertwined in the last few decades (Issing, 2001), it is worth remembering the Japanese "lost decades". After all, it is one of the major global events which led to the widespread of ultra-low interest rates in the global financial system. As pointed out by Bean, Broda, Ito, and Kroszner (2015), as of 1999 the Bank of Japan's policy rate reached its effective floor and apart from a small period in 2006-

2007, it has remained at its lower bound, having entered negative territory since 2016 (Bank of Japan, 2016a). The main reason behind this fall in rates was the subsequent crisis Japanese equity and real estate markets experienced in the late 1980s.

Bean, Broda, Ito, and Kroszner (2015) report that even when market prices started to fall, in the beginning of the 1990s, the Bank of Japan (BoJ) encouraged the movement by increasing rates and levying higher taxes on capital gains. The authors also argue that, with the benefit of hindsight, the move by Japan's central bank had started a detrimental feedback loop. Instead of helping asset prices to go back in line with fundamentals, the rise in interest rates, weakened both fundamentals and the economy in a mutually reinforcing spiral.

The implications of Japan's economic troubles are broad-based and have been felt in global financial markets. Tyers (2012) argues that the marked slowdown in Japanese growth delays the demise of the country's manufacturing industry and increases international competition. This, in turn, decreases the number of workers employed in US and European manufacturing plants. Among others, this development also contributed to the global episode of secular stagnation which Summers (2014) cites as being one of the main causes of the persistence of ultra-low interest rates.

4.2. Savings glut and secular stagnation hypotheses

- *The Secular Stagnation*

There are several causes put forward in the literature explaining why Central Banks have been obliged to pursue unconventional monetary policies in the form, among others, of negative interest rates (NIR). One of the main hypotheses cited by academics (Teulings and Baldwin (2014); Eggertsson and Mehrotra (2014)) when trying to explain the recourse of Central Banks to NIR policies is the "secular stagnation" phenomenon.

This theoretical concept was first described by Alvin Hansen in 1934 (Hansen, 1934), after the mid-1930s US recovery had proven incomplete, with GDP and employment Figures failing to return to pre-crisis levels (Rachel & Smith, 2015). Hansen found out that when

short-term economic stimuli (e.g. rise in Federal spending) had ceased, the recovery failed to sustain itself. Noting the economic stagnation, the author started to investigate secular factors, mainly in the form of demographics, that could explain the sluggish economic activity (Hansen, 1939).

However, Hansen's hypothesis did not prove right during that period. With the strong post-war productivity growth and the baby boom that accompanied it, the secular stagnation phenomenon was put aside (Rachel & Smith, 2015). However, after the 2008 financial crisis that some authors (Gordon, 2014) label as the Great Depression, the secular stagnation theory has resurfaced. Larry H. Summers has been the main voice in reviving and adapting the concept of secular stagnation to the last economic crisis.

In his view, there is a demand deficit -mainly driven by a slowing population growth and cheap investment options that derive from a strong fall in the price of capital- leading to a surge in savings (Summers, 2014). He further argues that changes in the structure of the economy, have altered the savings to investments ratio. This has ultimately led to a decline in the equilibrium real rate of interest associated with full employment (Summers, 2014), hypothesis that is also supported by Bernanke (2015).

Other economists like Gordon (2014) have explained the secular stagnation hypothesis thanks to supply-side factors. Indeed, the author points to four headwinds – demographics, education, inequality, and government debt – responsible for the slow in productivity and GDP growth rates in the US. The author also stresses the distinction between the four headwinds cited, and their pernicious consequences on the US aggregate output, from technological innovation which he does not deem responsible for the fall in supply.

On the contrary, Krugman (2014) argues that what has been deemed a normal pre-crisis period from 2000 to 2007, which is also one of the comparison periods in the secular stagnation theory, was according to him an exceptional economic cycle. The economic fundamentals of that period were different on two fronts to those experienced since the crisis argues the author. The end of a rising trend in household leverage (i.e. household

indebtedness) combined with the marked demographic slowdown, and chronic joblessness (Glaeser, 2014) is translated in low demand for new investments which led to a weaker aggregate output. This again confirming the need for a downward adjustment of the equilibrium real rate of interest (Krugman, 2014).

Eggertsson, Gauti and Mehrotra (2014) have put forward a model which links a slump in aggregate demand to no or very limited change in the workforce. They concluded that when an economy faces a prolonged period of weaker demand, the only way to ensure that the level of employment remains stable is to find a way to prolong negative real interest rates over a substantial period of time.

- *The Global Savings Glut*

Another theory put forward by Ben S. Bernanke, former chairman of the Federal Reserve, called "global savings glut" has also been described as one of the causes of the ultra-low and negative interest rates environment major economic poles are experiencing. When refining his theoretical proposition, Bernanke came to the realization that the secular stagnation hypothesis was mainly concerned with factors affecting domestic capital generation and spending.

Following Bernanke, the logical flaw is that the secular stagnation hypothesis does not account for the possibility of US households to invest abroad; in regions where those secular factors are less prominent. Therefore, this rationale holds that foreign investments earning a positive return abroad free up money in the US, which in turn promotes domestic spending. Simultaneously, the money outflows from the US to other regions should weaken the domestic currency, boosting exports by making them cheaper (Bernanke, 2015).

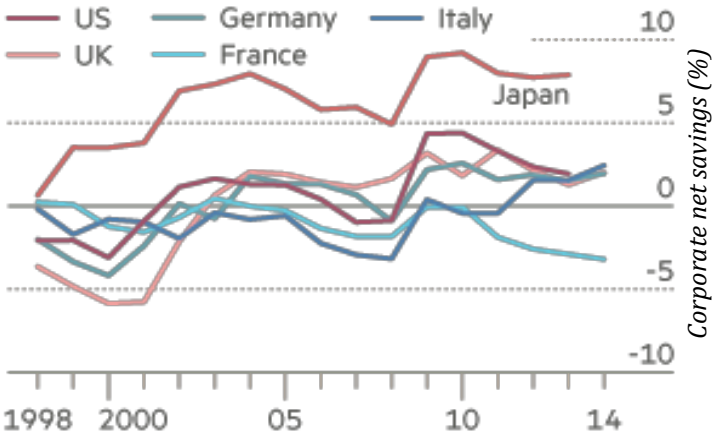
The author, in a speech given at the Bundesbank in 2007, summarizes the beginnings and latest developments of what he calls, the global savings glut. Bernanke equates the rapid rise (i.e. more than fivefold) of the US account deficit, between 1996 and 2004, to a decline in US savings. This reduction, as per national income accounting identities, corresponds to a similar rise of the domestic investment in capital goods (Bernanke, 2007). Even though the

investment rate between those years remained unchanged, the national savings rate declined from 16 to 14 percent.

This shift in national accounting balances, pursues the author, was accompanied by a sustained decline in long-term real interest rates. Bernanke then proposes a main hypothesis explaining these developments. Considering the world as a whole, it is a given that current account surpluses and deficits have to balance out, eventually equating zero. As he noted, emerging markets constantly displayed current account surpluses (i.e. China) while industrial economies (i.e. US) have mainly run current account deficits. Therefore, the realized savings rate had to fall relative to investment rates which could only be achieved by declines in real interest rates (Bernanke, 2007).

Corporations have played a big role in the marked shift between planned savings and investment that lies at the heart of both the savings glut and the secular stagnation hypothesis that preceded it (Wolf, 2015). In 2013, corporations among the high-income countries, generated from 50 to 60% of the total gross investment. Consequently, through the earnings they retain, corporations are also responsible for a great deal of a country's total pool of savings. The author argues that surpluses of savings over investment reflect feeble growth of potential supply which translates in a weaker aggregate demand.

Figure 4.3. Corporate Net Savings (as % of GDP)



Source: Financial Times

Therefore, as the author rightfully points out, if the corporate sector has trouble re-investing its own cash reserves, savings in the rest of the economy are deemed to have a low marginal value, causing and feeding the persistence of ultra-low interest rates (Wolf, 2015).

The most recent development regarding these economic theories concerns the European Union. George Saravelos, economist at Deutsche Bank, coined the term “Euroglut” in 2014, referring to the fact that Europe’s current account surplus is one of the main determinants of low long-end yields. Excess savings combined with the steep ECB’s quantitative easing programme have contributed to an exceptionally flat global yield curve (Kaminska, 2014). Following Saravelos (2014). The co-existence of a high unemployment rate and a large current account surplus are both a reflection of the same problem, an excess of savings over investment opportunities, which characterise the “Euroglut”.

Table 4.1. Causes and events leading to negative interest rates

	Authors	**Causes and Events**
Dotcom bubble (2000); Subprime crisis (2008) and Sovereign debt crisis (2012)	Bean, Broda, Ito, and Kroszner (2015); Holt (2009); Wigglesworth (2017); Shiller (2005); Brian and Patrick (2010); De Santis (2012); (Draghi, 2012); Khan (2016); European Central Bank (2016); Sanchez (2008)	- Steadily declining trend in interest rates from 1990 with two highs leading to the 2000 and 2008 crisis. - During the 2000s: low Japanese interest rates spurring demand for US assets and heavy domestic borrowing laid the grounds for the 2008 burst. - Heavy rise in EU sovereign spread after the "Greek discovery" of 2009 combined to the limited leverage of a central bank in curbing aggregate risk.
Japan's lost decades (1990-2010)	Issing (2001); Bean, Broda, Ito, and Kroszner (2015); Tyers (2012); Summers (2014); Bank of Japan (2016b)	- From 1999 the Japanese policy rate has remained close to its zero lower bound, entering negative territory in 2016. - When equity and real estate prices increased in the late 1980s, Japan encouraged the bubble to burst by increasing rates, starting a negative feedback loop. - The Japanese crisis implications fuelled the context of the global stagnation context contributing to the persistence of ultra-low interest rates.
Secular stagnation	Teulings and Baldwin (2014); Hansen (1934 & 1939); Rachel and Smith (2015); Gordon (2014); Summers (2014); Bernanke (2015); Krugman (2014); (Glaeser, 2014); Eggertsson, Gauti and Mehrotra (2014)	- Demand deficit driven by a slowing population growth and a fall in the price of capital. - Alteration of the savings to investment ratio have led to a decline in the equilibrium rate associate with a higher level of unemployment. - A demographic slowdown, chronic joblessness and a higher savings rate translate into lower demand for investments leading to a diminished output.
Global savings glut	Bernanke (2007); Bernanke (2015); Wolf (2015); Kaminska (2014); Saravelos (2014)	- While the current account deficit increased in the US, the national savings rate experienced a decline which had to be compensated by a sustained decline in long-term real interest rates.

Source: Personal Production

5. The expected consequences of low and negative interest rates

As reaffirmed in recent crises such as the chronic deflationary tendencies in Japan over the last two decades, there is quite a difference between what is expected by policy implementers and real-world results, as it is the case in many other sectors. In the following part, we will have a closer look at what is expected theoretically by academics and what the expected outcomes are by central banks when negative interest rates are implemented. If each of these expected consequences eventually occur in the real economy or not will be evaluated later in the thesis as well as consequences which have been unexpected or unwanted.

To guide the reader through the expected consequences, below is a table summarizing the main insights and mechanisms examined in this part of our thesis.

Table 5.1. The expected consequences of ultra-low and negative interest rates

Effect	**Authors**	**Mechanism**
Ensure price and financial stability	Taylor (2012), Piergallini and Rodano (2017) Friedman (1976), Smith (2014), Garcia-Schmidt and Woodford (2015)	Taylor's (1993) rule: $i = r^* + pi + 0.5\,(pi-pi^*) + 0.5\,(y-y^*)$ ↓Interest rates = money is cheaper = ↑consumer spending = ↑inflation Possible limitation: neo-Fisherian
Fight deflation	Bagus (2014), Buiter and Panigirtzoglou (2001) Bordo, Ladon-Lane, and Redish (2004), Bagus (2014), Bordo and Filardo (2004), Svensson (2003)	Fight deflation as it leads to liquidity traps Possible limitation: Good vs. Bad deflation view. Only if deflation is unexpected does it lead to a liquidity trap
Achieve full employment	Duprat (2015), Bernanke (2015) Layard, Nickel, and Jackman (1991), D'Autume (2001) Phillips (1958), Skarica (2016)	Wicksellian natural rate = price stability= minimised output gaps = optimal GDP level to induce full employment WS-PS: decreases in interest rates → decrease in unemployment Phillips curve: inflation and unemployment have a stable, inverse relationship. ↓Interest rates = ↑inflation = ↓unemployment

Effect	Authors	Mechanism
Currency depreciation	Swiss National Bank (2014)	Fight capital inflow through decreased (less attractive) interest rates = depreciated currency
	Das (2016)	↑ Policy rate = ↓home interest rate = depreciation home currency = ↑ net exports = ↑output
	Hannoun (2016)	Depreciation currency = ↑price of imports = imported inflation
Increase aggregate demand	Keynes (1936), Barua and Majumbar (2016), Hannoun (2015), Jackson (2015), Bean, Broda, Ito, and Kroszner (2015)	Consumer spending: ↓ interest rate = ↑investment = ↑income = ↑consumer spending Possible limitations: Unwillingness of commercial banks to pass negative rates on to consumers = ↑rates for end consumers If negative rates passed on to consumers: ↓savings = ↓available loanable funds = ↑cost of lending = ↓investment
	Suyuan and Khurshid (2015), Hannoun (2015), Sharpe and Suarez (2015)	↓Interest rates = ↑private investment and government spending ↓Interest rates = currency depreciation = ↓ prices of domestic products on global market = ↑ net exports

Source: Personal Production

5.1. Ensure price and financial stability

The ECB's Governing Council defines prices stability as a *year-on-year increase in the Harmonised Index of Consumer Prices (HICP) for the euro area of below 2%* (European Central Bank, 2017a). The ECB itself states that the primary objective of its monetary policy is to maintain price stability and that in pursuit of this price stability it will aim to maintain inflation rates close, but below 2% over the medium term (European Central Bank, 2017c). Large part as to why central banks use policy rates to steer inflation is explained by Taylor's rule.

The Taylor's rule is a guideline for how central banks should modify interest rates in response to economic conditions, more specifically in function of output and inflation rate. A Stanford economist, John Taylor introduced the concept in 1993 with amendments to the formula in 1999. The rule aims to adjust interest rate to stabilize the economy and price levels on the short term while fuelling sustainable growth. (Piergallini & Rodano 2017). Taylor's rule suggests central banks should adjust policy rates in function of three factors; targeted

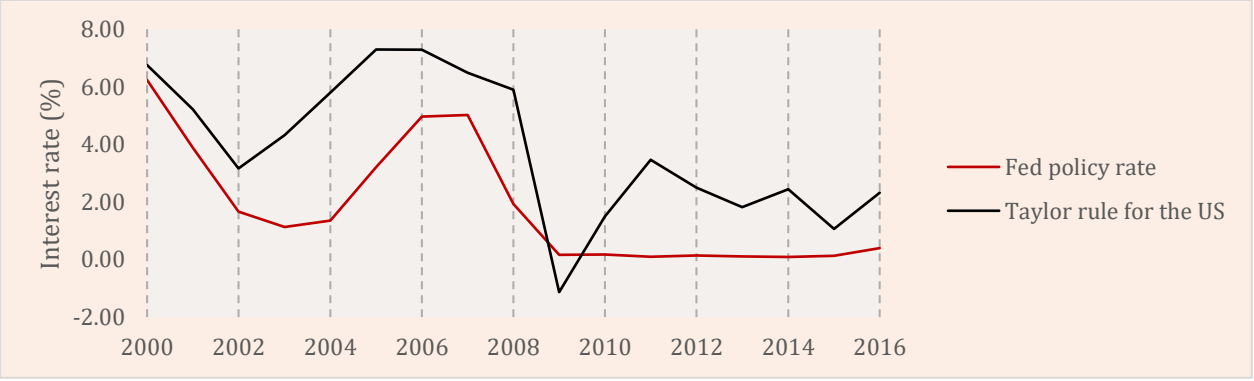
versus actual inflation levels, full employment versus actual employment levels, and the short-term interest rate consistent with full employment. The Taylor rule (1993) is:

$$i = r^* + pi + 0.5\,(pi - pi^*) + 0.5\,(y - y^*)$$

- i = nominal Fed funds rate
- r^* = real Federal funds rate
- pi ; p^* = respectively inflation rate and target inflation rate
- y ; y^* = respectively the logarithms of real output and potential output

It is now widely used by many central banks to help them set interest rates. The use by central banks of Taylor's rule is considered essential by many economists that some such as Piergallini and Rodano (2017), Meltzer (2011) and Taylor (2012) have even gone as far as to say that the Great Recession was caused the Federal Reserve not respecting the Taylor rule during the years preceding the 2008 crisis, from 2002 to 2006. To illustrate this argument, Figure 5.1. plots both the actual Federal Reserve's rate and the policy rate advised by the Taylor rule from 2000 to 2016. We computed the Taylor rule using GDP deflator as inflation rate as Taylor (1993) argues it to be the best indicator of inflation.

Figure 5.1. Difference between Fed policy rate and Taylor rule



Source: Personal Computations

Even without considering Taylor's rule there is quite a basic mechanism behind the primary objective of the large majority of central banks implementing negative interest rates which

is to stimulate moderate inflation. If a central bank decreases its interest rate, it makes money cheaper. If money is cheaper, consumer spending supposedly increases and thus inflation rises.

Nevertheless, major authors such as Friedman (1976) partially disagree with this approach. According to Friedman (1976) lowering nominal interest rates will in the short run indeed spur money growth and briefly encourage inflation, however over the long run money is neutral. Even the short-term encouragements for inflation might be countered by economic agents as they can escape the temporary nominal 'monetary illusion' by adapting their expectations. Which makes lower interest rates ineffective to increase inflation in the medium-long term.

Some authors even go as far as stating that central banks such as the ECB are doing the contrary of what should be done. Smith (2014) argues that, considering the Fisher equation (see *Part 1.3. Theory on interest rates* for our discussion of the Fisher equation): ($r_r = r_n - \pi_e$), if a central bank reduces its nominal rate in the long term, then the price levels will drop in the long term too to maintain the equation's equilibrium. Garcia-Schmidt and Woodford (2015) contend that the previous neo-Fisherian argument explains why the current deflationary issues do not improve considerably despite important monetary intervention.

Financial stability *is a state whereby the build-up of systemic risk is prevented. Systemic risk can best be described as the risk that the provision of necessary financial products and services by the financial system will be impaired to a point here economic growth and welfare may be materially affected* (European Central Bank, 2016b). Even though the International Monetary Fund (2015) argues with conviction that price stability is insufficient to ensure financial stability and that the latest global recession of 2008 is proof hereof, it also admits price stability is an essential part of monetary policy to sustain financial stability. Central banks such as the ECB continuously monitor macro-economic developments and implement all policies in line with the insurance of this stability (European Central Bank, 2016). As interest rates greatly influence price stability as explained above, central banks thus use interest rates to maintain financial stability over the long run.

5.2. Fight the possibilities of deflation and liquidity traps

It seems as if historically, and especially today, Central Banks use their main rates and other monetary tools to avoid deflation at all costs. The main reason therefore is that politicians and central bankers adopt the point of view of the Keynesian inspired theory on deflation, which strongly associates deflation with liquidity traps. Furthermore, it is adopted by numerous influential economists such as Lars E.O. Svensson, Ben Bernanke, Marving Goodfriend, or Paul Krugman (Bagus, 2014). They do not identify one single benign effect of deflation. As a reminder Buiter and Panigirtzoglou (2001) define a liquidity trap as a situation where no channel of any monetary policy is able to impact aggregate demand. Therefore, out of fear of deflation and liquidity traps, central banks use their interest rate as a tool to fight any possibility of these events occurring.

However, another view on deflation, inspired by the Chicago School argues that deflation does not need to be fought in all cases. This view is represented by economists such as Claudio Borio and Michael Bordo who claim that there are two types of deflation; good and bad. Good deflation in the Chicago School view is caused by a positive shock in aggregate supply with high profits, rising real wages and asset prices whereas bad deflation is caused by a negative shock in aggregate demand (Bordo, Ladon-Lane, & Redish, 2004).

Moreover, as Bagus (2014) mentions, these economists believe that it is only in the case deflation is unexpected that it has negative consequences. Whereas when deflation is unexpected the theorists representing the good vs. bad deflation concept identify a third type of deflation; ugly deflation, which disrupts the economy in a self-reinforcing spiral (Bordo & Filardo, 2004). Thus, in the Chicago School view, central banks would only have to fight deflation in case it is either bad or ugly, and only in the case it is ugly could it cause something similar to a liquidity trap. As interesting as it is to mention the good vs. bad deflation theory, the more likely situation which the United States, Europe and Japan are currently facing is a plausible liquidity trap as defined through the Keynesian lens.

Even though the basic mechanism of decreasing interest rates to consequently increase inflation should function in theory, ultra-low and negative interest rates have failed to do so. Deflation is a constantly lurking threat in Europe and Japan. In fact, headline inflation in the euro zone averaged approximately 0% in 2015 (0.0083%) and 0.24% in 2016. However, some encouraging months have recently occurred for the euro zone with inflation picking up in January, February and March 2017 to 1.80%, 2.00% and 1.50% respectively. (OECD, 2017b).

One of the reasons for the failures of negative interest rates to increase inflation from the start could be that from the beginning major events have counteracted the desired effect. For example, in June 2014, oil prices started their collapse at the same time as the ECB implemented a negative interest rate on its deposit facility for the first time. Certainly, this made it even more difficult for the ECB to push price stability to its objective of 2 percent inflation but it cannot be the only reason for the ECB's failure to increase inflation as it has been decreasing its main rates for years now. According to some major scholars, central banks have simply not been adopting the right tools to fight the lurking deflation or at least, have not been using the tools correctly.

Bagus (2014) claims that there is no way out of a liquidity trap through conventional monetary policies, that the public will hold onto the money supply created should the central bank increase it. To escape such a trap, central bank tools aside, recommendations include increasing governmental spending for example (Svensson, 2003), which is not the case in austerity struck Europe.

5.3. Achieve full employment

One of the objective central banks clearly aim to achieve through their monetary policies is full employment. For example, the Federal Reserve has full employment as one of its primary objectives, and the European Central Bank indirectly aims towards full employment (Federal Reserve, 2017a). Three economic models support the reasoning of targeting full employment

through the adoption of the correct interest rate; wicksel's natural rate, the WS – PS (Wage Setting – Price Setting), and Phillips Curve.

Firstly, over a century ago in 1898 Wicksel observed the interest rate in the market place which would result in an equilibrium between desired savings and investment at full employment. The Wicksellian interest rate leads to price stability, which as mentioned above is the current primary objective of central banks. Once price stability is attained through this natural rate, according to Duprat (2015), output gaps are minimised and GDP reaches the optimal level to induce full employment rates. (Duprat, 2015). However, even with current negative rate policies full employment rates are far from being attained in major economic blocks such as the euro zone or Japan.

Since the neutral Wicksellian interest rate is a hypothetical construct we cannot observe it but Duprat (2015) still suggests that the Wicksellian interest rate is currently lying too low for central banks as nominal policy rates are limited by a lower bound. According to Bernanke's (2015) hypothesis this phenomenon is due to the global savings glut which has been mentioned earlier in the paper.

Another model, WS-PS, introduced by Layard, Nickel, and Jackman (1991) suggests employment is dependent on interest rate levels. According to the WS-PS Model, the natural unemployment equilibrium is located where Wage Setting and Price Setting meet. D'Autume (2001) discusses how this equilibrium can be function of interest rates. D'Autume concludes that if interest rates decrease it will have a positive effect on unemployment, decreasing its level.

Finally, the Phillips Curve, developed by A.W. Phillips (1958) shows that inflation and unemployment have a stable and inverse relationship. The Phillips Curve suggests that increasing inflation decreases unemployment and vice versa. Most Central Banks, such as the ECB and the BoJ, are aiming to increase inflation levels to a stable 2% inflation through lowered interest rates. It is assumed by the Phillips curve that the increase in inflation will decrease unemployment levels. It is mainly due to the Phillips Curve that many central banks

currently adopt an inflation target rate. Although the Phillips Curve was contradicted by the stagflation period of the 1970s in the U.S.A when GDP growth consistently declined while inflation was on the rise, the relevance of the Phillips curve to analyse today's economic issues is confirmed by Skarica (2016).

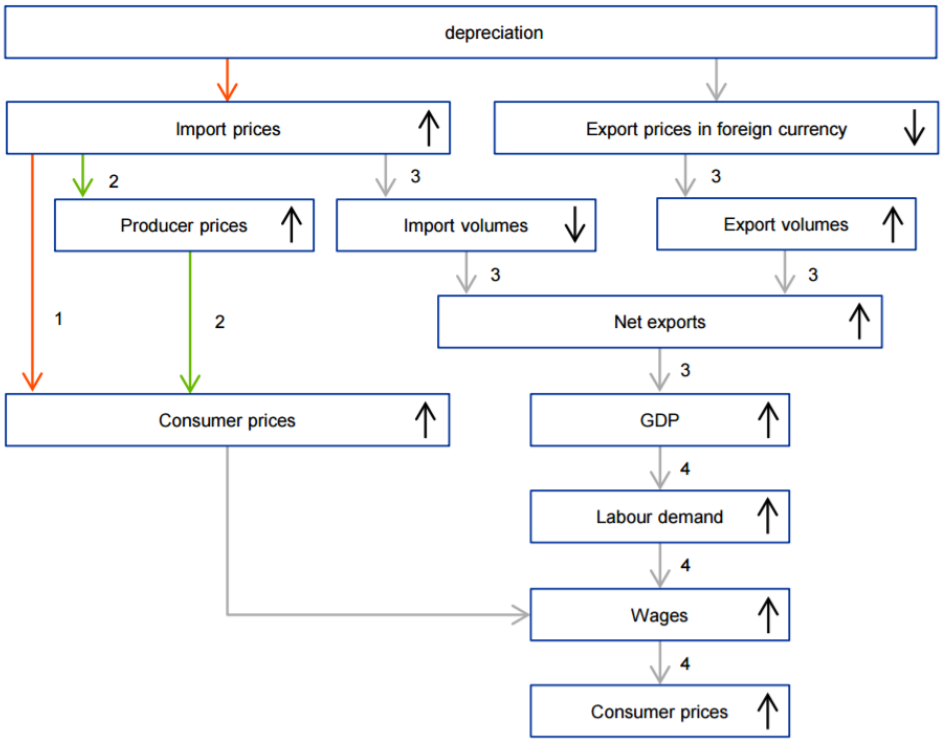
5.4. Stimulate currency depreciation and export competitiveness

Firstly, by decreasing interest rates central banks deter massive capital inflows to discourage agents to invest in the national or regional currency to prevent any excessive appreciations. In fact, decreasing interest rates has, for example, since long been the main tool for the Swiss National Bank (SNB) to fight a historically strong currency such as recently when the ECB implemented unconventional monetary policies in 2014 or when massive capital inflows threatened the national economy in the 1970s.

Secondly, a devaluated currency should theoretically increase exports as goods denominated under that particular currency become cheaper on the global market. For example, if the euro depreciates against the US dollar it is likely euro zone exports will increase as the euro exports become cheaper relative to US products. According to Das (2016), exports were indeed boosted in the euro zone as well as in Japan in the first round of their interest rate cuts in respectively 2014 and 2016. We will analyse this effect in depth in *Chapter 3* along with the real effect of ultra-low interest rates on exchange rates. Furthermore, this depreciated currency will make imported goods more expensive and so encourage domestic inflation discussed above in *Part 0. Ensure price and financial stability* (Hannoun, 2015)

To summarize all expected effects of a currency's depreciation, the following schema reviews all direct and indirect effects of depreciations, both those discussed in more depth in this part and those not, in order to give a complete overview.

Figure 5.2. Schematic overview of direct and indirect effect of depreciation



Source: European Central Bank (n.d.)

5.5. Boost aggregate demand by deterring savings and encouraging borrowing

The Keynesian equation for Aggregate Demand is (Keynes, 1936):

$$AD = C+I+G+(Nx)$$

- C = Consumer spending
- I = Private investment spending
- G = Government spending
- Nx = Net exports.

To boost Aggregate Demand, central banks around the world seem to aim at increasing each one of the equation's components through different elements of their monetary policy hence, the following discussion will address each of the equation's elements.

Addressing the consumer spending element of the equation; according to Barua and Majumbar (2016), the ECB as well as the BoJ aim to increase consumer spending (domestic demand) through their negative interest rates policies. Hannoun (2015) confirms that one of the main aims of an ultra-low or negative interest rate policy is to deter savings and encourage borrowing.

It is relevant to note that the Keynes "IS-logic" would undermine this argumentation. As a reminder, the "IS-logic" is derived from the combination of two Keynesian equations. The national output equals two elements, consumption of goods, and investment: O = C + I. While national income equals the consumption expenditure and saving: Y = C + S. As we know by definition, national output equals national income: O = Y. Combining the two equations results in: C + I = C + S. Hence, Investment = Saving; I = S. In chapter 9 of his book the *General Theory* J.M. Keynes remarks that any decrease in interest rate to increase aggregate investment would in turn increase the level of income. This increase in income would then result in an increase in nominal savings, as the percentage of savings would increase in the same measure as investment (Keynes, 1936).

Jackson (2015) states that negative rates should increase demand and should be no different in consequence on household behaviour as a similar sized rate cut when rates are above zero. Meaning the traditional mechanism of increasing demand through the credit channel applies to the same extent to rate cuts below zero. The traditional mechanism mentioned here is the following: a decrease in a central banks' policy rates encourages its depositors (commercial banks) to invest their excess reserves into other assets such as commercial or corporate lending. If negative interest rates are passed on to end consumers, credit facilities become cheaper while returns on risk free saving deposits at commercial banks decrease. Consequently, deterring savings, encouraging borrowing and so consumer spending.

However, there are some limitations to this theory. Bean, Broda, Ito, and Kroszner, (2015) highlight an interesting case; *since the introduction of negative interest rates in Switzerland, mortgage rates and the rates for some firm loans have been increasing instead of decreasing*.

According to Bean et all. (2015) this is because Swiss banks do not want to pass on negative rates to their end consumers while simultaneously facing pressure to maintain profit margins. Moreover, as a consequence hereof, banks face the dilemma of either raising lending volume or increasing maturity transformation. Both options leading to a riskier asset portfolio and thus financial stability risk.

Furthermore, Jackson (2015) highlights another dilemma in the opposite case where negative rates are effectively passed on to households. In this case, not only will lending rates decrease which benefits consumers as explained earlier but the other side of the coin is that saving rates will be reduced which would hurt consumers. Consequently, households could limit their savings deposits at retails banks and so the amount of loanable funds available to commercial banks would decrease, limiting their supply and thus increasing the cost of lending, all else equal. Which is the exact opposite of current monetary policy objectives.

Secondly, according to Suyuan and Khurshid (2015) the lowering of policy rates is expected to have an increasing effect on Private Investment and Government Spending. Due to low policy rates borrowing becomes a free lunch for some. As can be seen in the euro zone governments are encouraged to borrow more; public debt-to-GDP ratio increased from 73.3% to 108.4% between 2007 and 2015 while net interest payments fell from 2.5% of GDP to 2.2% (Hannoun, 2015).

Moreover, these parts of the aggregate demand equation are further encouraged by other unconventional policies such as Quantitative Easing. However, this effect also appears limited as Sharpe and Suarez (2015) find in their survey that most firms claim their investment plans are quite insensitive to decreases in interest rates, and only somewhat more responsive to interest rate increases.

Finally, the Net Exports component of the aggregate demand equation is expected to increase, as described in detail above in *part 2.3*. Currency depreciation makes a nation's products cheaper on the global market, more competitive and thus encourages exports.

To conclude, central banks aim to increase aggregate demand through unconventional monetary policies which should in theory be effective. However, many authors such as Jackson (2015), Bean et all. (2015), Sharpe and Suarez (2015) highlight many limitations and even adversary effect of current central bank policies on aggregate demand, especially in regards with the domestic demand component. In the next Chapter of our thesis we will attempt to find out what the actual consequences of ultra-low and negative interest rates are.

Chapter III. The actual consequences of low and negative interest rates

6. Data based verification of the expected consequences

6.1. Analysis framework

- *Description of the data:*

In order to perform our data-based verification of the expected consequences of ultra-low and negative interest rates, we collected data from 2000 up to the latest available record, which in most cases is March 2017. A shorter timeframe from 2007 could have seemed more relevant to analyse the effects of Central Banks' unconventional policies, however we considered it important to have this longer timeframe for two main reasons.

As the purpose of this research is to analyse the effects of ultra-low interest rates, we aim at having a comparative view between how interest rates at 'normal' levels and at ultra-low levels impact macroeconomic metrics. Moreover, we wanted to include in our analysis the two global events discussed in *Part 4.1.* to see the effects those events had on our selection of metrics. The dataset was created by combining data from OECD Statistics (Organisation for Economic Co-operation and Development), the ECB Statistical Data Warehouse, Eurostat, the Federal Reserve System, the Federal Reserve Bank of St Louis, the International Monetary Fund and FactSet.

When available monthly data was used, which is the case for most datasets. However, when some metrics were only recorded quarterly, we decided to keep the indicators and manage to find the negative interest rates in the corresponding frequency.

The areas (United States, Japan, and Eurozone) from which we collected data were selected for specific reasons. Obvious reasons include that these are the three major economic blocks in the global economy and that all three have implemented ultra-low or negative interest rates.

Among the reasons why Japan is included in our sample is that it is a very peculiar case of ultra-low interest rates with over two decades of interest rates below 0.5% which makes Japan an intriguing case. Therefore, we had the possibility to observe how our selection of metrics reacted over two decades at such a stable and flat policy rate compared to the other two regions where policy rates have been considerably more volatile. Both events having led to sustained ultra-low interest rates were originated in the United States thus it seemed essential to include the country in our analysis. The Eurozone was the first major economic block to implement negative interest rates. For both the purpose of relevant comparisons and the more fundamental reasons already exposed, the "final three" were the United States, Japan and the Eurozone.

When faced by the unavailability of data for the entire Eurozone (in *Part 6.4)* we computed a weighted average, in function of GDP, of the Eurozone's four major economies – Germany, France, Spain, Italy – representing 76% of the Eurozone's GDP. The 75% threshold is the one used by the OECD when computing Eurozone data as well.

- *Methodology:*

For some of the main metrics, in function of relevance and correlation factors, we applied a simple linear regression model to confirm our hypotheses. *This is a model with a single regressor x that has a relationship with a response y that is a straight line* (Montgomery, Peck, & Vining, 2015, p.12). The simple linear regression equation is:

$$y = \beta_0 + \beta_1 x + \varepsilon$$

Where the intercept β_0 and the slope β_1 are unknown constants and the ε is a random error component. We view the regressor x as controlled by the data analyst and measured with negligible error, while the response y is a random variable with a probability distribution for each value of x (Montgomery, et al., 2015). We used this specific type of regression as most of our analyses include two variables, one independent (the level of policy rate); x, and one dependent variable (the expected effect); y. As explained by (Montgomery et al., 2015) the level at which R square (R^2) is acceptable and is very dependent on the nature of the data. Therefore, we decide which level of R^2 is acceptable on the nature of the data for every

different type of data which we regress. For some of our metrics, a regression was not relevant, hence we analyse the data through qualitative insights.

6.2. Inflation and money supply

- *Inflation*

In order to assess the level of inflation in the economy and adjust its monetary policy accordingly, the ECB uses the Harmonised Index of Consumer Prices. This index, labelled in percentage, includes food and energy items. Even though, the United States uses another indicator to monitor the level of inflation (i.e. PCE), they also include energy prices in their measure.

To perform a levelled analysis, we choose to gather the comparable index (CPI) for Japan as well. Our reasoning behind this choice comes from the fact that energy and food are two important expenditure items in households' budgets and that including those gives a clearer picture as to where the level of prices stands for economic agents.

In our *section 5.1,* we examined what were the expected consequences of ultra-low interest rates on the level of inflation and how the academia theorized them. The baseline was that central banks decrease interest rates, and implement negative rates when the decrease is not deemed sufficient to spur inflation. However, this is in contradiction with the Fisher equation which postulates that, in the long-run, prices will drop as a consequence of low interest rates, in order to maintain the equation's identity.

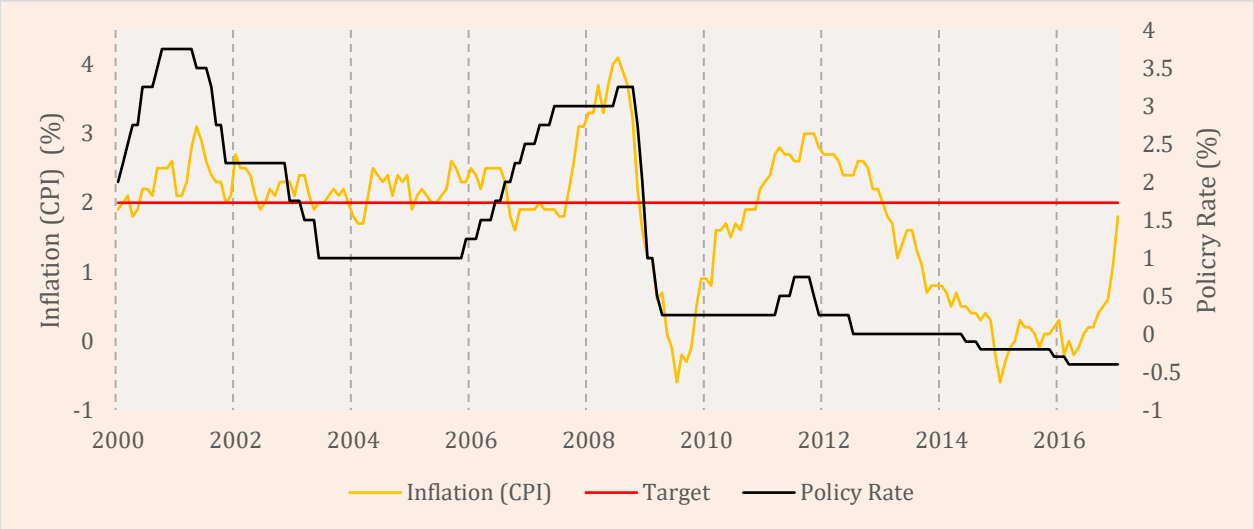
Since we are conducting an analysis of the correlation between two variables, it is important to mention that Kahn and Benolkin (2007) have examined another driver of the level of inflation; namely, the stock of M3 money aggregate. They argue that a level of M3 above its equilibrium suggests the build-up of inflationary pressures.

Let us now take a closer look at the real data gathered over the span of 17 years by major governmental institutions to assess whether these theoretical concepts materialise. We will

start by looking at the real-data from each country plotting the level of interest rate as well as the level of M3 money aggregate against the inflation rate. Starting with the Eurozone followed by the United States and finishing with Japan, where the effect seems to be the mildest.

For the Eurozone, and using ECB data, we can see how the Central Bank closely monitors the level of CPI inflation in the monetary area, and adjusts its policy rate to it. If we examine what occurred during the two economic shocks that the Union experimented (namely the spill overs from the US subprime crisis and sovereign debt crisis that have been exposed in *section 4.1)* we can observe, in Figure 6.1, the mentioned effect.

Figure 6.1 Eurozone CPI inflation



Source: ECB; Eurostat; Personal Design

In July 2008, while the CPI inflation level peaked (4.1%), the Central Bank decided to increase its deposit facility to an historical high of 3.25%. Less than a year after, in June 2009, the monetary area experienced deflation, a level of CPI inflation below zero (-0.1), while the ECB's deposit facility decreased 300 basis points to 0.25% in April 2009. It was only when the level of CPI inflation markedly overshot the ECB's target of 2 percent, that the Central Bank took action.

In April 2011, the level of CPI inflation came back to 2.8%, therefore the bank increased the rate on its deposit facility, 25 basis points, to 0.5%. Seven months after, the inflation rate started to decline again, when it crossed the 2.4% mark, the bank decided to bring its policy rate to 0% leaving it there during nearly two years before deciding to adopt negative interest rates in June 2014.

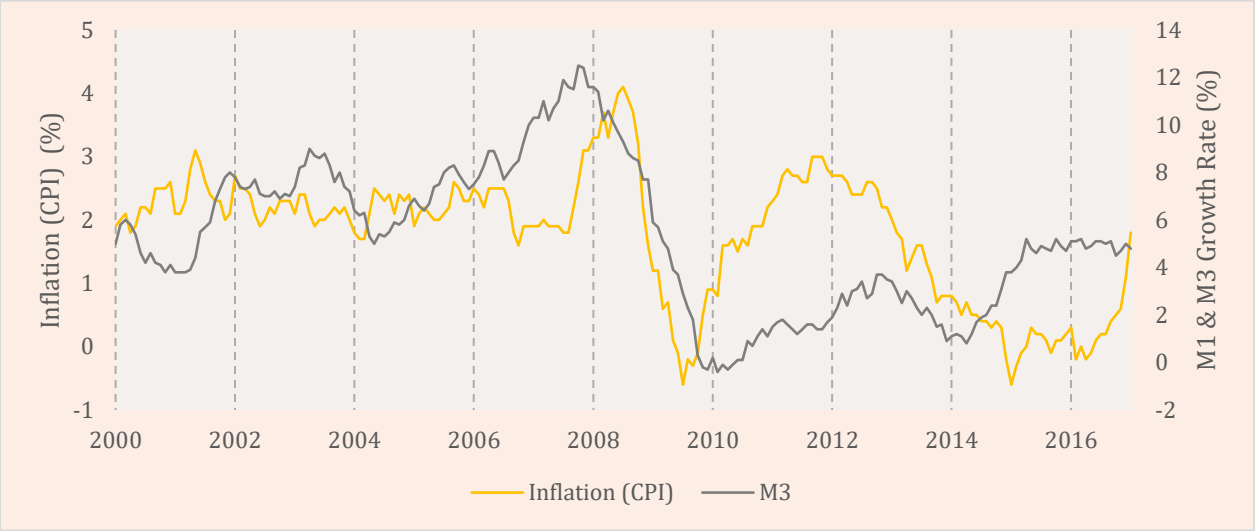
However, the effect wanted by the Central Bank of decreasing interest rates in order to induce inflation did not work from November 2011 to January 2015, when the inflation rate steadily declined until hitting a period-low of -0.6%. Various structural factors can explain this steady trend. The effects of the sovereign debt crisis weighted heavily on the morale of European households. We can also make a case as to why the ECB started with more aggressive monetary packages once this trend was vividly apparent.

The discretion of a central bank to react to short-run macroeconomic fluctuations is bounded by two factors: the nature of the shocks and the credibility of the banks' objectives in light of those shocks.

According to us, it is apparent that the ECB acted with some lag but perhaps in a premeditated manner. Expecting economic conditions to deteriorate even further and with interest rates at their lowest levels in history, they might have wanted to keep some dry powder (i.e. Quantitative Easing) in order to be able to avoid a stagflation spiral.

It seems that the inflation rate has been recovering as of January 2016 and it is on the upward trend pre-supposing a long-term efficiency of the ECB's policies, this effect, however, might be short-lived and only due the strong increase oil prices registered during the year. We can also observe in Figure 6.2 that the M3 growth rate seems to fuel inflationary pressures in the economy as Kahn and Benolkin (2007) predicted. Indeed, the growth rate of M3 money aggregate shifted from 7.7% to 11.6% between July 2006 and August 2007. The CPI inflation level responded with a lag jumping from 1.8% in August 2007 to 4.1% one year later.

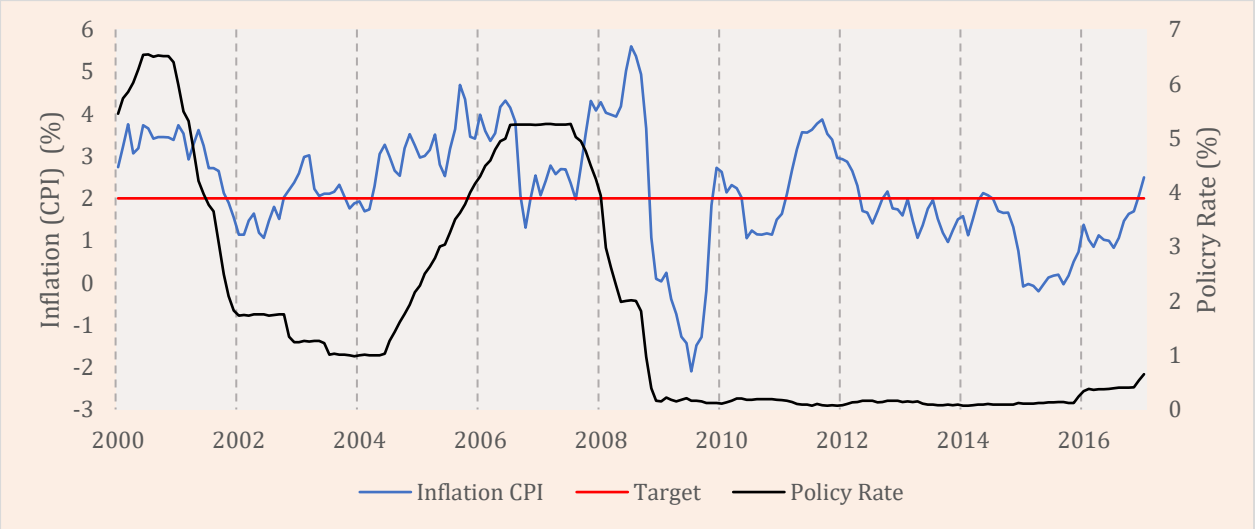
Figure 6.2. Eurozone money growth rates



Source: Eurostat; ECB Statistical Data Warehouse; Personal Design

In the United States, Figure 6.3 shows that, as a consequence of the subprime crisis, the Federal funds rate (i.e. US policy rate) declined from its peak of 5.26% in July 2007 to 0.39% in November 2008, which amounts to a decrease of 4.87 percentage points. During this time, the level of CPI inflation, switched from 2.4% to 1.1%, which constitutes a decrease of 1.3 percentage points. However, CPI inflation responded with some lag to the decrease in the policy rate. Effectively dropping more than 7 percentage points from August 2008 (5.4%) to July 2009 (-2.1%).

Figure 6.3. United States CPI inflation

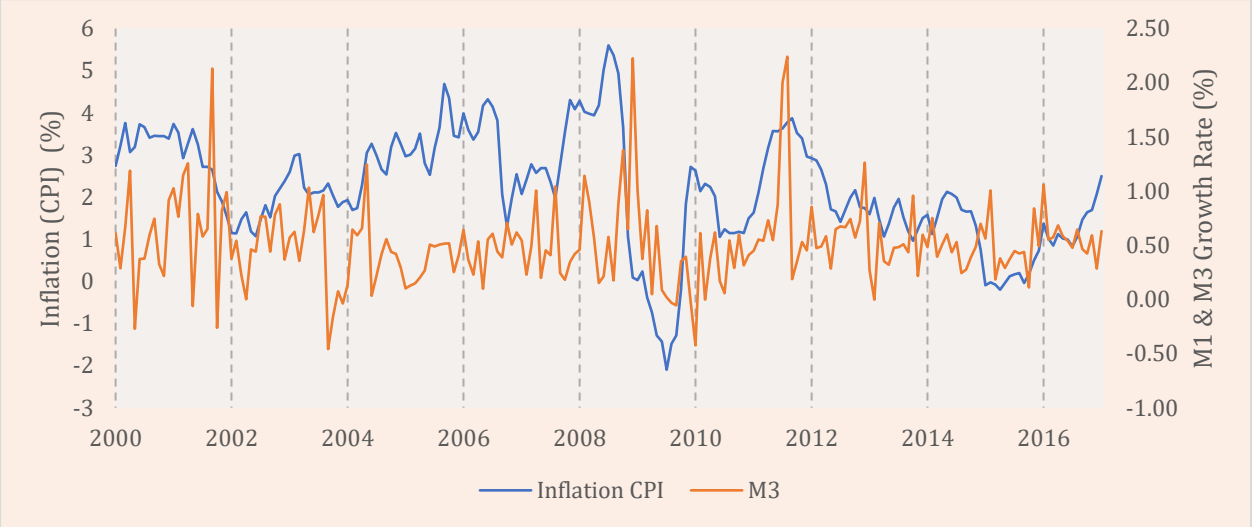


Source: Federal Reserve Bank of New York; OECD Statistics; Personal Design

Following us, and as it can be seen in Figure 6.3, the inflation rate has been steadily increasing for the past year, with most recent data suggesting it has overshot the FED's target rate. Therefore, it is questionable whether the FED is "behind the curve" (i.e. increasing rates too late) or not. Aside from the delay in rising interest rates, there is another element that could highly influence interest rates and that is the size of the FED's balance sheet, having passed from $800bn to $4.5tn from 2008 to 2017.

Confirming what Kahn and Benolkin (2007) posited, it does seem that, as depicted in Figure 6.4, a spike in the level of M3 money in circulation accompanies a jump in the inflation level. As we can see, inflation was building up from November 2010 (1.1%) to August 2011 (3.8%). During the same time, the M3 growth rate changed from 0.31% to 2.24%.

Figure 6.4. United States money growth rates

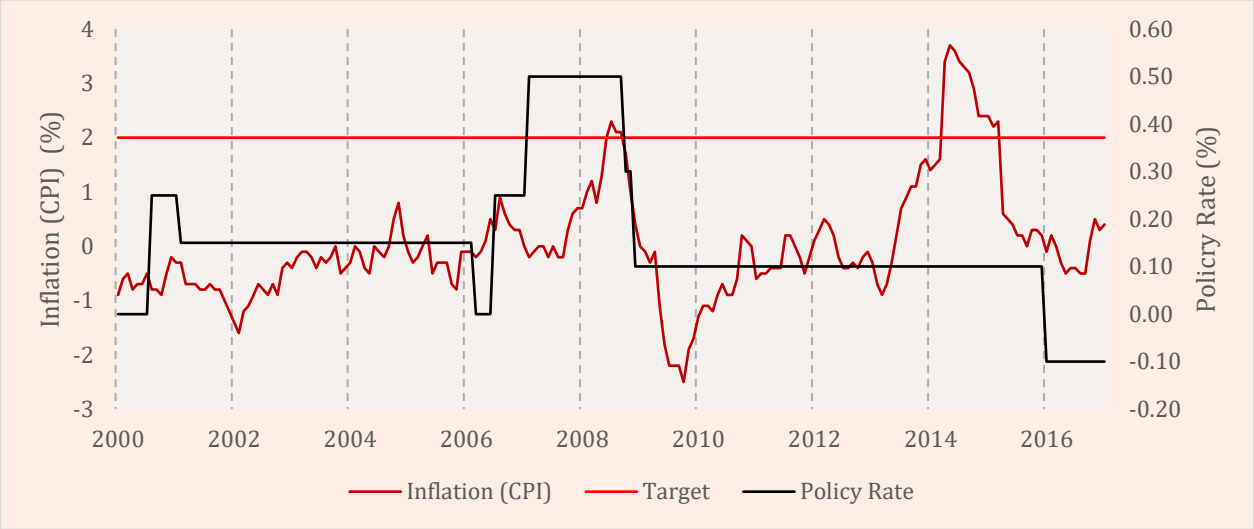


Source: St. Louis Federal Reserve Bank; OECD Statistics; Personal Design

Regarding Japan, it is harder to derive trends since the policy rate has stayed within a 0.70% fluctuation band for the 17 year-period analysed. However, we can see in Figure 6.5 that while the interest rate has stayed at 0.10% from December 2008 to December 2015, the inflation rate has spiked from -0.9% to 3.7% between March 2013 and May 2014. One of the main reasons for this sudden pick-up in inflation is due to an approved law by the Japanese

parliament, in June 2012, that doubled the sales tax (i.e. VAT) from 5 to 10% by October 2015, therefore, automatically increasing prices and translating into a higher inflation rate (De Michelis & Iacoviello, 2016).

Figure 6.5. Japan CPI inflation

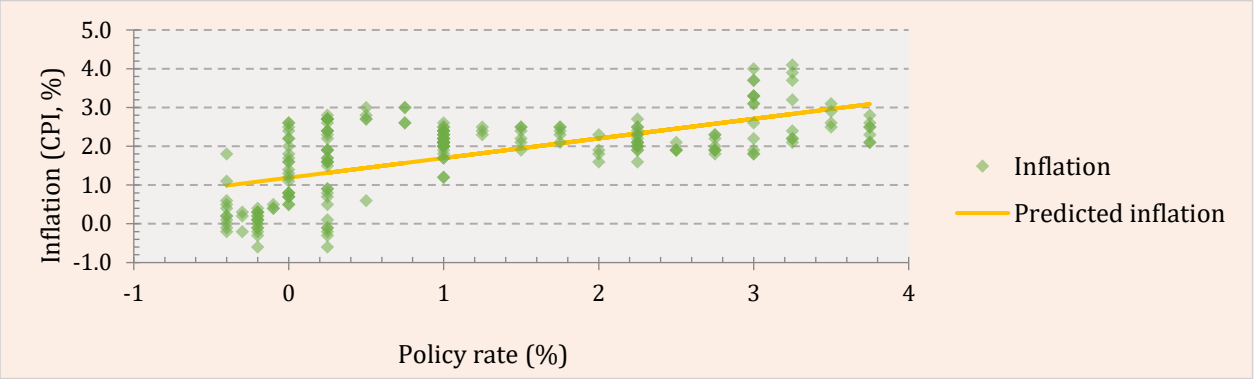


Source: FactSet; OECD Statistics; Personal Design

To conclude, we can derive that long-term trends in the three countries are fairly similar as it seems that a decrease of the policy rate does not provide the price stimulus that Central Banks want. Furthermore, it seems that the correlation between the policy rate and the level of inflation over a significant period of time is positive.

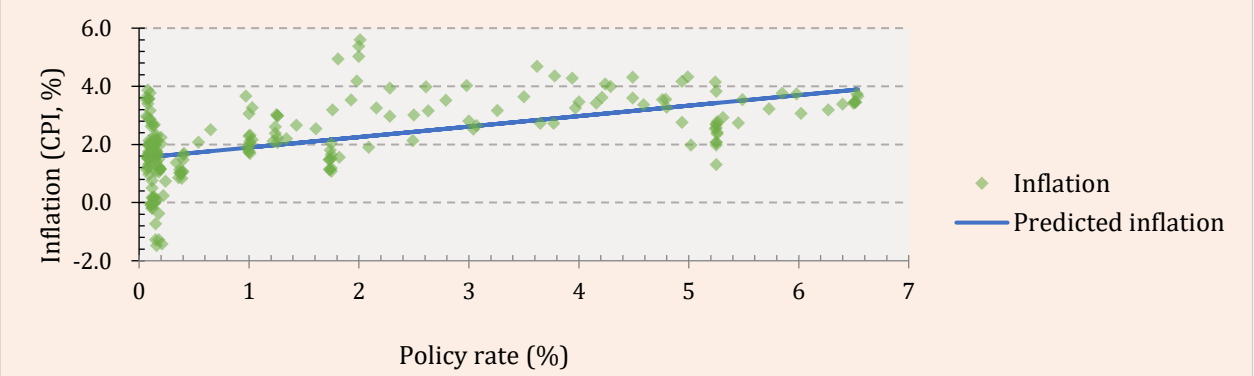
Indeed, by regressing and deriving the correlation coefficients of the monthly data aggregates concerning the policy rate and the level of inflation from January 2000 until January 2017, we found a positive correlation between the data sets. For the Eurozone (Figure 6.6) and the United States (Figure 6.7), with R^2 of 0.40 and 0.31 respectively.

Figure 6.6. Eurozone policy rate; line fitted



Source: Personal Computations

Figure 6.7. United States policy rate; line fitted



Source: Personal Computations

However, in the case of Japan and as the data about the policy rate does not allow us to derive a sound regression, we omit the results from the corpus of our work. Jonsson and Reslow (2015) results seem to corroborate these findings and are particularly relevant for Japan's situation. They argue that the rational expectations of economic agents allow them not to make systematic errors when they form expectations about the future monetary policy. Therefore, they understand the policy cut will be long-lived, and that its duration is associated with a lower inflation rate in the long term.

In our view, they might be hidden forces at play in what regards the level of interest rates and their correlation with the level of inflation. For instance, why the ECB as it saw the level of inflation overshooting its target for almost two years (2011-202) did

not decided to significantly raise rates? As most European countries are running budget deficits and have high debt-to-GDP ratios it is in their best interests to keep borrowing costs as low as possible.

One of the reasons of this increase in spending by central governments is an ageing population and the pensions' burden that this entails. Over time, and with interest rates below inflation rates, it is easier for governments to erode or liquidate their debt without having to resort to spending cuts or tax hikes. Since government debt is hold by many banks and pension funds managing consumers' savings, keeping interest rates at record lows acts as a hidden tax on people's wealth. As a consequence of this mechanism, consumers are subtly subsidizing governments.

- *Money supply*

The role given to money aggregates differs markedly between central banks (Kahn & Benolkin, 2007). The former Federal Reserve Governor, Lawrence Mayer, has said that *money plays no role in today's consensus macro model…. and virtually no role in the conduct of monetary policy, at least in the United States*. (Kahn & Benolkin, 2007, pp.1). Whereas, former ECB executive board member, Otmar Issing, has said that money should never be ignored neither in the conduct of monetary policy nor in research.

In summary, it is commonly argued that an increase in money supply impacts nominal interest rates through two channels: liquidity and inflation. Hamilton and Herrera (2004) argue that increased liquidity should reduce interest rates, while more rapid inflation would cause them to rise. Economists argue that for an unexpected monetary expansion, the liquidity effect would dominate.

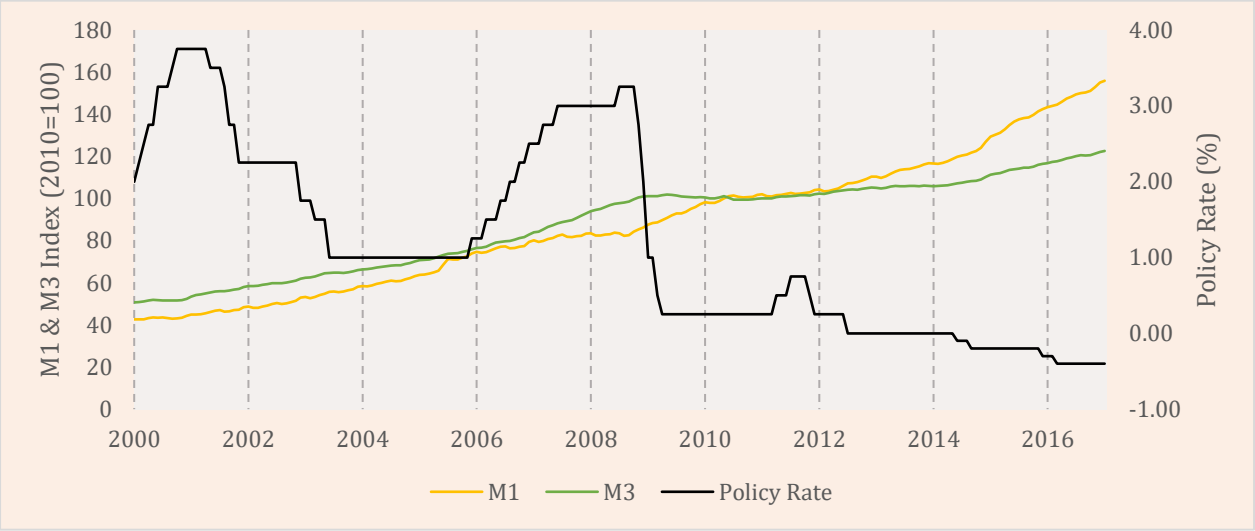
Schabert (2005) asserts that, since the central bank's optimal policy goals are tied to interest rate targets, monetary aggregates should be irrelevant for the analysis of the monetary stance. The results of his empirical research regarding the link between money aggregates and the level of interest rates shed light on an important result, that is contradicted by the data we gathered. Schabert (2005) advances that an increase in money supply is generally

associated with higher interest rates. Alatiqi and Fazel (2008) bring additional arguments in that sense arguing that when an economy experiences stagflation, as it has been the case in Japan for the last two decades, households might, nonetheless, increase their demand for money in response to a marginal rise in prices. In this scenario, an expansionary policy might induce higher rates.

In order to analyse how these theoretical assumptions, hold compared to actual data from the ECB Statistical Data Warehouse and the OECD statistical database, we chose to plot two graphics for the Eurozone. In the first one, the stock of money aggregates, M1 and M3, is displayed following an index with base 100 in 2010. In the second, the year-on-year growth rate of the same money aggregates is displayed in percentage points. The two graphs are plotted against the level of interest on the deposit facility, which the ECB uses as its policy rate.

Data from the European Central Bank regarding the level of interest rates and the money supply contradicts his point. Indeed, as shown in Figure 6.8, the level of interest rate in the deposit facility has been steadily declining from 0.75%, in July 2011, to -0.40%, the level in January 2017. While the stock of money supply has climbed from 102.6, in July 2011, to 155.9 in January 2017, in indexed terms. Furthermore, when we compute correlation coefficients between the M1 money supply and the policy rate in the Eurozone and the US, we find, respectively, -0.77 and -0.63, positing the inverse relationship than the one advertised in the literature.

Figure 6.8. Eurozone money supply

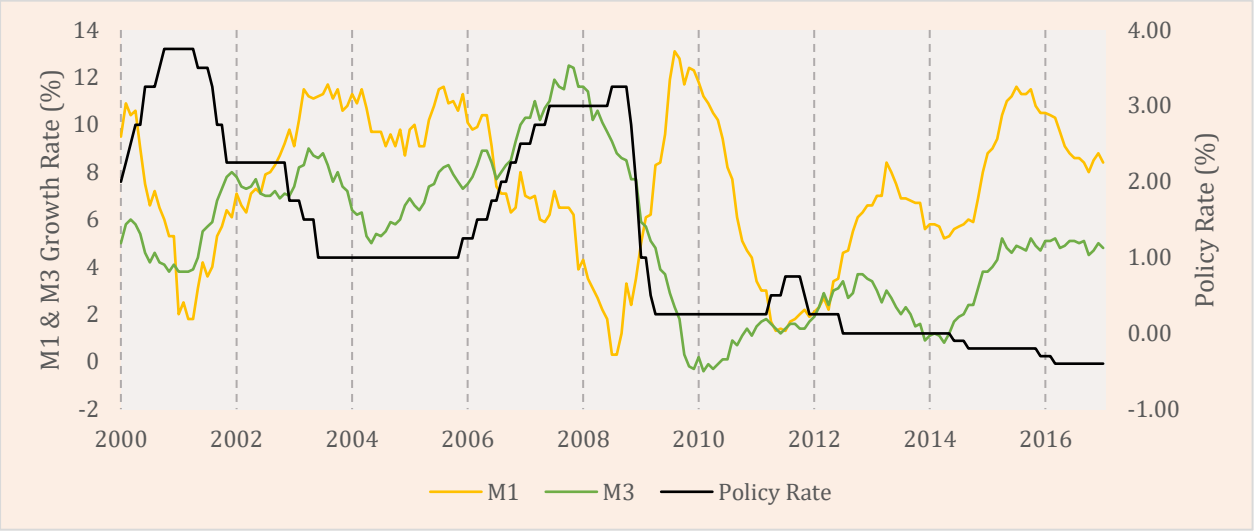


Source: ECB; ECB Statistical Data Warehouse; Personal Design

Moreover, Figure 6.8 shows that within the Eurozone the stock of broad money (with a long maturity) (M3) has been superior to the stock of narrow money (M1) (with a short maturity) from January 2000 until July 2010. The sudden drop in interest rates that started in July 2008 and continued into July 2010 has been followed by an increase in the money supply M1 surpassed M3 and has stayed so until today. This can be explained by the decrease in the M1 money multiplier, which measures the ratio of money created by central banks compared to the money created by commercial banks, however, some authors doubt the effect of such metric (Carpenter & Demiralp, 2012). The tendency inversion can be attributed to several factors; Central Banks are pouring more money in the economy through their QE programmes (McLeay, Radia, & Thomas, 2014), while commercial banks are reluctant to lend because of poor economic prospects (Brunnermeier & Sannikov, 2016).

The ECB has set as reference value, in 1998, a year-on-year growth of 4.5 percent of its M3 money aggregate. In Figure 6.9, we can see that the M3 monetary aggregate growth rarely matches the ECB target. A common trend between the three countries analysed and that the academia (McLeay, Radia, & Thomas, 2014), deems to have been caused by the extensive QE programmes, is that both the stock of M1 as well as the year-on-year growth rate surpasses the one of the broader aggregate, M3.

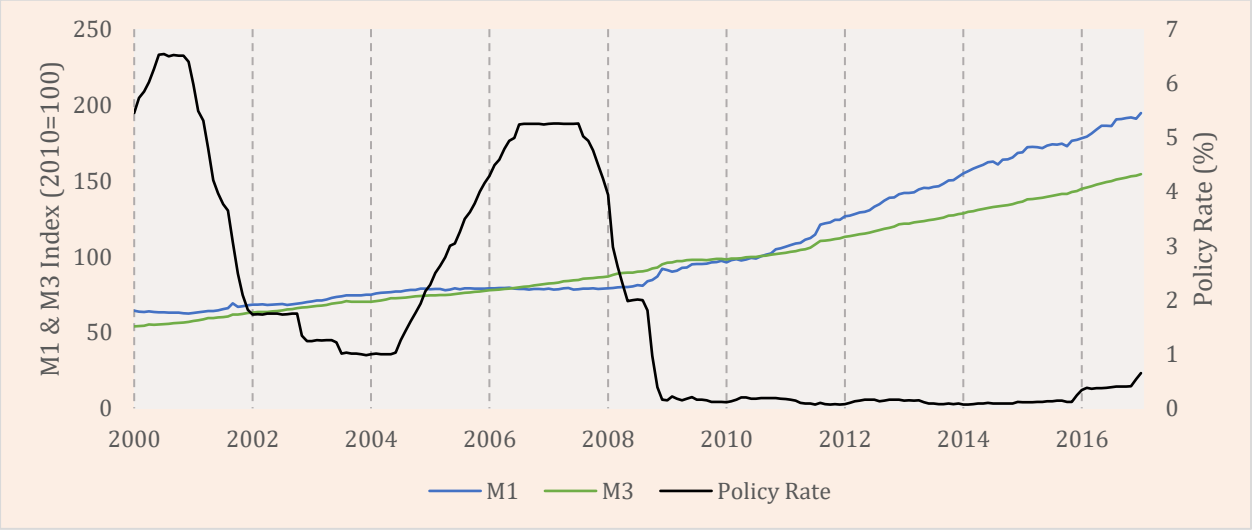
Figure 6.9. Eurozone money growth rate



Source: ECB; ECB Statistical Data Warehouse; Personal Design

In the United States, we can observe, in Figure 6.10, that the relation between a higher money supply and higher rates does not hold either. **In our view, this might be due to the extensive bond-buying programme that was triggered by the FED as of 2008. While the FED was buying obligations from banks', these ones had more liquidities available (M1) to, supposedly, reinvest in the real economy through higher lending. Therefore, rates remained subdued while the most liquid monetary aggregate (M1) increased.**

Figure 6.10. United States money supply

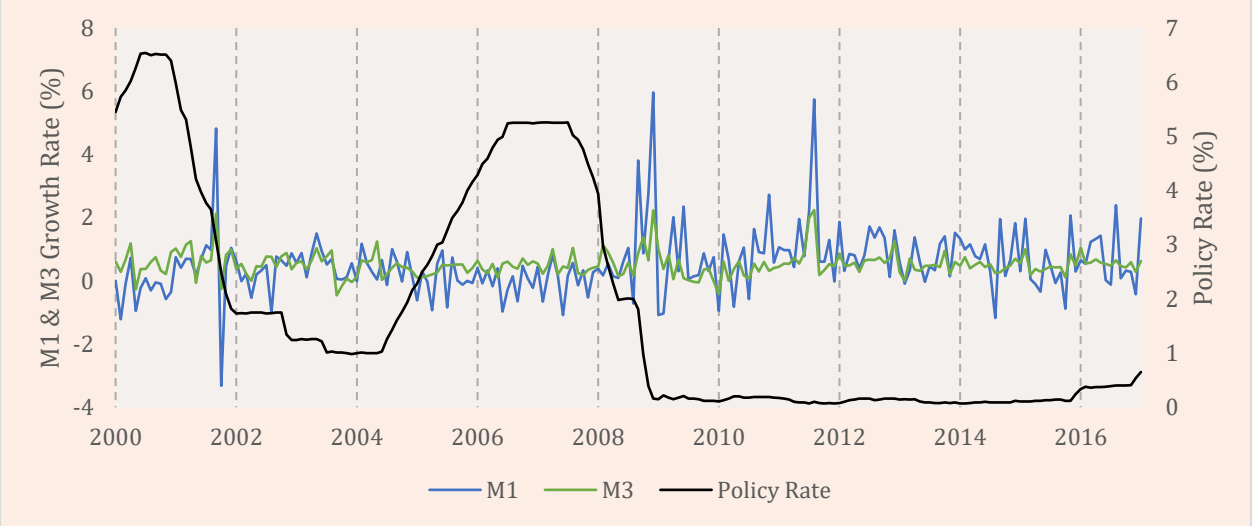


Source: Federal Reserve Bank of New York; OECD Statistics; Personal Design

As seen in the Eurozone, the money supply of M1 is higher than M3 from February 2011 (which coincides with the start of the third round of QE by the FED following the 2008 financial crisis) until January 2017. During the same period, the Federal funds rate (i.e. the policy rate) has fluctuated between 0.16% and 0.65%.

Furthermore, when we analyse the money growth rates in the United States, we can see, as plotted in Figure 6.11, that there are two peaks in the M1 growth rate relating to the initiation of the first two phases of the FED's QE programme.

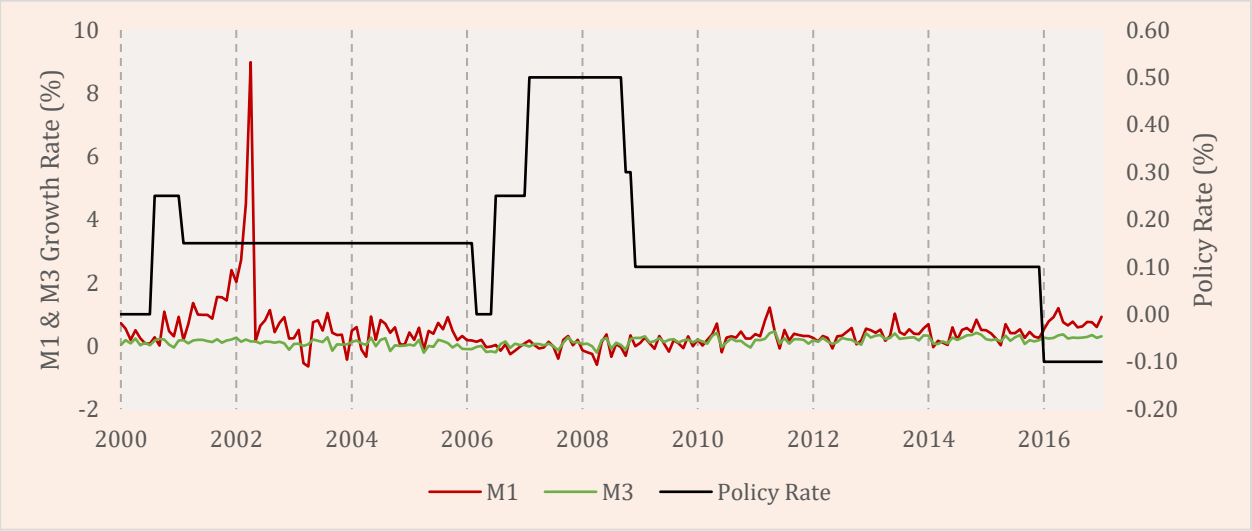
Figure 6.11. United States money growth rate



Source: Federal Reserve Bank of New York; St. Louis Federal Reserve Bank; Personal Design

Regarding Japan, it is worth mentioning the reason for such an outlier in Figure 6.12, namely the overshoot in the M1 growth rate in April 2002, jumping more than 6 percent compared to February 2002. Hetzel (2003) sheds light on the switch that took place between time deposits (which form part of the M2 money aggregate) and demand deposits (included in the M1 money aggregate). The Bank of Japan decided, in April 2002, to ensure time deposits only up to 10 million yen while demand deposits remained fully and unlimitedly covered. Since no interest was paid on either deposit, consumers received free unlimited insurance for switching from one to the other. This explains the spiked growth of the M1 monetary aggregate in 2002.

Figure 6.12. Japan money growth rate



Source: FactSet; St. Louis Federal Reserve Bank; Personal Design

To conclude, it is worth mentioning that empirical evidence suggests that money growth is more closely monitor by the ECB than by FED because the link with inflation is stronger for the Eurozone than for the United States (Kahn, & Benolkin, 2007). The authors also mention that there is more stability in money demand within the Eurozone, and hence more reliance from the Central Bank on it as a policy measure. As a consequence of aggregating data for numerous countries, idiosyncratic and desynchronized shocks offset each other in time, leading to a more stable indicator than in the United States.

Another explanation as to why the ECB puts a stronger focus on money aggregates as a predictor of inflation versus the FED comes from historical reasons. The ECB, since its inception, carries the tradition of the German Bundesbank where money growth was fundamental. In its early days and as the bank needed to establish credibility, it sought to take a pronounced anti-inflationist stance by announcing that its strategy would emphasize money growth, the same way the Bundesbank did. It is also important to mention that the ECB considers money growth as one of its two pillars in conducting monetary policy and closely monitors its level throughout the year. Finally, the authors argue that strong money growth can be a consequence of a low-interest-rate context or marked real GDP growth.

6.3. Employment and the Philipps curve

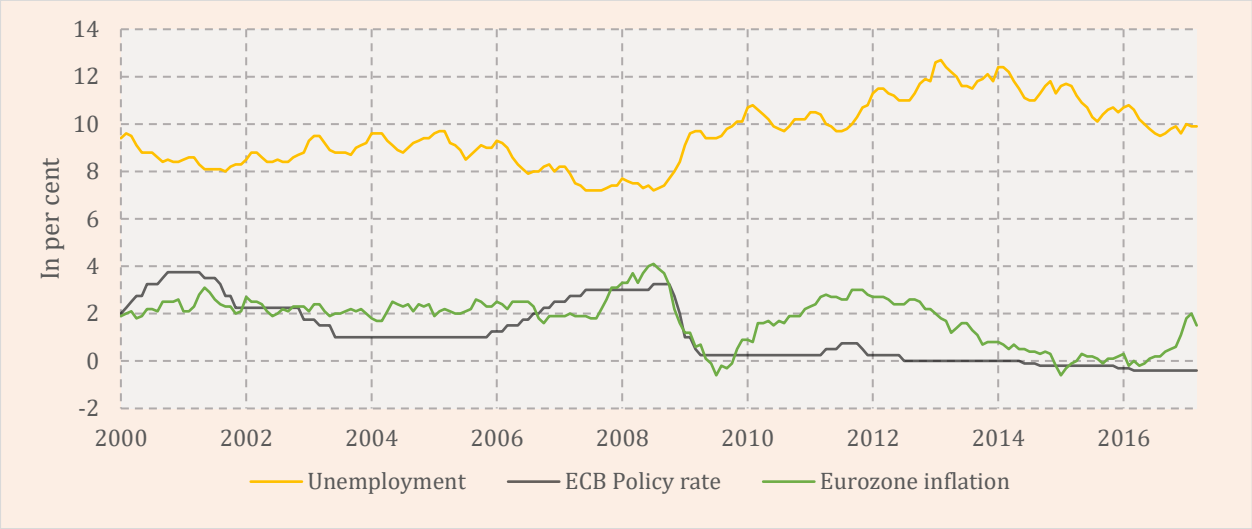
We mentioned the Philipps curve as a conclusion to the previous part *5.3. Achieving full employment*. It suggests that inflation and unemployment have a stable and inverse relationship which is also supported by Friedman (1977). As central banks studied in our cross-country analysis, such as the ECB, are aiming at increasing inflation to a stable rate of 2% by applying negative interest rates (European Central Bank, 2017c) this would in turn, through the Philipps curve relationship, support the macro-economic objective of achieving full employment (Friedman, 1977). As a reminder, the implicit mechanism is that by decreasing interest rates to ultra-low or negative levels, central banks believe they will encourage an increase in inflation and consequently decrease unemployment.

In the previous part, we analysed how interest rates and especially ultra-low interest rates impact inflation. As a follow-up, we have a data-based view of how unemployment is in turn impacted by inflation in the United States, Japan and the Eurozone. Firstly, we qualitatively examine the correlations and relationships between inflation, unemployment and interest rates. Secondly, we confirm or disprove these relationships through one or multiple simple linear regressions with inflation as a predictor of unemployment. During the analysis, we examine the effectiveness of the Philipps curve relation at 'normal' compared to ultra-low and negative interest rates.

- *Philipps curve in the Eurozone*

To examine the relationship between inflation, unemployment and the ECB's policy rate, Figure 6.13 plots all three variables for the Eurozone from January 2000 to March 2017. Even though the policy rate varied between 3.75% and 1% in the period between January 2000 and the start of the Great recession in 2008, inflation stayed relatively stable while employment also had stable cycles between 8 and 9.7% in that same time frame. However, from its deflationary peak in July 2009 at -0.6%, inflation rose until December 2011 to 2.8%. In the meantime, unemployment also rose from 9.4% to 10.8%; contradicting the Philipps curve theory. Moreover, from a high of 12.7% in February 2013, unemployment decreased to 10.2% in April 2016 while inflation also decreased from 1.8% to a negative -0.2%.

Figure 6.13. Philipps curve Eurozone



Source: OECD Statistics; Personal Design

These observed tendencies either disprove that there is a relationship between inflation and unemployment for the Eurozone or prove that the inverse of what was advanced by Philipps has materialized for the period since the Great recession. In order to observe the effect of ultra-low interest rates on the targeted variables, we performed two separate linear regressions; one before ultra-low interest rates were implemented and one after.

These regressions and all of the following regressions in this part plot inflation as the explanatory, independent variable *x* and unemployment as the dependent variable *y*. As explained by (Montgomery et al., 2015) the level at which R square (R^2) is acceptable is very dependent on the nature of the data. Given the data at hand and the numerous external events affecting both variables – inflation and unemployment – we consider 25% of results explained by the model, meaning an R^2 equal or superior to 0.25, as an acceptable R^2. This is also valid for the other regressions in this part as they consider the same variables.

As the fluctuations during the subprime crisis are not representative of the general Eurozone economy (Drudi, Durré, & Mongelli, 2012) and in order to eliminate the bias caused by these fluctuations; we consider the two following periods for our two linear regressions:

- January 2000 – December 2007
- January 2010 – March 2017

The full results of both regressions can be found in Table 6.1.

Table 6.1. Main regression results Philipps curve Eurozone

	Eurozone	
	Before January 2008	After January 2010
Correlation coefficient	0.155	0.074
R^2	0.024	0.005

Source: Personal Computations

As to the first regression, for the period between January 2000 and December 2007, the R square (R^2) is insignificant at 0.024 while the correlation coefficient (Multiple R in Table 6.1.) is also low at 0.155. We can hereby confirm the hypothesis emitted above in the descriptive graphical analysis that there is no Philipps curve relation between inflation and unemployment in the Eurozone at 'normal' interest rate levels during this period. Regarding the second regression, for the period between January 2010 and March 2017, the R^2 is also insignificant in this regression at 0.0054. While the correlation coefficient is even lower than in the previous regression at 0.07.

As a result of these two regressions and the descriptive graphical analysis above we can conclude that the relationship between inflation and unemployment, as posited by the literature, did not hold in the Eurozone over the last two decades, be it at 'normal' or ultra-low interest rates.

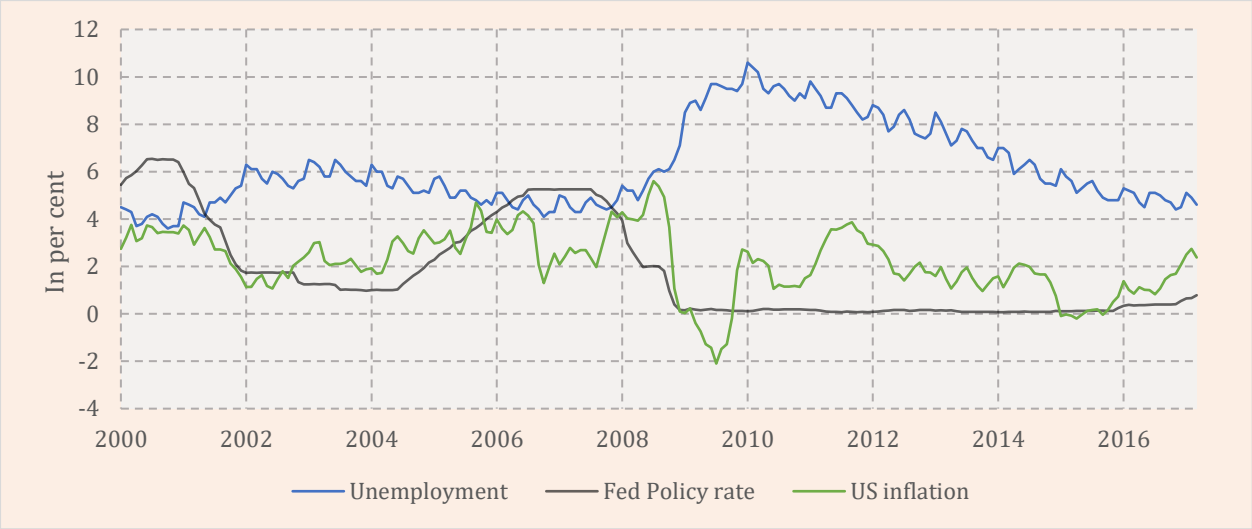
In our view, this is due to the inflexible nature of most European countries' job markets, even more so when compared to the US job market. In the aftermath of the 2008 crisis and during the sovereign debt crisis, in times of great uncertainty, European firms have 'hoarded' labour because workers are too expensive to fire and

unions are powerful. The underlying implication here is that full employment cannot be reached in the Eurozone by modelling policy rates downwards into negative territory to stimulate inflation, or at least not through this only lever.

- *Philipps curve in the United States*

To examine the relationship between inflation, unemployment and the FED's policy rate (i.e. Federal funds rate), Figure 6.14. plots all three variables for the United States from January 2000 to March 2017.

Figure 6.14. Philipps curve United States



Source: OECD Statistics; Personal Design

Inflation in the United States reached a low in January 2002, then steadily increased to 4.3% in June 2006 while unemployment decreased in this timeframe from 6.3% to 4.4% implying an inverse relationship between both variables. On the contrary, from September 2011 to September 2015 a positive relationship between inflation and unemployment holds as inflation decreased from 3.9% to 0.0% while unemployment also decreased from 8.8% to 4.9% in that timeframe.

To confirm these two hypotheses, we performed two separate linear regressions in two separate periods. The two periods are selected, as in the Eurozone's case, to eliminate the non-recurrent values caused by the subprime crises. Consequently, the periods are:

- January 2000 – December 2007
- January 2010 – March 2017

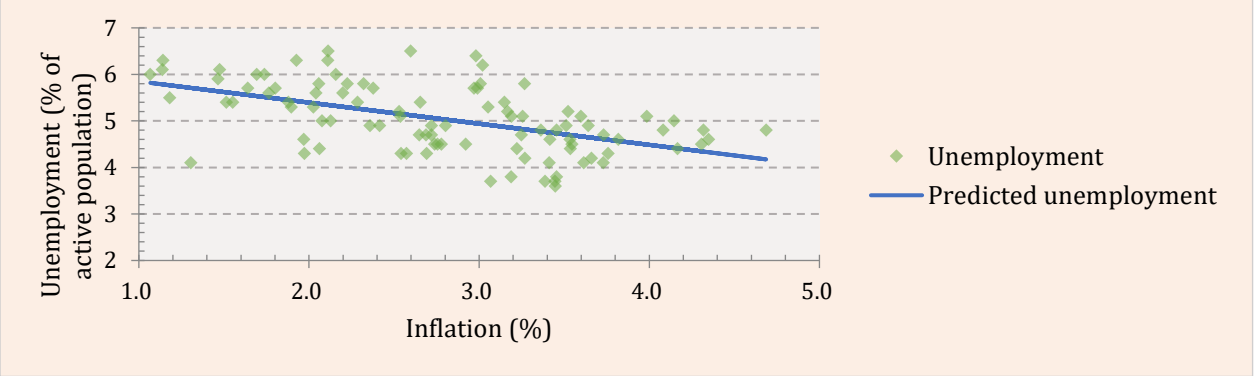
Table 6.2. Main regression results Philipps curve United States

	United States	
	Before January 2008	After January 2010
Correlation coefficient	0.530	0.525
R^2	0.281	0.275

Source: Personal Computations

According to its acceptable R^2 of 0.28 (Table 6.2.) and the symmetrical distribution of its residuals (Appendix 1) the first linear regression is an acceptable prediction model for the unemployment rate as explained by the inflation level. The downward slope of the predicted unemployment line observable in Figure 6.15. confirms the hypothesis of an inverse relationship between inflation and unemployment in the period where 'normal' interest rates were implemented, hence confirming the Philipps curve relationship for that period.

Figure 6.15. Philipps curve United States; inflation line fitted prior Jan. 2008

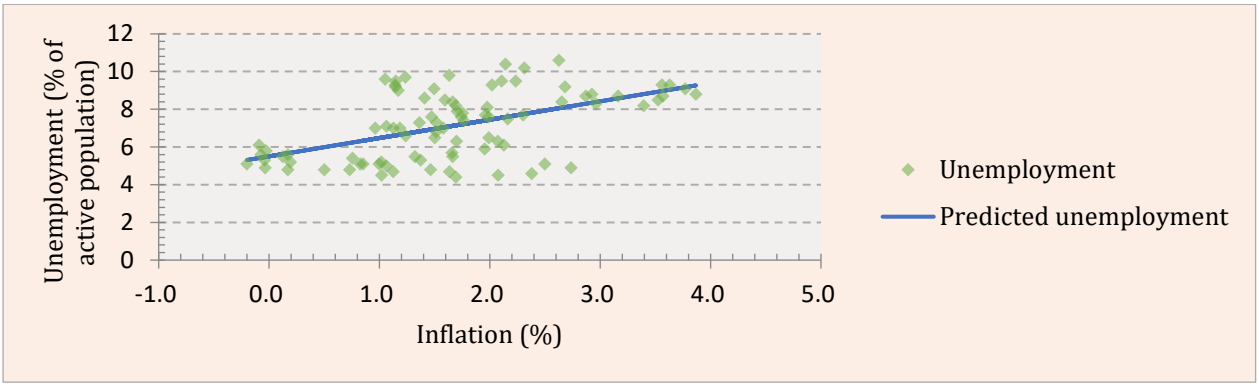


Source: Personal Computations

The second linear regression also has an acceptable R^2 of 0.28 (Table 6.2.) and has a symmetrical distribution of its residuals (Appendix 2). Hence, we use this regression as a prediction model for the unemployment rate in function of inflation in the period between

January 2010 to March 2017. The upward slope of the predicted unemployment line confirms the hypothesis emitted previously in the descriptive graphical analysis, that there is a positive relationship between inflation and unemployment in the United States during the times where ultra-low interest rates prevailed (Figure 6.16.). Therefore, contradicting the Philipps curve in this period in the United States.

Figure 6.16. Philipps curve United States; inflation line fitted post Jan. 2010



Source: Personal Computations

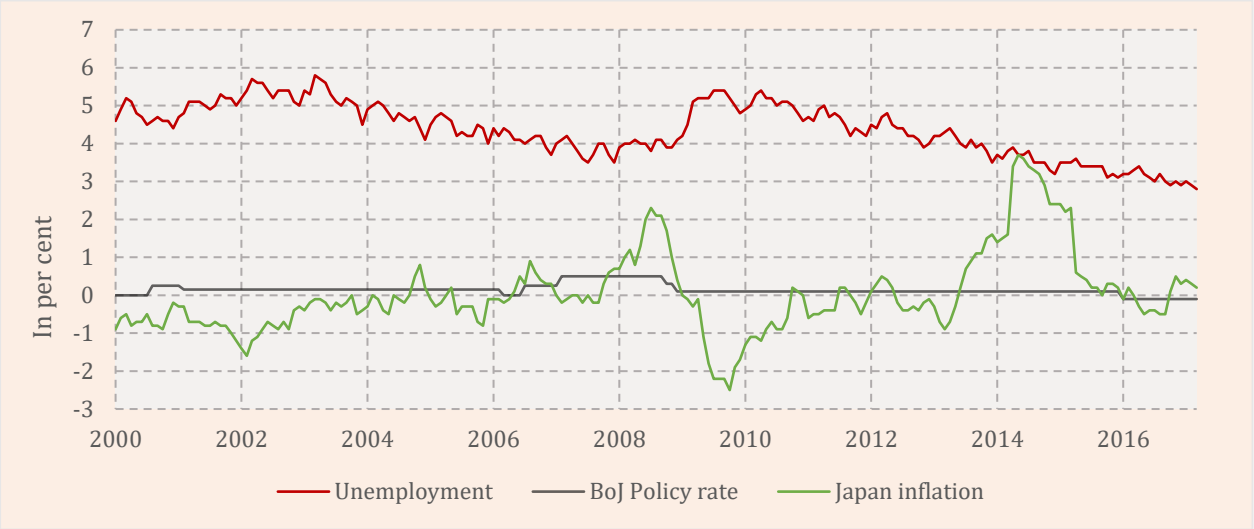
According to us, the reason why the Philipps curve is confirmed in the US prior to January 2008 is its flexible job market which adapts swiftly to macro-economic changes such as rises in inflation. On the other hand, the reason why the Philipps curve is contradicted since the Great recession is that interest rates, especially policy rates, have been kept artificially low. In other words, the Federal Reserve rate is behind the curve: it has kept interest rates ultra-low even though the United States' recovery was on track. Through these accommodative monetary policies, the Fed has brought down the unemployment rate while inflation was on the decline.

- *Philipps curve in Japan*

To examine the relationship between inflation, unemployment and the Bank of Japan's (BoJ) call rate, Figure 6.17 plots all three variables for Japan from January 2000 to March 2017. As mentioned earlier in the research, the BoJ kept its call rate at a very low and stable rate over the last two decades. In fact, it remained between 0% and 0.5% up until January 2016 when interest rates entered negative territories at -0.1%. Japan mostly experienced deflation in the

past two decades except for the periods between September 2007 to February 2009 and June 2013 to March 2016 which have been previously examined.

Figure 6.17. Philipps curve Japan



Source: OECD Statistics; Personal Design

Regarding the relationship between inflation and unemployment in Japan, in the period from January 2000 up to March 2017, the correlation seems relatively high. To exemplify this statement; we can see that Japan experienced some highs and lows inflation increases quite steadily from -0.9% to 0.7% between January 2000 and December 2007. During the same period, unemployment steadily decreased from 4.6% to 3.5%. Inflation experienced a negative peak at -2.5% in October 2009 while unemployment reached a level of 5.4% during the same time.

Apart from the period where inflation peaked at 3.6% in June 2014 due to a new tax on sales (explained in the previous *Part 6.1. Inflation and money supply*), there is an inverse relationship from October 2009 up until March 2017. Except from the two outlier periods which can be observed on Figure 6.17. of September 2007 to January 2010 and the inflationary peak in June 2014, the descriptive graph analysis suggests a confirmation of the Philipps curve in Japan during the period examined.

To confirm or disprove this assumption we plotted one single linear regression. The period over which we regressed is over the entire period from January 2000 to March 2017. We did not split the period in two, as on the contrary of two cases above, Japan has experienced ultra-low policy rates over the entire period. Results of the regression can be found in Table 6.3.

Table 6.3. Main regression results Philipps curve Japan

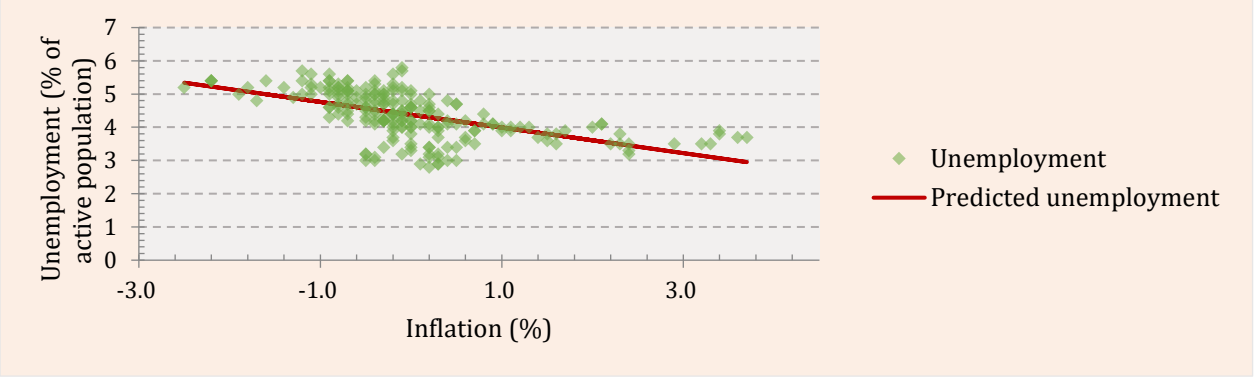
	Japan
Correlation coefficient	0.574
R^2	0.329

Source: Personal Computations

Here, the resulting regression has an acceptable R^2 of 0.33 and shows a correlation coefficient (Multiple R) of 0.57 between both variables (Table 6.3.). The residual plot (Appendix 3) shows a symmetrical distribution of residuals, clustering around the middle of the plot. These factors show that we can use the regression model with sufficient confidence to examine if the Philipps curve held true or not over the last two decades in Japan.

Figure 6.18. plots the predicted unemployment rate in function of inflation according to the model. We observe that the inverse relationship between unemployment and inflation is confirmed by our model as the predicted unemployment regression line has a downward slope.

Figure 6.18. Philipps curve Japan; inflation line fitted



Source: Personal Computations

Considering the BoJ's stable ultra-low policy rate since 1996, we can conclude that in Japan's case, according to our regression model and observations, the Philipps curve holds true at ultra-low interest rates.

According to us, one important reason why the Philipps curve functions in Japan is demographical. Japan has been undergoing a demographic transition in the last twenty years. The active population has been declining and even though the economic situation has been weak on average, jobs are still often in excess when compared to the active population. So, when the Japanese economy is supported by inflation, the little unemployment present on the job market is more easily countered. To exemplify, in March 2017, there were two jobs for every applicant in Tokyo. (Oda & Reynolds, 2017). This is reinforced by the cultural factor that Japanese individuals are eager to work and have the reputation to be hardworking (Lewis, 2017).

The main target of Central Banks while lowering interest rates, even into negative territory, is to increase the level of prices in the economy, by that triggering spending in a self-reinforcing cycle. As a consequence, researchers (Friedman, 1977) expect the central banks to have a peripheral effect on unemployment which will tend to decrease through the Philipps curve inverse relationship as a result of the Banks' accommodative policies. Unfortunately, according to our research, the Philipps curve majorly does not hold at ultra-low interest rates.

In the United States, our research even suggests that a lower inflation rate is associated with lower unemployment, mainly through the action of the rational expectations of economic agents (Jonsson & Reslow, 2015) and so the contrary of the Philipps curve would be true. However, no direct link of causality is intended to be drawn from our research as the two metrics discussed -inflation and unemployment- are influenced by numerous other variables.

6.4. Exchange rates and exports

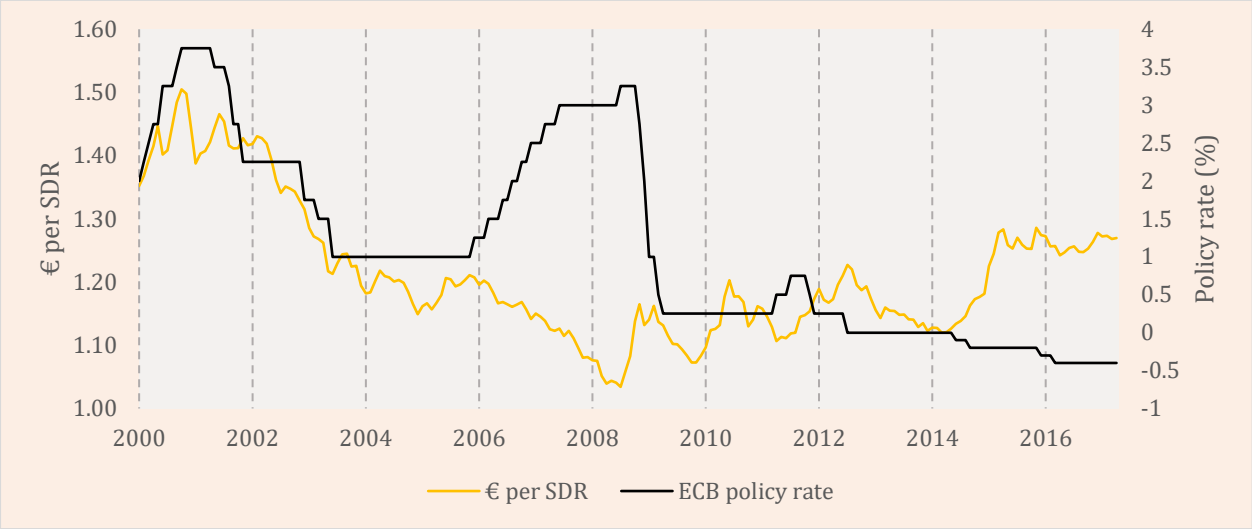
Previously, in *part 5.4. Stimulate currency depreciation and liquidity traps*, we mentioned how a decrease in interest rate is expected by both scholars and central banks, such as the ECB, to depreciate currency which in turn will increase exports (Hannoun, 2015; European Central Bank, n.d). In the following part, we will evaluate if this principle held true since 2000 and especially if the principle still holds true at ultra-low or negative interest rates.

As to the methodology, in order to provide the least biased view possible of the evolution of all three currencies – Yen, US Dollar, Euro – we use the Special Drawing Right (SDR) which *is an international reserve asset created by the IMF in 1969 to supplement its member countries' official reserves. […]. The value of the SDR is based on a basket of five major currencies – the US dollar, the euro, the Chinese renminbi (RMB), the Japanese Yen and the British pound sterling.* (International Monetary Fund, 2017). The charts in this part represent the amount of currency per SDR, meaning that the higher the amount of a given currency per SDR, the weaker that given currency (depreciation). If the mechanism – a decrease in interest rates results in depreciation – studied here is true, there should be an inverse relationship between interest rate and exchange rate as a currency's depreciation is translated by an upward slope of that given currency.

- *The Euro exchange rate and Eurozone exports*

The euro has since its creation been among the strongest currencies in the world economy and still is today. Naturally numerous variables influence exchange rates other than policy rates but it is interesting to observe that there is a negative correlation between the ECB interest rate and euro exchange rate since late 2011 when the ECB started its continuous decrease of its policy rates. In fact, as can be seen on Figure 6.19. while decreasing the overnight policy rate from 0.75% to -0.4% the euro depreciated from 1.12€ to 1.28€ per SDR between August 2011 and December 2016, confirming the mechanism between interest rates and the exchange rate assumed by central banks, over the long term. The mechanism also seems to be confirmed in the run-up to the subprime crisis when the ECB steeply increases its policy rate and the exchange rate steeply appreciates in the same time span.

Figure 6.19. Euro exchange rate history

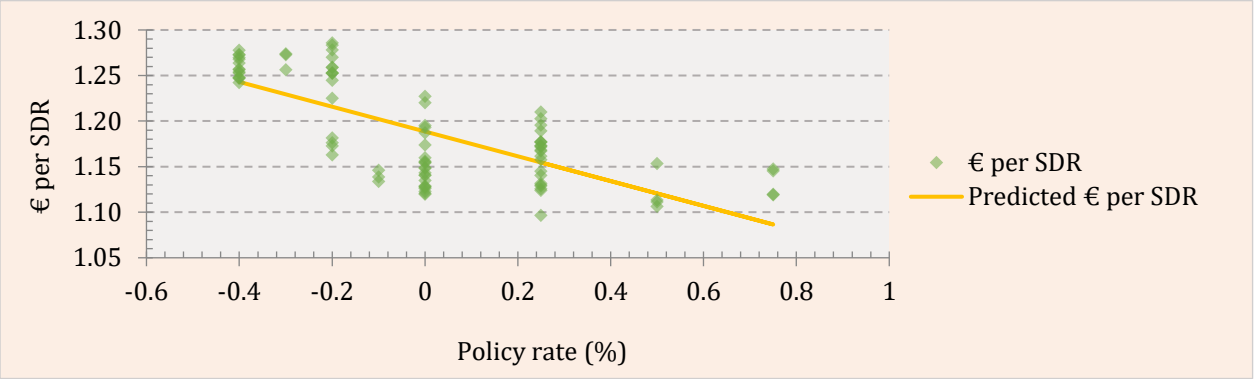


Source: International Monetary Fund; Personal Design

On the contrary, even though the ECB consistently decreased its policy rate from 3.75% to 1% between October 2000 and June 2003, the euro appreciated from 1.50€ to 1.21€ per SDR. **However, in our view this is due to the novelty of the euro at that time as well as to the need for markets to adapt to the new currency and gain confidence in it.**

We perform a linear regression between the exchange rate as a dependent variable *y* and the policy rate as independent variable *x* to confirm or disprove the previous observations regarding the functioning of the mechanism in the latest period. On the same criteria, as in *part 6.2.* above, in order to eliminate bias caused by the fluctuations during the subprime crisis, we regressed both variables in the period from January 2010 onwards. The R^2 is 0.52 and the distribution of residuals is symmetrical (Appendix 4). Therefore, it is reasonable to conclude that this linear regression confirms our previous assumptions as it shows an inverse relationship between both variables (Figure 6.20.). Hence, implying that the exchange rate – interest rate mechanism functioned at ultra-low interest rates since the ECB started decreasing its policy rate in October 2011.

Figure 6.20. Euro per SDR line fitted post January 2010



Source: Personal Computations

In our view, this correlation could however be biased by the recent Sovereign debt crisis in the Eurozone which led to a certain deterioration of confidence in the euro currency and hence encouraged its depreciation.

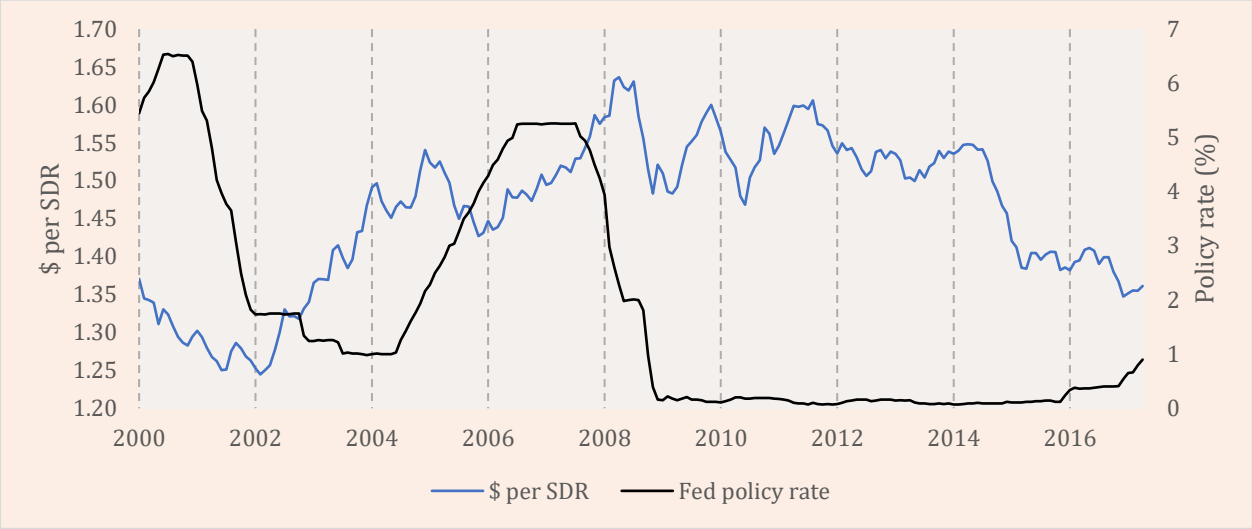
To examine the subsequent consequences on the Eurozone exports we plotted the export growth rate (on previous period) and the exchange rate fluctuations. There seems to be no real correlation between the two elements over the long term (Appendix 5) which is confirmed by a linear regression with a very low R^2 of 0.006. Hence, disproving the mechanism implying that changes in exchange rate would affect export volumes in Europe. Nevertheless, it is important to note that momentary correlations take place with some delay in time for exports (Appendix 5). Strong depreciations of the euro are often followed by a strong export growth rate in the following quarter. Hence, implying a positive correlation in the short term.

- *The US dollar exchange rate and US exports*

As the worldwide reference currency in contemporary economics, the US dollar is influenced by innumerable different variables over time. Nevertheless, the Federal Reserve still influences the US dollar exchange rate through several of its policy tools, among which is its policy rate (Federal Reserve Bank of New York, 2010). However, the US dollar exchange rate does not seem to have an inverse relationship in most of the period illustrated in Figure 6.21. In fact, the contrary of the presumed mechanism in this part of our research seems true, the

correlation is positive prior to ultra-low interest rates. At ultra-low levels, the gradual increase in policy rate in 2016 correlates with an appreciation of the US dollar, confirming the relation between interest rate and exchange rate.

Figure 6.21. US Dollar exchange rate history



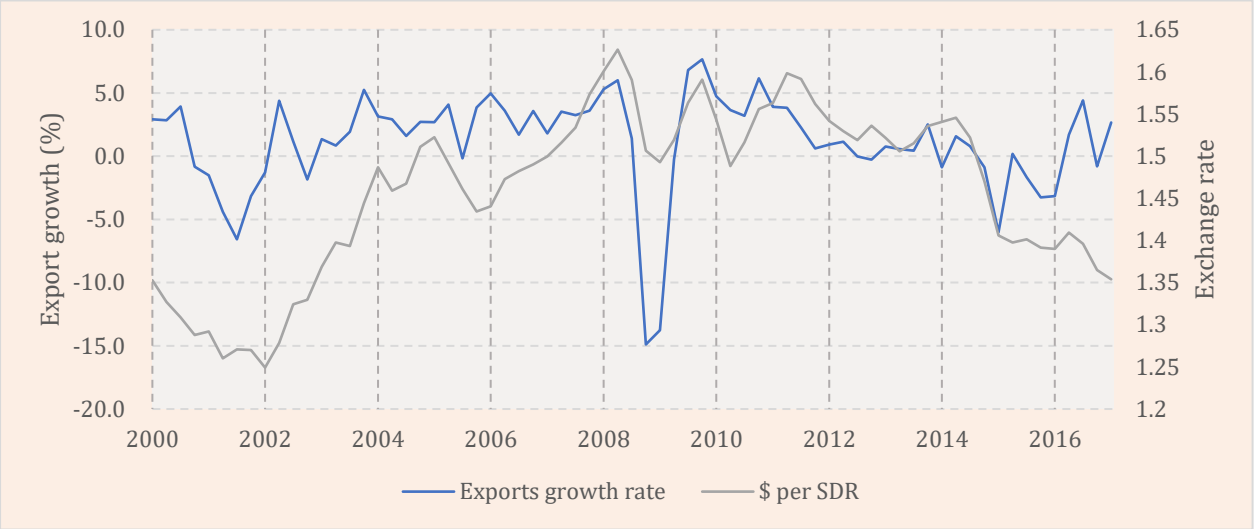
Source: International Monetary Fund; Personal Design

In our view, this recent appreciation is, to some extent, counteracted by the Federal Reserve's Quantitative Easing program. Without the Fed's QE program the US dollar would have highly likely appreciated even more since the start of rate hikes in 2016. According to us, the Fed's Minutes also have an important impact on the exchange rate, which aligns with our discussion on Forward Guidance in *Part 2.1. The different types of monetary policies*. This can be observed through a strong appreciation of the US dollar (downward slope) from 1.55$ to 1.38$ per SDR between March 2014, and April 2015. During that period the Fed strongly discussed rate hikes in its Minutes (Flaherty & Schneider, 2015)

On the other hand, exports growth rate in the United States seems to be highly positively correlated to the US dollar exchange rate, with some logical delay in time. This is mostly true for the entire observed period except for January 2015 to January 2017. This timeframe approximately coincides with the period where the Federal Reserve started to slowly

increase its policy rate again, suggesting this increase indeed appreciated the dollar but did not in turn negatively affect exports.

Figure 6.22. United States exports growth



Source: OECD Statistics; Personal Design

- *The Yen exchange rate and Japanese exports*

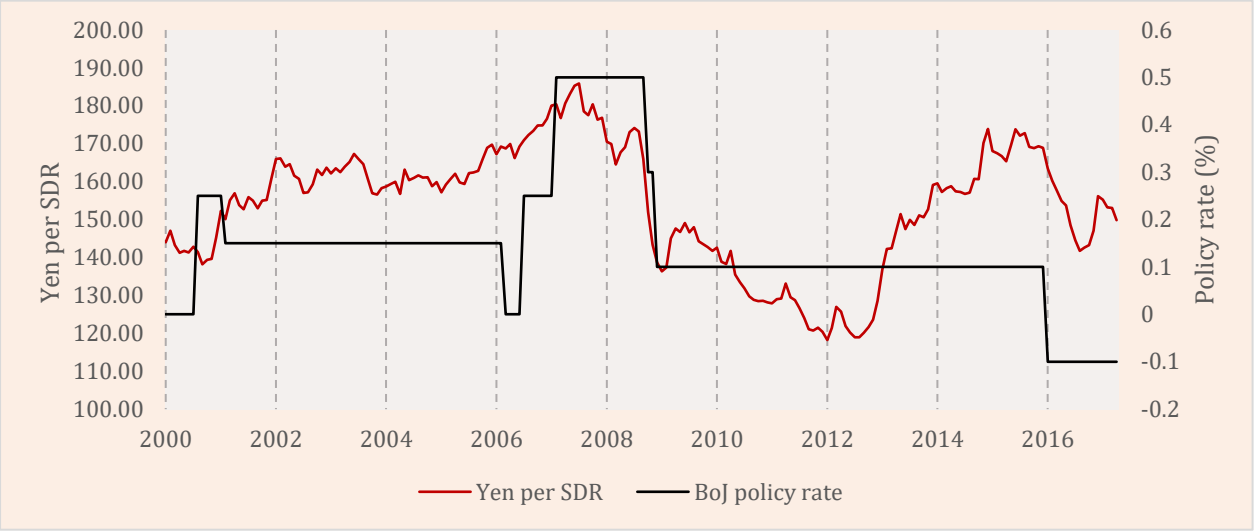
As its counterpart, the Swiss franc, the Yen has built itself a reputation as a currency with safe heaven features (Dimitriou & Kenourgios, 2013). This makes it more difficult for the Bank of Japan to influence its currency through monetary policies but even though these difficulties it still does so. One tool to do so is through its policy rate or the announcements thereof (Hillebrand & Schnabl, 2008).

However, little correlation between both variables seem to hold true in the timeframe depicted in Figure 6.23. except for two periods:

- During the BoJ cut its policy rate from 0.5% to 0.1% during the subprime crisis.
- During the latest policy rate cut of January 2016 from 0.1% to -0.1%. (Appendix 6).

Strangely both periods seem to correlate with an appreciation of the Yen, suggesting a positive correlation, hence contradicting the presumed mechanism between both variables.

Figure 6.23. Yen exchange rate history



Source: International Monetary Fund; Personal Design

In our view, the contradiction here of the logical relation between interest rate and exchange rate is due to two factors. First, the Yen is regarded by many as a 'safe haven' in times of uncertainty, hence, pushing the yen to appreciate in such times. During the Great recession when markets were on a 'flight to safety' and in 2016 when markets feared the consequences of Brexit, the Yen was pushed to appreciate. Second, as inflation decreased in 2016 and real interest rates increased as a consequence, once again encouraging the Yen to appreciate.

As to the relation between the exchange rate and export volumes there seems to be little correlation in both the short and long term as can be observed in Appendix 7.

6.5. Aggregate demand

- *Households*

In order to quantify the impact of ultra-low and negative interest policies on households' aggregate demand, we choose to follow the logic exposed in *Section 5.5* and answer two questions. Do these policies encourage consumption and deter households from saving? Consequently, does the debt burden of households increase as a result of such behaviours?

The statistical database of the OECD allows us to extract some of the indicators most prone to answer those questions.

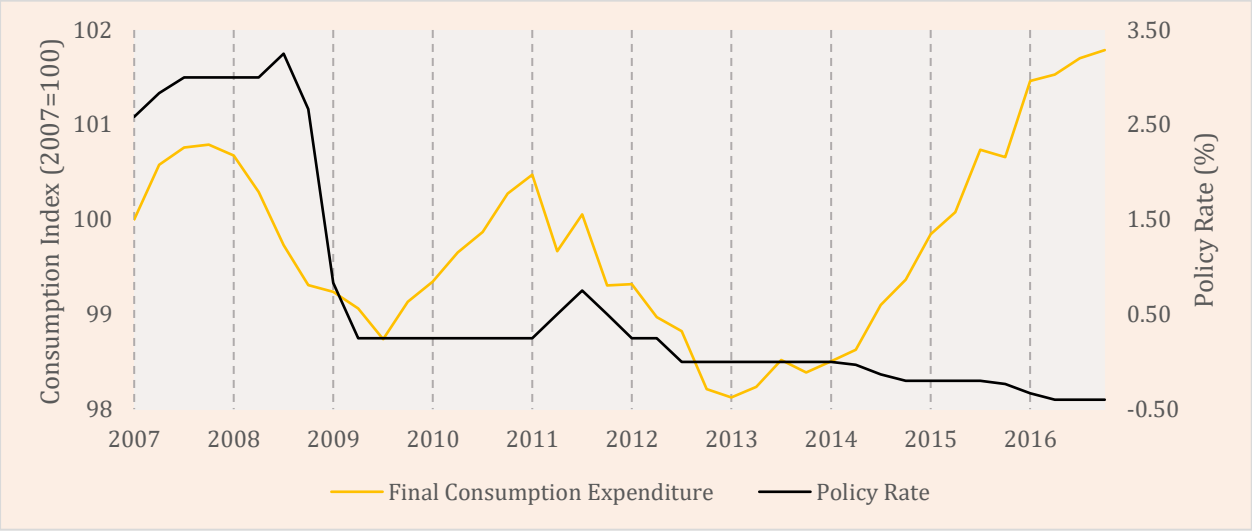
In order to assess consumption, we plotted the seasonally adjusted household final consumption expenditure with the level of policy rate. This indicator covers the whole spectrum of expenditures households make in order to cover their everyday needs. Ranging from food, clothing, housing (rent) and energy, to health costs and leisure. Since this type of spending accounts for about 60% of the total GDP of a country it is an essential indicator to assess demand for goods and services (OECD, 2017c).

The bulk of resources available to households are included their gross disposable income. The households gross savings rate is equal to their disposable income plus pension entitlements (when applicable) minus their final consumption expenditure. It is worth noting that this indicator is significantly affected by the government provision of pensions (significant in the Eurozone while absent in the United States) and the demographic age structure (older population in Japan might overstate the level of savings).

The household indebtedness ratio shows a clear picture of the debt burden supported by families. It is computed by taking the total outstanding debt (mortgages and consumer credit) and dividing it by the 4-quarter rolling sum of disposable income. Therefore, a level above (below) 100 indicates a level of debt that is superior (inferior) to the annual flow of disposable income.

For the Eurozone, Figure 6.24 shows that after a marked push back in consumption (falling more than 2 points in indexed terms from 100.5 to 98) as a reaction to the sovereign debt crisis that saw its peak from 2011 until 2013, households spending rose significantly from 98.5, in the beginning of 2014, to 101.8 as of year-end 2016. This rise signals growing confidence in families which corroborates the effect sought by Central Banks when easing credit conditions.

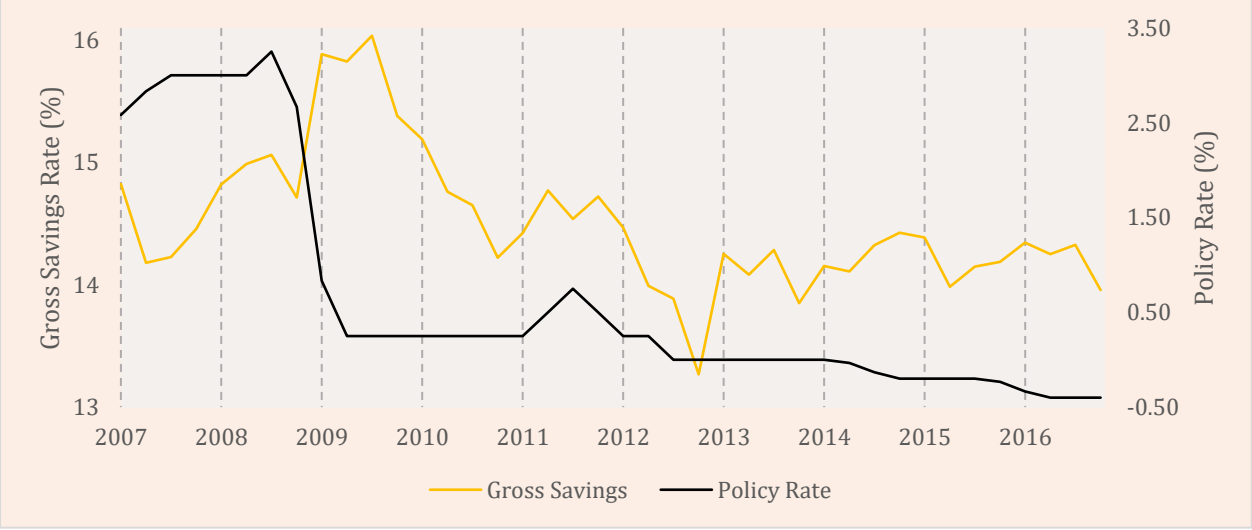
Figure 6.24. Eurozone households' consumption expenditure



Source: OECD Statistics; Personal Design

As it is depicted in Figure 6.25, as households spend more, the portion of their disposable income that they save decreases which is also one of the effects wanted by the ECB when implementing their ultra-accommodative policies.

Figure 6.25. Eurozone households' gross savings



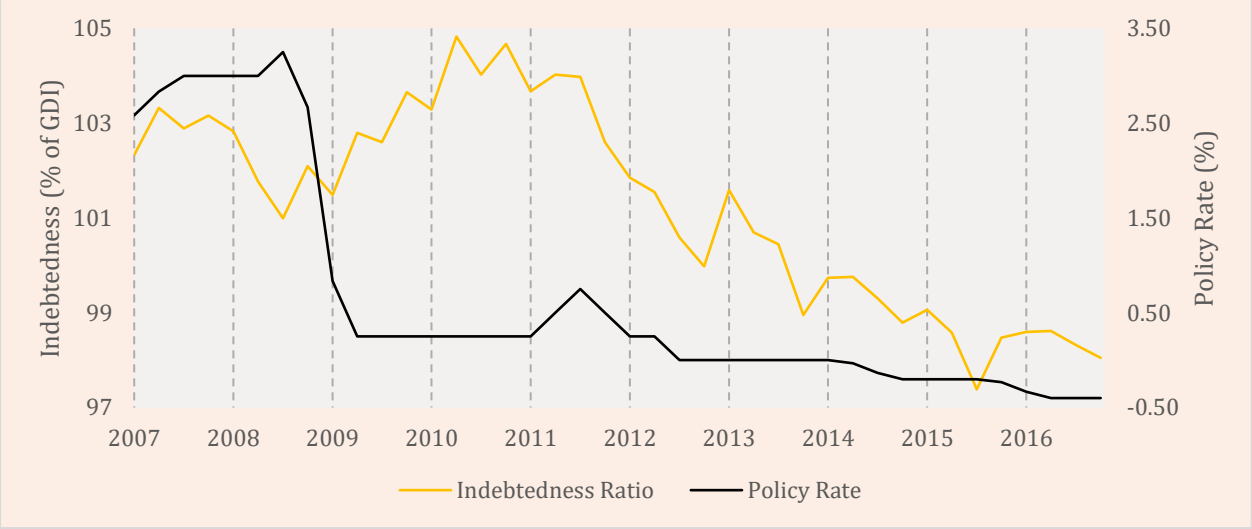
Source: OECD Statistics; Personal Design

Following us, this behavior does not always apply. From 2014 to 2015, we see that the savings rate increases markedly while interest rates are on a declining trend. We

argue that this might be due to confidence issues. Households seeing that central governments "classic" tools do not work and that they are obliged to adopt unconventional policies, might form negative expectations about the economy's future and save more as a consequence regardless of the level of remuneration on their funds. In that case, the fear of unemployment and a possible recession is greater than the effect of lower interest rates.

One of the pernicious side effects of ultra-low interest rates, echoed by the academia (Gross, & Souleles, 2002), is an increase of the debt levels of households as credit is cheaper and easier to get. However, real-data, at least in the long-run, does not display such a trend. As it can be observed in Figure 6.26, there has been a substantial increase in indebtedness from 2009 until end 2010 in reaction to the sudden drop in interest rates following the crisis. Even though rates kept on falling from the fourth quarter of 2010 (0.25%) until the end of 2016 (-0.40%), households' indebtedness decreased significantly from 103.7 in 2011 to 98 in 2016 as the major Eurozone members (Germany and Spain especially) kept on deleveraging.

Figure 6.26. Eurozone households' indebtedness



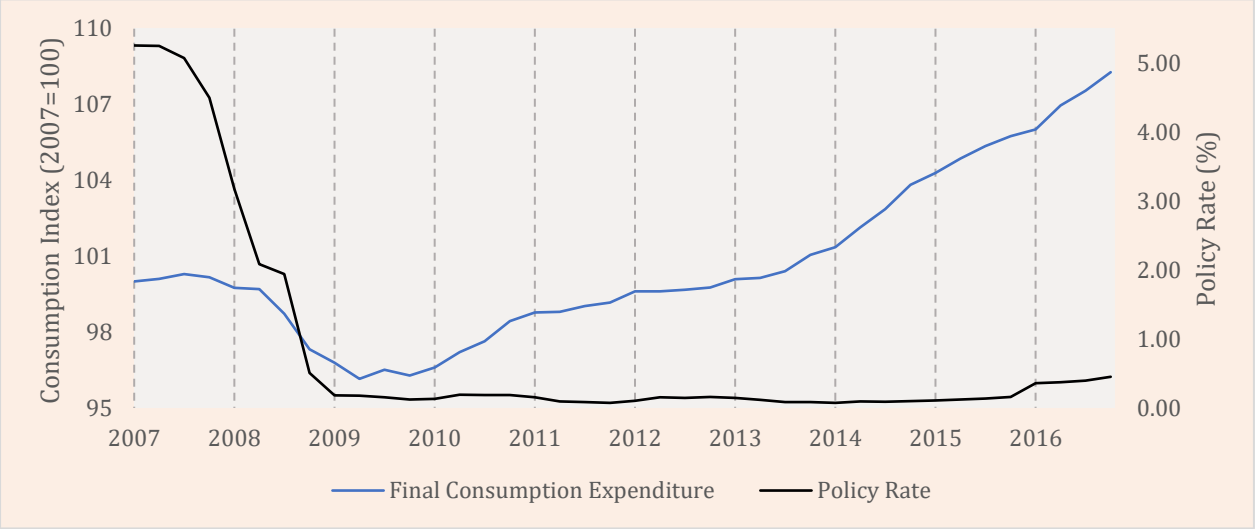
Source: OECD Statistics; Personal Design

In our view, there is another positive effect to the deleveraging of EU's households as the debt servicing costs decrease in response to lower interest rates. A wealth effect is

at play where indebted households (who have a higher marginal propensity to consume) increase spending and investments as their interest expenses are diminished.

In the United States, households' response to the crisis as well as the magnitude of its effects are similar to the ones experienced in the Eurozone. As can be seen in Figure 6.27, and using comparable terms, consumption rose about 2 points more in comparison to the Eurozone. Effectively switching from 96.3 in the last quarter of 2009 to 108.3 during the same period in 2016, once again, displaying the trends sought by Central Banks.

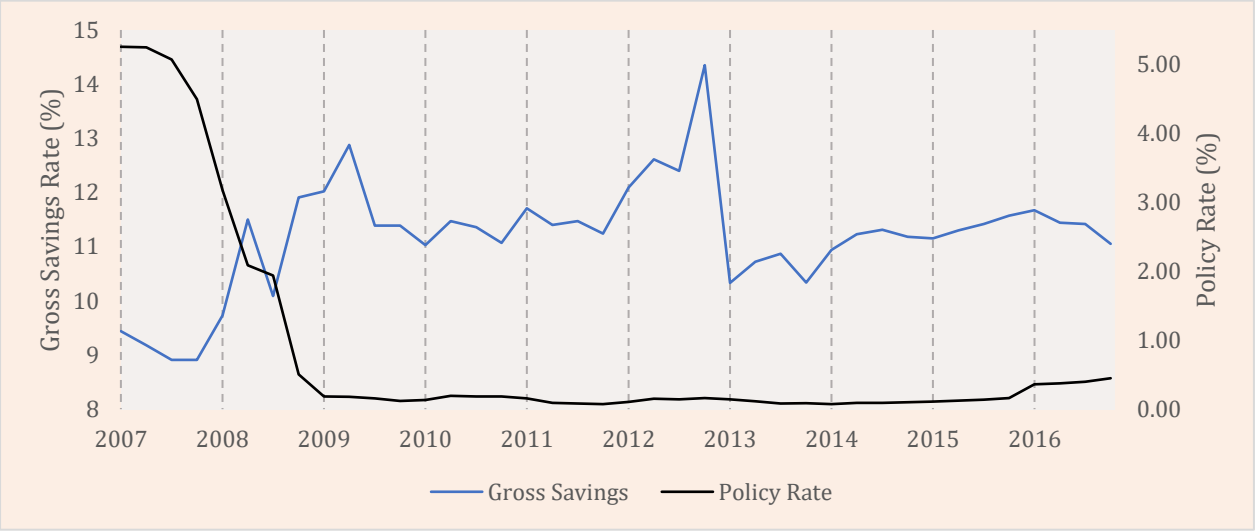
Figure 6.27. United States households' consumption expenditure



Source: OECD Statistics; Personal Design

The fourth quarter of 2012 saw a dramatic decrease of American's households' savings with the ratio dropping a whopping 4 percentage points from 14% in October 2012 to 10% in January 2013. Figure 6.28 while depicting this trend, sheds light on another important development. From 2014 to 2016 and while rates were at an all-time low for the United State, the savings rate barely declined indicating that, even in presence of unusual Central Bank policies, the behaviour of economic agents was not significantly changed.

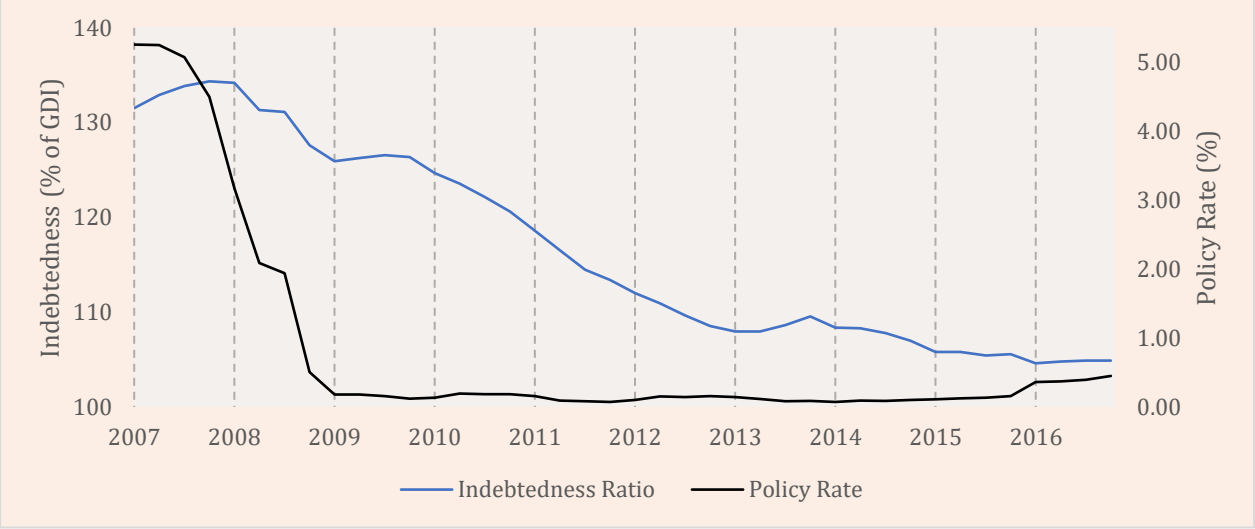
Figure 6.28. United States households' gross savings



Source: OECD Statistics; Personal Design

Figure 6.29 shows that households' indebtedness peaked before the financial crisis of 2008, reaching 134.4% of the families' disposable income. From then, it has been steadily declining standing at a much more reasonable 104.9% of disposable income as of year-end 2016.

Figure 6.29. United States households' indebtedness

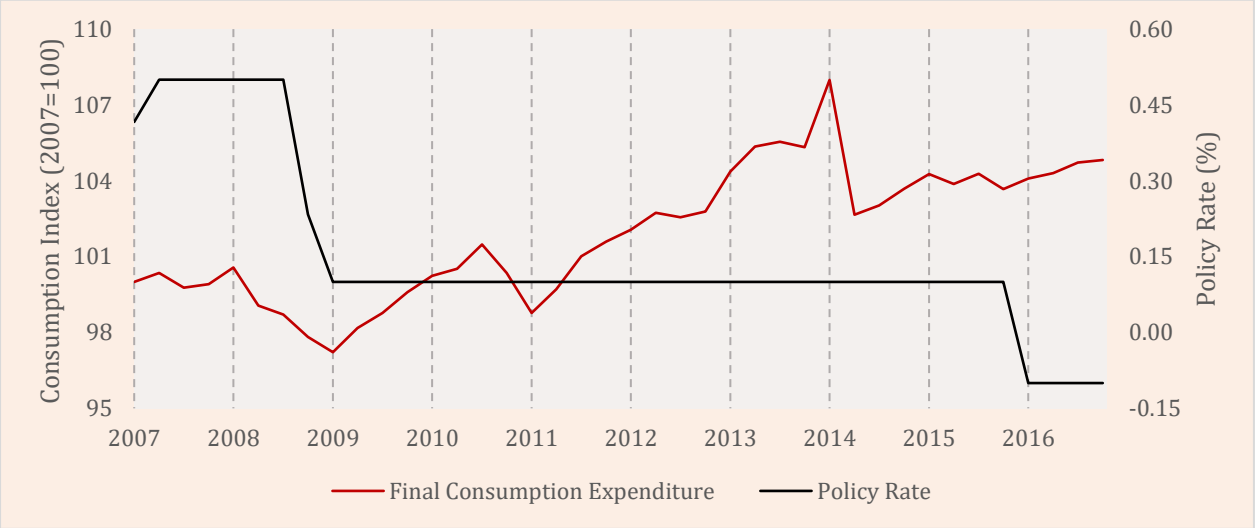


Source: OECD Statistics; Personal Design

According to us, another reason explaining why savings rates in the Eurozone and the US have basically been flat notwithstanding the introduction of ultra-low interest rates comes from the demographic structure of the population. The population ageing and the rise in healthcare costs that this brings combined with uncertainty about the funding of pensions, encourage households to respond to a decrease of income on their savings by trying to save more. This reaction would help to explain the counter-intuitive behaviour of the savings rate in the ultra-low interest rates environment.

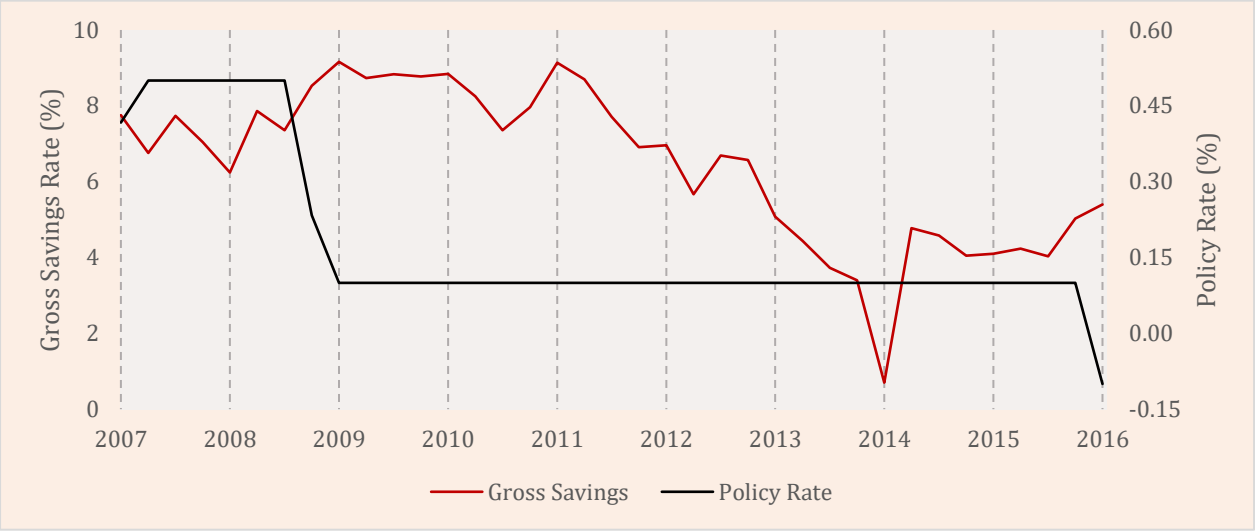
As it is shown in Figure 6.30 and Figure 6.31 respectively, Japan experience a sudden drop in consumption, and an increase in savings during the first quarter of 2014 in response to a rise of the sales tax (VAT) that decreased consumer confidence and put a strain on the families' finances.

Figure 6.30. Japan households' consumption expenditure



Source: OECD Statistics; Personal Design

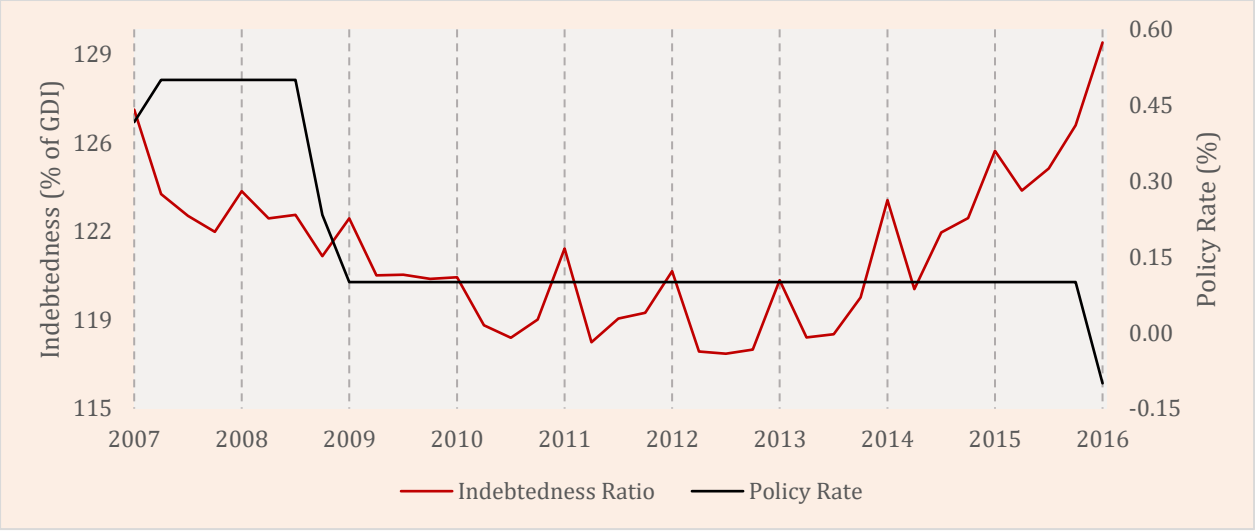
Figure 6.31. Japan households' gross savings



Source: OECD Statistics; Personal Design

It is also depicted in Figure 6.30 that consumption rose significantly from 2011 until 2014, with the index gaining close to 10 points while Japan's savings rate halved. However, after the increase in taxes, the consumption growth rate has been slower and savings have kept on rising showing that the decision of the BOJ to implement negative interest rates, at least in the short-term, has not worked. Figure 6.32 shows that the debt burden of Japanese families has been steadily increasing from 2013 to 2016. This corroborates Gross and Souleles (2002) hypothesis that ultra-low interest might increase a country's level of debt.

Figure 6.32. Japan households' indebtedness



Source: OECD Statistics; Personal Design

In our view, one of the reasons leading to this development in indebtedness is linked to Japan's population age which is the highest in the world. As households retire, they dent their savings in order to supplement their pension plans or pay for extra healthcare costs which in turn, increases the likelihood of more precarious families to become indebted in order to afford those expenses.

- *Confidence Indicators*

Confidence indicators such as the Business and Consumer Confidence Indexes computed by the OECD play an increasing role in shaping trends among economic agents and communicating to governmental agencies what is the perceived economic climate.
Therefore, when analysing aggregate demand and in order to be comprehensive it is important to take a look at these indicators and their evolution since the implementation of ultra-low interest rates policies.

As it will be seen in our analysis, businesses seem to be more optimistic about economic conditions than consumers. Even if it has been found that falling business confidence increases the probability that growth will dip and that rising consumer confidence increases the likelihood of a recovery, these relationships are not enough to anticipate turning business cycles (Batchelor, 2001).

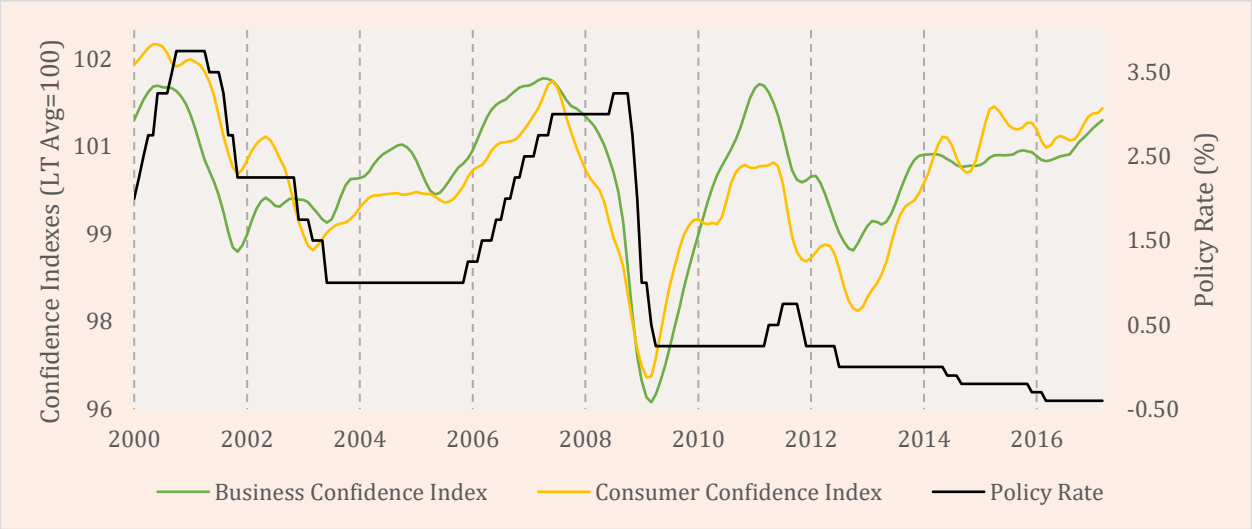
The Business Confidence Index (BCI) is based on the companies' assessment of production, orders and stock, as well as their current position and expectations about the future (OECD, 2017c). Opinions collected are compared to a "normal state" and the difference between negative and positive answers is computed providing a qualitative index on economic conditions. The OECD only computes the index for the manufacturing sector, because of the lack of data availability in other sectors and in order to draw a comparable basis between the different countries.

The Consumer Confidence Index (CCI) is built on households' plans for major purchases and their economic situation, both current as well as their expectations for the near future. As for the BCI, opinions collected are compared to a "normal state" and the difference between

negative and positive answers is computed providing a qualitative index on economic conditions.

In Figure 6.33, we see that from 2001 to 2003, interest rates decreased as a consequence of the dotcom bubble having impacted global financial markets, confidences indexes followed that trend also reporting significant drops. However, since 2014 and notwithstanding the implementation of negative interest rates and the depressed economic climate that lead the ECB to take such actions, the confidence of both business and consumers has been increasing, with households becoming more optimistic than companies about the future growth prospects.

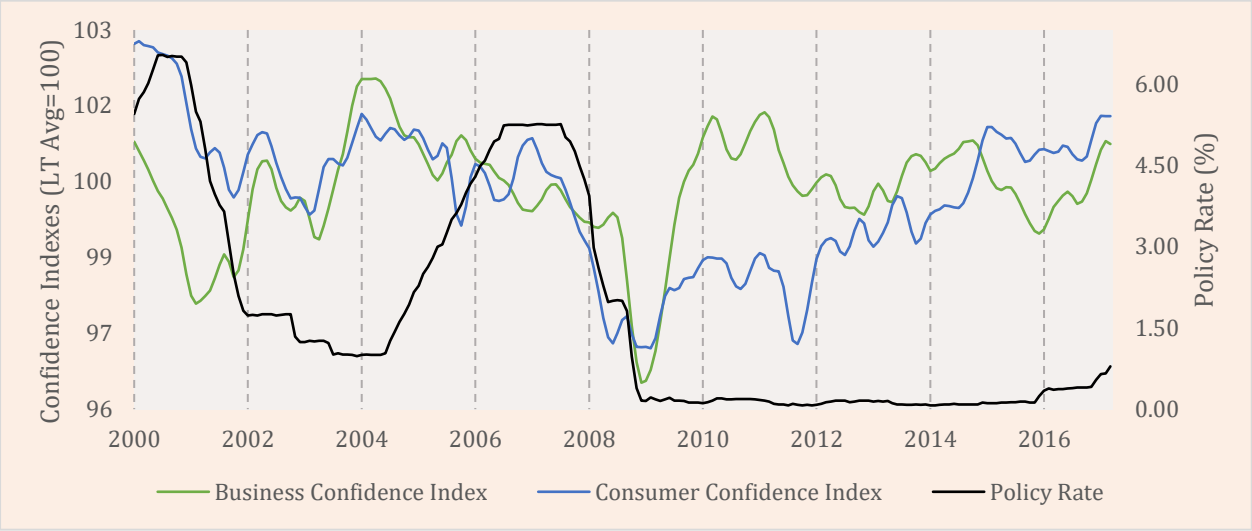
Figure 6.33. Eurozone Confidence Indexes



Source: OECD Statistics; Personal Design

In the United States, depicted in Figure 6.34, the trends are fairly similar to the ones experienced by the Eurozone. However, in the aftermath of the Great Depression, and as the FED dramatically decreased rates, business confidence jumped twice the size of consumers translating the perceived easier business conditions as access to credit suddenly became easier.

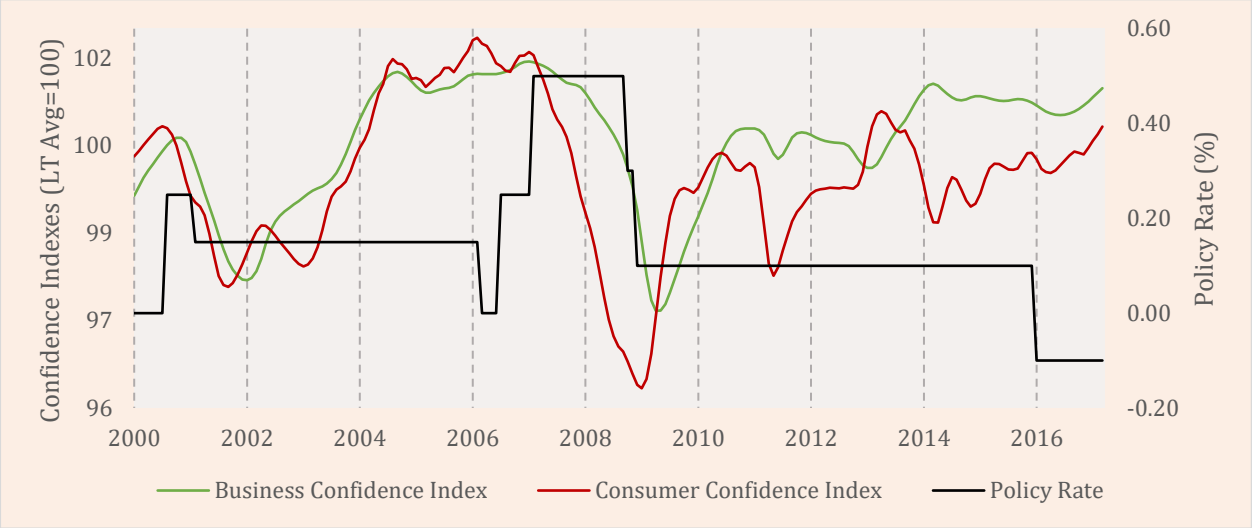
Figure 6.34. United States Confidence Indexes



Source: OECD Statistics; Personal Design

Figure 6.35 sheds light on an important development in Japan and that is that, compared to the two other economic blocs, consumer confidence is almost permanently subdued compared to business morale. While registering the highest gap for the period studied in 2014, the implementation of negative interest rates by the BoJ has not reversed the trend with consumer confidence, in March 2017, still close to one point below business confidence.

Figure 6.35. Japan Confidence Indexes



Source: OECD Statistics; Personal Design

7. Limitations

Using numerous metrics over the course of our work it seems important to underline the possible limitations and pitfalls of these, but also demonstrate why we used these metrics even though they represent possible limitations.

7.1. Biased metrics

- *Inflation*

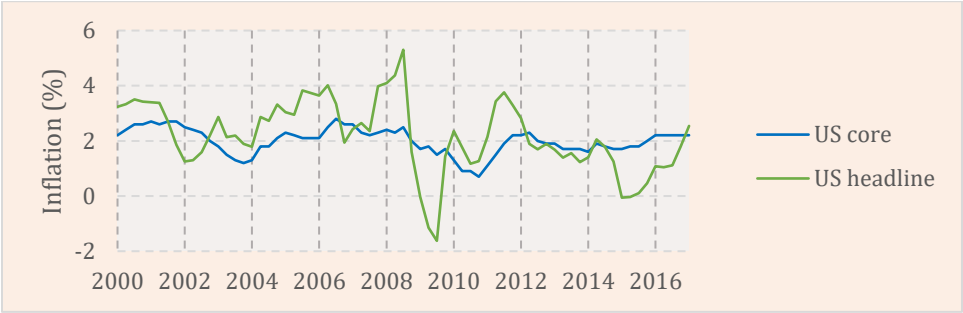
Over the entirety of our work, for uniformity reasons and other reasons mentioned in *Part 6.1.,* when inflation was discussed Headline Consumer Price Index inflation was used. Meaning that both food and energy are included from the inflation metric. Nevertheless, all three banks use different measures of inflation to measure and re-evaluate their objective. The ECB uses the Harmonized Index Consumer Price (HICP), which includes both energy and food prices (European Central Bank, 2017b). For its inflation target, the Federal Reserve uses the Personal Consumption Expenditures index (PCE) produced by the Department of Commerce (Federal Reserve, 2016), which includes food and energy prices (U.S. Department of Commerce, 2016). Nevertheless, the Fed views core PCE (excludes fresh foods and energy prices) as a better measure of the medium-term inflation trend and as a better predictor of future inflation (Bernanke, 2016). While the Bank of Japan uses a core inflation index for its target inflation rate which excludes fresh food prices but the BoJ also strongly communicates on its core-core inflation index (Miller, 2015). The latter excludes fresh food and energy prices.

By using the headline inflation for all three zones examined in *Part 6.1. Inflation and money supply* some disparities could originate from the differences between headline inflation and the indexes actually used by the three central banks to evaluate their objectives. This limitation mainly applies to the BoJ due to its exclusion of certain prices and the Federal Reserve as it uses a different measure than Consumer Price Index, namely Personal Consumption Expenditures. Furthermore, Harding (2016) argues that using headline

inflation might cause bias in the observations of short term changes in inflation rate due to the volatility of energy and fresh food prices.

However, we are confident in our selection of the headline inflation as one might question the logic behind excluding such price elements from one of the prominent metrics defining central banks' monetary policies. After all, fresh food and energy prices are an important element within household expenditures. Surely, in our view, for those banks targeting or communicating a type of core inflation one of the reasons must be that these core inflation metrics present results which are less volatile, closer to central banks' objectives and hence are more likely to instil confidence in the economy and increase the bank's credibility. To illustrate, Figure 7.1. demonstrates the difference between core (excluding energy and fresh food) and headline inflation (all items included) for the United States.

Figure 7.1. Headline vs Core inflation in the United States



Source: OECD Statistics; Personal Design

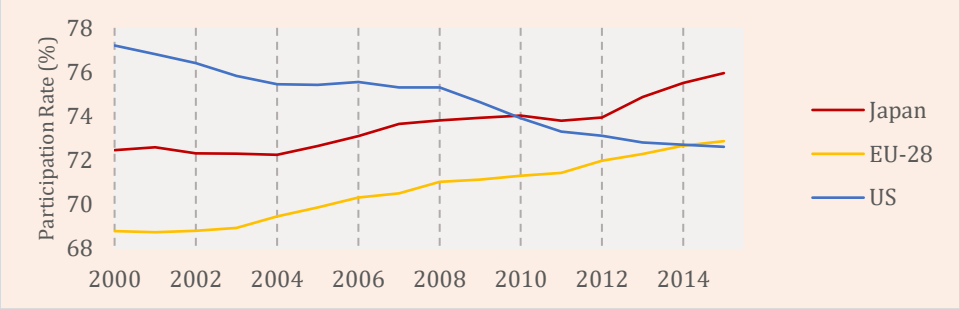
- *Unemployment*

The employment rate is one of the most widely reported indicators and one that is also closely scrutinised by decision makers. However, what this number actually contains is not always clear-cut. Even though for the sake of our analysis, we had to "play by the rules" taking the numbers as they are reported. We would like to take advantage of this limitations chapter to expose some of the pitfalls (also included in our work) that are common when dealing with unemployment figures.

As defined by the OECD (2017c), the labour force consists of citizens that are either employed or looking for employment. While the unemployment rate is the ratio of the people looking for a job over the labour force. What is missing from the picture is that there is a whole population stratum that forms part of the working-age (15-64) population but that is not reported in the labour force; that is discouraged job seekers. There is, however, a metric where they appear and that is the labour participation rate.

Indeed, as can be seen in Figure 7.2, the number of working-age citizen participating in the labour force (i.e. the participation rate) has dramatically decreased (10%) in the US since the dotcom bubble of 2000 showing that more and more people, who are discouraged of seeking employment, are left out of employment figures displaying a brighter picture than real. Whereas in the European Union close to 30% of the people in age to work are not actively seeking for employment.

Figure 7.2. Labour Participation Rate



Source: OECD Statistics; Personal Design

- *Policy rates*

Even the very essence of our work is in a way biased due to central bank policies and frameworks. The lowest rate is the one mediatised, and this is certainly the case regarding negative interest rates which have massively been publicised in financial media. The real rates applied to commercial bank their deposits vary. In Switzerland, Sweden, Denmark and Japan three tier systems are implemented (Mayger, 2016).

In the case of the Bank of Japan's current framework, the upper first tier is named the Basic Balance and stands at +0.1%, the second tier at 0% is the Macro Add-on Balance, and the Policy Rate Balance is the lowest at -0.1%. They respectively affect 210 trillion yen, 40 trillion yen and 10 trillion yen. As can be seen in this case the lowest interest rate only affects a small part of the deposits at the central bank. Hence, this can represent a limitation to our work as we decided to analyse the BoJ's lowest rate, impacting the smaller amount of deposits.

However, this decision is in line with the rest of our work as we also use the lowest rate (overnight deposit) of the Federal Reserve and the ECB even though neither of them apply such three tiered systems (Bech & Malkhozov, 2016; Mayger, 2016). Furthermore, the lowest rates are the most mediatised thus impacting important factors examined such as confidence metrics.

- *Confidence surveys*

We examined both consumer and business confidence levels in *Part 6.4. Increase aggregate demand.* It is important to underline that such confidence levels can be biased through the methods in which they are collected. For example, consumer confidence surveys are measured by two different indexes in the United States; the Consumer Confidence Index (CCI) and the Michigan Consumer Sentiment Index (MCSI). Both involve questioning households with questions divided into five categories. The categorisation and the way the questions are asked can bias the interviewee's replies. Moreover, the amount of non-responses and the disproportionate distribution of these non-responses among different demographic groups can also bias the confidence survey metrics (Curtin, Presser & Singer, 2000).

7.2. Data gathering

In *Part 5* of our work, we found ourselves constrained several times by the availability of the data, its time distribution or the information displayed by it. To counter such hindrances, we had to apply several transformations to the data, that have been explained in the methodology part. We are aware that these transformations might have skewed the data with the outcome of decreasing its reliability.

While we tried to have as much as possible monthly data in order to fine-tune our analysis, when some important indicators were not available in the same frequency, we prefer to report it but are aware that it posed a certain limit as to the sharpness of our study.

Furthermore, during our literature we put a special focus in being as broad as possible. However, in the analytical part we had to give way to some trade-offs, choosing comprehensiveness over depth while choosing simple linear regressions over multi-variate ones in order to cover an extensive range of indicators and economic zones.

Nevertheless, we remain aware of the limitations and pitfalls of such computations as the variables studied are impacted by numerous other variables and events that the level of policy rate decided by Central Banks. The goal of our work as exposed in the introduction was to shed a new light on the evolution of the major economic indicators in the three most important economic blocs, and given the scope limitations of a master thesis, to employ such a methodology was a must.

Conclusion

In order to convey the effect of ultra-low and negative interest rates on the real economy, we started with a relatively broad and extensive literature review analysing the concepts of money, interest rates, and monetary policies. While discussing the history of ultra-low and negative interest rates we learned that negative interest rates are not a new concept and its origin dates back to the very beginning of the 20th century when economist Gesell Silvio came up with the concept of stamp scrip or what equates to a tax on money. More than a hundred years after, in Denmark, negative interest rates were actually implemented by a central bank for the first time.

We narrowed down the scope of our work from Chapter II onwards where we started with the review of the major causes of ultra-low interest rates such as worldwide spread crises and developments such as the global savings glut. In the assessment of expected consequences, in order to lay the fundamentals for the analysis and comprehension of Chapter III, we reviewed concepts such as the Taylor rule helping central banks define policy rates since 1993, the neo-Fisherian view on deflation, the Philipps curve and many others.

In the introduction, we announced we would evaluate how ultra-low and negative interest actually affect some major macro-economic metrics compared to the expected consequences.

- Regarding price stability, we observed that inflation reacted with a severe lag to ultra-low interest rates policies, only approaching central banks' targets as of recently. We also observed that long-term money creation, especially in the Eurozone, has accompanied central banks' measures.

- According to our analysis, the Philipps curve – stating there is an inverse relation between inflation and unemployment – does not seem to hold true in most of our cases studied at ultra-low interest rates. In the case of the United States, in the period

between January 2010 and March 2017, we have even noticed that the opposite of what the Philipps curve suggests is true.

- The national or regional exchange rates of both the United States and the Eurozone are influenced by the fluctuations in interest rates prior to the era of ultra-low rates. Except for two specific periods, the BoJ's call rate does not correlate with the Yen exchange rate. While only the euro is affected by changes in interest changes at ultra-low levels. However, as pointed out in *Part 6.4.* these correlations could be due to or enforced by a number of other factors.

- As to aggregate demand, households' consumption has been strong since the implementation of accommodative monetary policies. Surprisingly, negative interest rates do not seem to significantly influence the savings rate of households which has stayed relatively flat over the last 5 years, nor their level of indebtedness which has been on a declining trend.

After mentioning the main results, reminding the main limitations of our work is relevant. Each variable analysed in our work is in a macroeconomic setting, influenced by numerous variables. Hence, no direct causality should be concluded from our two variables based analyses and should serve as a general guide for correlations. The metrics used – inflation, unemployment rate, policy rates etc. – are, as pointed out in *Part 7.1.,* often biased. Unemployment seems to be more of a political than economic metric, inflation is twisted to fit market expectations or central bank objectives whereas the lowest policy rates are the most bespoken of, while only applying to a minority of deposits. Also notable is that our research of the real consequences on private corporations did not include analyses on share buy backs, corporate levering or investments. The further analysis of these economic agents could extent the precision of our research.

When observing the main results of our research contradicting many key economic models of the 20th century, we wonder if those models are still relevant in the new era of ultra-low interest rates. We argue that best practice to counter these counter intuitive results would

be to evaluate how and if some of the economic models of the 20th century could be adapted to the new realities. The extent of our research led us to some other open-ended questioning.

Negative policy rates are promoted as a tool to attain price stability and sustainable growth (European Central Bank, 2017c), but when taking a closer look at the main beneficiaries one might wonder what the true underlying objective is. In the Eurozone case, Governments are making a free lunch out of sovereign debt and some, such as Germany, are even getting paid to borrow (Goodman, 2016). Hence, the ultra-low ECB policy rates favour Eurozone governments at a convenient time after the European Sovereign debt crisis (2009-2013). In fact, public debt-to-GDP ratio increased from 73.3% to 108.4% in the Eurozone between 2007 and 2015 while net interest payments fell from 2.5% of GDP to 2.2% (Hannoun, 2015).

On the other hand, ultra-low interest rates across the Euro area penalise households and especially pensioners with real interest rates on numerous saving accounts below zero. (Rampell, 2012). Moreover, monetary policies accompanying ultra-low policy rates such as Quantitative Easing have forced upwards prices of many types of assets such as stocks and real estate. Thus, increasing income inequalities by boosting the wealth of the richest and creating a wealth effect where corporations and individuals who previously invested in stock or real estate will feel richer and theoretically consume more. Moreover, these price increases could create, or already have created, bubbles in financial markets, real estate markets or even art as these markets are currently at all-time highs (Farhi & Tirole, 2011).

When the European Central Bank (2017c) states the end objective of ultra-low policy rates is sustainable growth we question the sustainability aspect of this claim. In fact, economists such as McKibbin (2016) argue 'unreal' interest rates, such as negatives rates, will only create artificial demand, hence artificial growth. Consequently, the potential growth seems artificially fueled by ultra-low interest rates and other monetary policies such as Quantitative Easing. Furthermore, can we question how a transition to 'normal' interest rate levels is possible once economic agents start considering such policies as the new normal. Moreover, Quantitative Easing has forced asset prices up, boosting the wealth of the richest and making it even more difficult for the ECB to reverse policy. The same reasoning is valid for other

central banks applying negative interest rates such as Japan, Sweden, Switzerland and Denmark.

For central banks to continue playing a role in preventing recession and raising growth, we believe there has to be a rethink of the entire premise of monetary policy with a closer aim at consumer spending as well as corporate investment. Expecting further cuts in interest rates to function seems improbable, expecting those cuts to provide sustainable growth seems impossible.

It would be interesting to study the consequences of ultra-low and negative interest rates on the real economy in the next five to ten years to check whether it has not been a considerable mistake with short term gains and long-term pains.

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