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Negative Interest rates: Effects on Monetary policy and Bond market

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Introduction

Central banks (CBs) have traditionally used interest rates as a tool to achieve their monetary policy objectives, raising them to limit unrestrained economic growth and reducing them to

boost a stagnant economy. In doing this, though, CBs always operated using positive values for the interest rates they charge on their deposits. To raise the economies after the most recent financial crisis instead, Monetary Institutions begun to consider the use of negative nominal interest rates (NNIR), together with other unconventional policies. According to CBs, they simply cut interest rates to stimulate the economy, but doing so implies establishing a contradiction without precedent in history. Operating at negative rates in fact, means paying a borrower an interest for taking someone else's money and impose on the lender an interest payment for giving up its wealth. Moreover, imposing negative rates on deposits accounts leads to the appearance of debt instruments, close substitutes of deposit accounts, yielding negative return. The most interesting thing though is not the introduction of negative interest rates nor the generation of negative yielding bonds, but the huge and increasing volume of trades that these assets are experiencing.

The purpose of this thesis is to comprehend the dynamics that cause CBs to contemplate such a measure, as well as why negative yielding bonds created by the measure themselves are in such great demand. With this objective I started explaining the theory behind Negative interest rates policies (NIRPs) and Negative yielding bonds in the first chapter. In the second instead by analyzing the factual proofs I have tried to give an explanation to the dynamics that lead CBs to adopt NIRPs and to the ones that pushes the market of negative yielding bonds to have an incredibly high volume. The main founding of this thesis suggests that extended periods of economic stagnation even in a low interest rate environment pushes some CBs to implement an unconventional monetary policy that further lowered interests driving them into negative territory. This measure together with other unconventional policies are aimed at pursing the objective of financial stability, even though there are no factual evidence that witness its success yet. For what concern negative yielding bonds instead, they owe the largest part of their demand to Quantitative Easing (QE) programs enhanced by CBs together with NIRP to stimulate the economy. Moreover, it will be demonstrated how this action pushes monetary and non-monetary financial institutions holding lot of capital, to consider negative bonds as an alternative to deeper negative CB facilities. Whereas households, usually holding less amounts of capital, due to the reluctancy of some commercial banks to pass negative rates on their deposits, are refrained to invest in negative yielding bonds.

CHAPTER 1

Definining Negative interest rates

This chapter will study what are the reasons that make the interest rate to be negative rather than positive, and what are their implications on the money market. But first let's define what exactly an interest rate is.

1.1 Defining interest rates

Interest: "legal claim or right; concern; benefit; advantage", earlier "Interesse" from Anglo-French: "What one has a legal concern in", from latin "Interesse"- [comp. inter.-(in between), + -esse (to be), to be in between], is the price paid or the price that has to be paid by the borrower to the lender for the credit conceded to the former, it is usually expressed as a percentage of the principal, accounted on an annual basis; **rate** or essay for **interest** (3%, 6%, etc.), the ratio between the amount paid or received as interest and the amount of credit, expressed as a percentage, on an annual basis; the active interest is the one collected for a capital loaned or used; the passive is the one paid for a sum received on loan; the. nominal, the rate paid in monetary terms; the. real, the difference between nominal interest and inflation rate;

1.1.1 Nominal interest rates

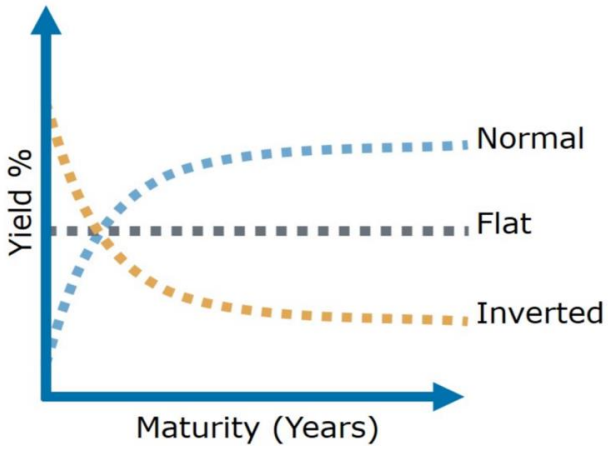
In particular, being X the amount lent by the lender to the borrower at time 0 (t_0), the sum that has to be given back by the borrower at time 1 (t_1) is X'. Now, the ratio X'/X is the quantitative definition of '*gross* nominal interest rate' represented by (1 + i). By simply deducting 1 from the previous value the '*net* nominal interest rate' **i** is obtained, and it is expressed as a percentage of the principal X. The first component of the interest rate is time. The time component is the return the lender wants to receive for letting the borrower use his money: more extended is the window of time the lender has to give up his money, higher the interest he wants in exchange. The key concept around which this component mechanism revolves is the time value of money (TVM). It measures the value of money at t_0 in terms of money at t_1, and it is possible to consider the nominal interest rate as an index of the TVM: if the interest rate rises it means that the value of money at t_0 increases in terms of money at t_1, and vice versa. Normally, there is an inverse relationship between time and value of money, that is, as time flows, the value of money is declining (i.e., 'A dollar today worth more than a dollar tomorrow'), but with the current scenario in the money market this relation may hold no longer.

In both cases this relationship between time and returns (yields) can be represented through the so called ‘yield curve’.

Yield curve

The yield curve is built on the interest rate value of a bond along different maturities. Bonds are particular forms of debt contract between two parties, and in order to have a correct representation of the yield curve, the analyzed bonds must be of the same quality. The curve can be represented as a graph, in which in the x-axis there is time and in the vertical one there are returns.

Figure 1 (yield curves’ shapes)



Source https://www.colotrust.com/the-shape-of-the-u-s-treasury-yield-curve/

A solid theory for describing the shape of a yield curve must explain the following points.

I. why interest rates of different maturities move together,
II. why yield curve tends to show steep upward slope when short term interest rates are low and a downward one when they are high,
III. finally, why the Yield curve usually slopes upward.

Three theories have been developed in the attempt to explain these facts. The first one is the Expectations Theory, according to which long-term bonds’ interest rates are equal to the average of the short-term rates that people expect to occur during the life of the long-term bond. That is for example:

Consider a three-years bond of a determined quality, with the current interest rate on one-year bond at 4%. Consider also that the projected interest rates on the identical short-term investments with maturity dates two and three years from now are 5% and 6%, respectively

(i.e., $i_1 = 4\%$, $i^e{}_2 = 5\%$, $i^e{}_3 = 6\%$). According to the expectations theory the rate of the long-term bond should be equal to:

$$i^e{}_{3\text{-years}} = \frac{4\%+5\%+6\%}{3} = 5\%. \quad (1)$$

This Theory is based on the assumption that short and long-term bonds are perfect substitutes with the implication that the expected returns of assets with different maturities are equal (i.e., at time 0 both strategies, investing in long- or short-term bonds, lead to the same level of wealth). The expectation theory explains why the Yield curve tends to be upward sloping when short rates are low and vice versa. Indeed, when short rates are low, they are expected to rise back to their average level (= long term rate), implying that long term rates are above to the current level of short-term bonds, which gives as a result an upward sloping yield curve. On the other hand, when short rates are high, they are expected to fall to their normal level, implying a today's value of short-term bonds which is higher to the one of long term bonds, inferring to the yield curve a downward slope. Considering long and short terms bonds as part of the same market, pure expectations theory also explains why the interest rates of these two kinds of assets comove. Indeed, starting with the fact that short-term interest rates are persistent, that is, if they rise now, they tend to rise again in the future, their average value increase as well. Given that the long rate is defined as the average of the short rates, if the average is greater, so is the long-term rate. On the other hand, this theory fails to explain why the Yield curve usually slopes upward. Indeed, future interest rates are as likely to grow as they are to fall; hence, the average of their expected value is not always larger than the present short rate, and therefore the yield curve does not slope upward according to the expectations theory.
The second theory is diametrically opposed to the pure expectations and is called Segmentation theory. This thesis posits that the short-term and long-term bond markets are totally distinct, with respective interest rates established by each market's demand and supply equilibrium and no chance that changes in one market would impact the other in any manner.
Segmentation theory, then, implies that bonds with different maturities are not substitutes at all. As a consequence of this, it implicitly fails to explain why a short and long-term bonds comove, since there is not correlation between them. It also fails to explain how the behavior of short-term bonds affect the Yield curve's slope, since it is unclear their effect onto the long-term bonds market. Actually, the only explanation Segmentation theory is able to provide is the fact that Yield curve usually slopes upward. Based on the widely held belief that investors favor more liquid assets, short-term bonds are favored over long-term bonds. As a result, the

demand for, and consequently the price of, short-term bonds is higher, and interest rates are lower, conferring the yield curve an upward sloping shape.

Finally, the third theory, called the Liquidity Premium Theory, succeed to explain all the three features of the Yield curve. It is based on the Expectations theory but with the fundamental difference that it assumes long and short-term bonds as substitutes, but not perfect ones. It also captures determined features of the Segmentation theory and in particular the fact that short term bonds are preferred over the other. This thesis indeed, alleges that in order to be totally indifferent, investors must be compensated for the lack of liquidity, meaning that, lower the liquidity of an asset (i.e., longer the maturity), higher must be the liquidity premium on it. The Liquidity premium theory assumes as the expectations theory that the long-term rate is the weighted average of the short ones, but in addition it adds to the average the liquidity premium associated to the maturity date of the long-term bond. Thanks to this, it explains all the three characteristics of a yield curve, in particular I and II for the same reasons of the pure expectation theory and the III, coherently with the segmentation theory, since it adds the premium that confers to the curve its increasing shape.

Many economists give always much attention to the yield curve's shape because it can give important clues about the future economic condition of a country. Indeed, almost all economic slowdowns have been preceded by an inversion of the yield curve, and even if not all the inversion of the yield curve has been followed by an economic contraction, as Cwik (2005) points out, approximately one year before an economy ends up in a recession, an inversion of the yield curve tends to occur.

From the figure it is possible to understand why the term 'inversion' of the yield curve is used. In a normal situation the Yield Curve is upward sloping, so that short-term returns are lower with respect to long-term ones, respecting the TVM and also the risk component associated with time. The risk component is the probability that during the life of the debt contract an unfortunate event may happen and would impede the lender to repay his debt, clearly, longer the period between t_0 and t_1 more likely is the probability that such event will occur.

A normal yield curve is then associated with periods free from uncertainties and economic expansion. Moreover, another useful information about the yield curve is given by its slope: a steeper yield curve is normally associated with periods of accelerated rates of economic growth, conversely a flatter curve reflects slowing pace periods of economic expansion.

An inversion of the yield curve, then, is when the sign of curve's slope happens to change and becomes negative. In such a scenario short term returns are higher than long term ones, which

is, at first sight, against any theory explained so far. This inversion is the result of investors' behavior, whose are willing to accept low rates in the long term because expect economic conditions to deteriorate and an expansionary monetary policy (which consist in lowering short term rates) to be implemented by the authorities to stimulate recovery. Such controversial behavior from investors is the clue of an unstable economy that pushes them to accept assets with lower interest rates and greater time-risk component.

In the figure, it is possible to notice that yield curve's shape is not linear, and it is due to a third determinant of the interest rate: the liquidity risk. The liquidity of an asset is generally defined as how quickly the asset is convertible into cash. Generally, markets with a great number of participants tend to have a high degree of liquidity, since a greater demand makes the selling activity (convertibility into cash) much easier. In the liquidity premium theory, a rational investor would prefer a more liquid asset everything else being equal, because in this way he can easily liquidate his position in every moment. This theory also imply that investors should be compensated with an extra unit of liquidity premium for every unit of liquidity they are giving up. Taken two bonds with similar features but different maturities, the one having the shorter maturity date happens to be more liquid than the other. So, given this preference on short term bonds over long term ones, the increasing liquidity premiums associated to long term bonds, confer to the yield curve its particular shape.

Finally, a determinant that particularly influence the interest rate of an asset is the inflation rate. Defined as the percentage change in the price level ($\pi = (P_{t1} - P_{t0}) / P_{t0}$), the inflation rate is an index of the purchasing power of money. An inflation rate of 1% per year for instance, means that the price of the same basket of goods has increased of 1% in a year, if it had a value 100$ last year, it would now cost 101$. A positive inflation rate is linked with a decrease in the purchasing power of that currency, since what it is possible to purchase with 100$ last year requires now a higher amount of (less valuable) money. The depreciation of the currency is something for which the lender must be rewarded and, even in this case, the normal shape of the yield curve is coherent with this dynamic. Indeed, given a positive inflation rate, as time goes by the value of the currency diminishes and in order to have at t_1 the same purchasing power of the principal at t_0 the amount reimbursed must be increasingly greater.

1.1.2 Real interest rates

As Humphrey (1983) reports, Despite being the proponent of the current definition of real interest rates, Irving Fisher was not the first to tackle this challenge. The most ancient work

dealing this argument comes from William Douglas, that in 1740s introduced the concept in the attempt to explain the reason of paper currency denominated bond depreciation against the ones denominated in silver coins. Again, during the Napoleonic wars (1811) Thornton use the same notion to explain how inflation rate was incorporated and cause a rise in the interest rates of British bonds. Another relevant mention of real interest rate has been made by Alfred Marshall in 1890, who established the interest-inflation connection in 1890 as a fundamental idea in the transmission mechanism for understanding how changes in the value of money affect various trade cycles. Finally in his work of 1896 *'Appreciation and Interest'*, Fisher restated the concept of real interest rate Among the four main determinants of the interest rate, inflation is the one that most influence its value because it is directly affecting the purchasing power of money. For this reason, it has been introduced a measure of the interest rate based on purchasing power of money, that allow to net out the effects of inflation: the real interest rate. Being $1 + \pi$ ($= P_{t1}/P_{t0}$) the gross inflation rate, the *gross* real interest rate is given by:

$$1 + r = \frac{(1+i)}{(1+\pi)}, \quad (2)$$

By simply deducting one from both sides the *net* real interest rate is obtained:

$$r = \frac{1+i-(1+\pi)}{1+\pi} = \frac{i-\pi}{1+\pi}, \quad (3)$$

moreover, for small values of π:

$$\frac{i-\pi}{1+\pi} \cong i - \pi, \quad (4)$$

So, by replacing this in the previous equation it is obtained that:

$$r \cong i - \pi. \quad (5)$$

As it is possible to observe from this final equation the real rate and the inflation rate are negatively related, so that for any value of π different from 0 the real rate will diverge from its nominal value by the same amount, but with an opposite direction with respect to π.

- $P_1 > P_0$: the price index has increased and inflation rate with it ($\pi > 0$), this means that the currency has depreciated, and its purchasing power has decreased (i.e., the real value of money at t_1 is smaller than its face value: $r < i$).

- $P_1 < P_0$: unlike before, the price level has fallen and inflation rate with it ($\pi < 0$), in these cases the currency is acquiring value and negative inflation (deflation) occurs. With deflation the purchasing power increase and the real value of money is greater than its corresponding nominal level (i.e., $r > i$).
- $P_1 = P_0$: when instead the inflation rate is constant there are no divergencies in values between nominal and real interest rates (i.e., $\pi = 0 \Longrightarrow r = i$).

Now the matter is that actual levels of inflation are determined at the end of the year, but since it is a very important component of the interest rate inflation has to be included in the estimation of its value. The variable which is involved in the construction of the interest rate is then an expectation of the inflation rate (π^{exp}). The issue with expectations is that they not always match the reality, for this reason, even in this case three different scenarios may occur.

- $\pi^{exp} = \pi$: when expectations are met no party is harmed by wrong forecasting of inflation rate, and the real value the lender receives at t_1 coincides with the expectations made at the moment of the contract.
- $\pi^{exp} > \pi$: the actual level of inflation is below the expectation and as a result of this the lender is better off. That's because at inception the interest rate has been estimated with higher than actual level of inflation. This implies a higher-than-expected purchasing power of money when the debt is repaid.

  Example: suppose that at the moment of the contract the two parties agree an expected inflation level of 2% and, as consequence of that an interest rate of 4% is established on a principal of 100$. One year later, independently from inflation, the lender will get back a nominal amount of 104$. According to expected level of inflation this amount at t_1 worth as 102$ at t_0, but if the level of inflation measured during this year is instead 1% ($\pi^{exp} > \pi$), the real value of the principal at t_1 is 103$, conferring to the lender a higher-than-expected purchasing power.
- $\pi^{exp} < \pi$: in the opposite scenario is the borrower that is better off since he has to give back at t_1 an amount that has a smaller than expected real value forecasted at t_0. For sure, then, a higher-than-expected level of inflation reduce the real interest rate, but in some cases the lender may end up even with a loss in real terms.

Example: suppose that 1% level of inflation is forecasted, and 3% interest rate is then agreed on principal of 100$. If at t_1 the actual inflation is 2% the lender will receive 103$ that buys

like 101$ (instead of an expected real value of 102$) at t_0. In this case the lender receives a less valuable purchasing power but still higher than the amount lent out at inception. Suppose now that instead of 2% the actual inflation happens to be 4%, in this case the 103$ the lender receives at t_1 has a purchasing power that corresponds to 99$ at t_0. This would represent not only a loss with respect to the expected real value but also with respect to the initial value the lender gave to the borrower.

In the latter scenario, actual inflation rate exceeds the nominal interest rate of the contract, so that the lender ends up with a negative investment in real terms. From this it is possible to infer that every time inflation rate is greater than nominal interest rate ($\pi > i$), an investment of **Negative Real Interest Rate** is made (i.e., $i - \pi < 0 \Longrightarrow r < 0$).

1.2 Negative interest rates

A first, important distinction when talking about negative interest rates has to be made between real and nominal ones. As explained in the previous section, real negative rates are the result of nominal interest rates being outpaced by inflation levels. As a consequence of that, they are not a direct choice of investors, but rather a consequence of wrong expectations. This means that, when entering in the contract, investors expect to have a positive return on their investment and the borrowers only happen to be lucky thanks to favorable external factors. The lack of certain profits has not, however, prevented governments (major class of borrower) from exploiting this source of profits. There exists a maneuver of credit transfer from creditors to debtors which took the name of financial repression tax and consists in ceiling the nominal interest rates in order to cut government expenditures on bonds, reducing in this way, the government's deficit. An important feature of this measure is that unlike others, that reduce deficit through tax increasing and cut in expenditures, interest ceiling allows to obtain similar results in a 'opaquer' way, avoiding disappointing taxpayer class. Such a policy happens to be particularly profitable for governments when inflation rate outpaces the interest rate ceil imposed by the authorities, so that real interest rates become negatives and there is a real transfer of credit towards borrowers, allowing the latter to reduce or liquidate existing debts. For example, starting from 1940's US government managed to reduce its debt adopting this policy for the following 30 years. By applying a ceiling rate of 0,375%, 0,875 % and a maximum of 2,5% for 3-months T-bills, 12-months certificates and long-term bonds respectively, they achieved to reduce their debt burden up to 40% of GDP per decade. These results have been made possible thanks to inflation levels that, in the interested period, have

driven the real interest rates below zero allowing the government to reduce its deficit. Consistently with the study of Elmendorf and Mankiw (1999), this policy has been especially effective for US government since the growth rate of GNP in that period has been considerably higher than the interest rate authorities have to pay on their debt, setting in motion, in this way, a debt reduction cycle that ended up in a record decrease (from 121% to 32%) of the debt-to-GDP ratio. After 1975, the Fed and the treasury didn't manage to keep interest rate ceil fixed as a result of an expansionary economic period that was about to start. This strategy indeed, works in contractionary periods where the interest rates are kept steadily low and there a consistent positive rate of inflation is registered. This is the reason why today the US government may consider to re-adopt this strategy to finance its debt, since there is a parallelism between the current economic situation and the one after the World War II.

Negative nominal interest rates are a controversial phenomenon that occurs when, at the moment of the contract, the lender accepts to lend out an amount of money, knowing that she/he will receive a lower amount when the contract expires. Such a concept seems to go against the definition of interest rate, that implies a premium, as previously mentioned, for the part that gives up part of its wealth in favor of another. The simple reasoning implies that instead of lending money out, a saver would rather keep it, dampening the credit channel and, as a result, the real economy. Why, then, have some CBs decided to apply negative interest rates on their deposits to stimulate the economy? This question will be addressed more in detail by the next chapter, but in this section below will be explained the theory upon which Negative Nominal Interest rates are based.

1.3 Theoretical perspectives on interest rates

1.3.1 Loanable funds market

The market for loanable funds is a concept developed by classical economists to describe how borrowers have access to credit. Assume for instance that a company need external money to finance a new investment; the loanable funds market illustrates how such events occur. As also Mankiw explains (2014), the pillar around which this theory revolves is the savings-Investment expenditure identity:

$$S = I \quad (6)$$

This equality, in turn, comes straight from another identity, the one of the national incomes and aggregate expenditures:

$$Y = C + G + I + NX, \quad (7)$$

Let's assume, for simplicity to be in a closed economy, so that NX = 0 and (7) becomes:

$$Y = C + G + I. \quad (8)$$

Now, in order to estimate investment spending (and savings) it is necessary to isolate "I" from (8):

$$Y - C - G = I, \quad (9)$$

From this equation it is clearer that Investments are equal to Incomes minus aggregate expenditures. But it is also possible to distinguish further between private and public savings, by adding and subtracting Taxes (T):

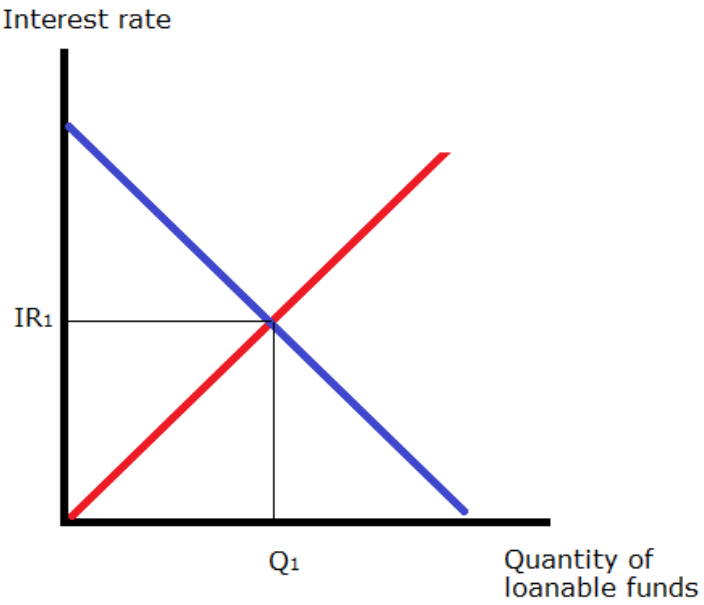
$$(Y - T - C) + (T - G) = I, \quad (10)$$

the terms in the first parenthesis represents private savings (i.e., what is left from disposable income (Income minus Taxes, Y - T), after consumption expenditures), whereas the difference in the second parenthesis constitutes public savings (i.e., budget surplus: taxes collected minus government expenditures). As a result of combining private and public savings, national savings are generated. Considering instead a more realistic model reflecting an open economy it is important to take in consideration that part of savings in the left-hand side of the equation may be spent for imports needing or be incremented because of exports sales. In order to complete the equation, then, a third element must be introduced, the Net Capital Inflows (NCI), that comes from the difference between capital entering and leaving the economy:

$$(Y - T - C) + (T - G) + NCI = I, \text{ or } S = I. \quad (11)$$

Equation (6) is particularly relevant for the loanable funds market because it represents the equilibrium condition between demand and supply. Demand for loanable funds is represented by the amount of wealth borrowers are willing to "buy" while the supply is represented by savers' wealth. In this particular market the price of the good (i.e., money) is represented by the real interest rate, which in effects can be seen as the price paid by the borrower in order to obtain a determined amount of money belonging to the lender. In this way, is easy to understand how demand curve slopes downward and the supply one slopes upward: an increase in the real interest rate renders savers more willing to provide loans and refrain borrowers from taking one.

Figure 2 (Loanable funds market Equilibrium)

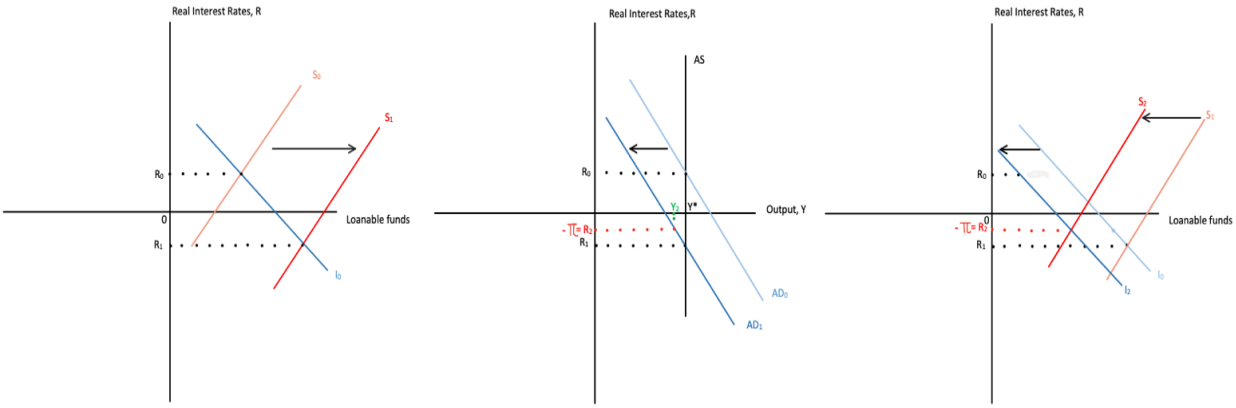


https://econ101help.com/the-market-for-loanable-funds/

As any other market, the Equilibrium is found when quantity of funds demanded (blue line in the graph) equals the quantity supplied (red line in the graph) and the price adjusts to make these quantities equals. This simple dynamic implies that real interest rates, according to loanable funds theory, are determined by the equilibrium between demand and supply and that any exogenous shock shifting demand or supply curve is adjusted by a movement in the real interest rate. Being the rate free to move along the vertical axis to equate the two curves, it may happen that sudden shock in one of the two curves would force the rate to go below 0. If something similar happen the economy face the problem of the Zero Lower Bound (ZLB).

It is common wisdom that ZLB threshold hampers the recovery of a country injured by a financial crisis. Let's consider for example what has happened in the subprime crises of 2007-2009 in US. Krugman (2016) explains how US households reacted at the Great Recession of 2007, they started a deleveraging activity to pay-down their debts and fixing their balance sheets. As a consequence, the full employment loanable funds supply has increased (as savings accounts started to recover). To re-balance the equilibrium of shifted supply a fall in the real rate of interest was necessary, but this possibility was prevented by ZLB. Having as a result a surplus in supply of loanable funds, it implied a contraction on the output and on the employment level.

Figure 3 (Shock and adjustments in the Loanable Funds Market)



https://www.semanticscholar.org/paper/Zero-lower-bound-(ZLB)-economics%3A-The-fallacy-of-of-Palley/6f5708662cf254768e0cbd11862fb44846e2c0e3. Personally revised.

As it is observable from the left-ward graph, the deleveraging activity effect discussed above breaks the equilibrium in the loanable funds market, shifting the supply curve to the right (from S_0 to S_1). Such a change requires a real interest drop (from R_0 to R_1) to maintain full employment equilibrium, but this is blocked by the ZLB. The same phenomenon shifts the Aggregate demand of goods market from its full employment equilibrium (at R_0, Y*) moving from AD_0 to AD_1. The market clearing condition would require an interest rate level of R_1, but again this is prevented from ZLB, leaving the goods market with a demand shortage and an excess supply. With a nominal interest rate at least equal zero (i = 0), the real interest rate coincides with negative of inflation, which is not sufficient yet to achieve the equilibrium. This surplus of both savings and outputs causes a contraction of outputs themselves, which is reflected by a movement along the new AD line in the central graph. Outputs continue to decrease until the level of output equals the new AD which happens at the new equilibrium rate R_2 (giving as a result an output level of Y_2). Finally, the fall on outputs (from Y* to Y_2) cause both the Savings and Investments to fall in the loanable fund market (supply curve shifts left ward from S_1 to S_2, and Investment curve shifts left too, from I_0 to I_1 as shown in the left-hand graph), the contraction in outputs continues until the equilibrium in the market is restored at the real interest rate level of R_2. As the dynamic represented by the graphs have shown, the ZLB is the cause of output contraction and unemployment, since it prevents nominal rates to fall. These dynamics that the US economy experienced during the subprime mortgage crisis are a good example of what might happen in the loanable funds market if a parallel shift of a curve pushed the equilibrium rate below zero. Although the classical model of the loanable funds market has been challenged the modern liquidity preference theory postulated by Keynes (see the next chapter), the loanable funds market is still used by central banks to identify which

monetary policy to adopt. And when rates fall below the zero threshold, they may decide among two alternatives to restore the equilibrium through conventional monetary policy. They may try to increase the inflation expectations, since according to the fisher equation, a higher inflation rate lowers real interest rate given a fixed nominal one, but rising the expected inflation is a difficult goal to achieve if not accompanied with real economy growth. The second alternative is to simply drive nominal rates nominal rates down to negative territory, so that, given inflation, CBs are able to reach the full employment equilibrium condition in the loanable fund market.

1.3.2 Liquidity Preference theory

In his book "General Theory of Money Interest and Employment" (1938), Keynes developed the liquidity preference theory according to which there are three main reasons that determine the demand for money.

Transactions motives can be actually decomposed into *Income* and *business* motive. The former claims that money is held to bridge the period that goes from the receipt of an amount of money to its disbursement. Business motive, on the contrary, claims that money is used to bridge the period that goes from the occurrence of business cost to the first sales.

Precautionary motive, according to which, money is held to hedge the risk of sudden expenditures and to exploit an eventual unforeseen opportunity.

These first two categories represent households' reserves of money to face ordinary expenses. Their main concern is the one to protect this part of capital, and therefore they that part of money demand which is less affected by changes in interest rates.

Speculative motive, that, as Keynes himself sustain, is the less understood, but the main responsible for determining the money demand. Indeed, this theory claims that an investor may decide whether investing in securities (bond market) or holding cash instead. The risk of cash is assumed to be zero, whereas securities are bearing the credit risk. So, everything else being equal the investor would prefer cash to securities (safer asset). The return on cash is zero as well, while the return on bonds is given by: interest rate payment (r) plus gain on capital ((expected price at sale's time – current price)/ current price). By expressing prices in term of interest rates we will have:

$(1/r)$ = current price,

$(1/r^{exp})$ = expected price at sale's time:

$$Expected\ return = r + \frac{\frac{1}{r^{exp}} - \frac{1}{r}}{\frac{1}{r}} . \quad (12)$$

So, an investor would buy bonds whenever the expected return on securities will be higher than the one on money (i.e., when (12) is greater than zero).
In particular this happens when:

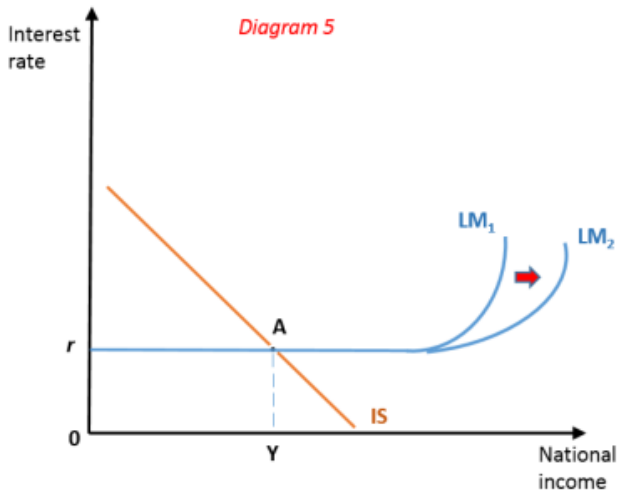
$$r > \frac{r^{exp}}{1+r^{exp}} . \quad (13)$$

The main determinant on investors choice is then the interest rate: Bulls are those investors that expects interest rates to fall in the future, so that it is convenient to buy securities in the present or at least refrain to sell them. Conversely bears are those investors that believe interest rates will rise and is convenient to hold cash now. Each investor, then, according to its strategy can be both a bull and a bear. In particular, when interest rates are high, and therefore expected to fall, the market is prominently made of bulls that invest on securities instead of holding cash. This leads to a low demand of money. On the other hand, the demand of money is high when rates are expected to rise, and investors starts to hoard money for a more profitable future investment. But what happens, according to Keynes, when interest rates on bonds hit zero?

1.3.3 Liquidity Trap

The Liquidity trap is that concept developed by Keynes that occurs when interest rates attain zero, making money and bonds being perfect substitutes. Indeed, investors, given the same returns, would prefer holding money that, unlike bonds, does not bear the default risk. In other words, the inequality (13) does not hold any longer, and as a consequence, Keynes continues, the elasticity of money demand becomes nearly infinite as it adjusts immediately to any shock. This is where the trap triggers, the channel through which Central Banks (CBs) transmit their monetary policies to the real economy, is the credit one. The liquidity trap hinders the ability of CBs' conventional policies to affect the real economy through the credit channel. CBs, in fact, manage an economy's money supply and may thus set targeted interest rates by pumping or sucking money out of the system. When the preference of money is nearly infinite though, trying to modify the level of interest through money supply becomes impossible since any additional unit injected into the economy would be held as cash by savers. Here the effects of a monetary policy expansion in a liquidity trap scenario:

Figure 4 (Liquidity Trap IS-LM)



https://www.ukessays.com/essays/economics/effect-expansion-monetary-policy-income-6513.php

Notice from the graph that the left-ward part of the LM curve is flat due to the high elasticity of money demand, and as long as the equilibrium level (A) lies in that part of the curve, the effect of any expansionary policy (represented by right-ward shifting of LM curve, i.e., from LM_1 to LM_2) would not lead to any change neither on output (Y) nor on rates (r).
According to this theory developed by Keynes, expansionary monetary policies should avoid lowering the nominal rates below zero in order to maintain their effectiveness. That's why many economists speak about the Zero Lower Bound when referring to the 'no trespassing' limit through which rates should not go.

1.3.4 Zero Lower Bound

In the "*General Theory"* Keynes disputed the conventional assumption that interest rates are determined to adjust the AD and AS in the loanable fund market but are rather established according to its theory of liquidity preference. As explained above, part of money demand is aimed at satisfying consumption purposes (L_1, transaction motive), while the other part is held to foster savings. When money is held for this purpose, it assumes the role of a store of value, and while money has no rivals for the other purposes, as a store of value, it does have certain alternatives, such as bonds. That because bonds allow savers to gain interest on their savings increasing further their wealth. This is the reason why Keynes sustains that this part of money demand is affected, and more specifically, negatively related with interest rates. As soon as the

ZLB is reached, however, money becomes more appealing to investors since, for the same returns (i.e., Re = 0), they are assumed to be risk-free, unlike bonds. When something similar happens the liquidity trap phenomenon explained above triggers. The most important implication of the liquidity trap is that given the infinite elasticity of money, any monetary policy ends up being ineffective. Consider two hypothetical situations that central banks (CB) may face: one in which nominal interest rates are substantially positive, i.e., a typical condition, and one in which the nominal rate is at its Effective Lower Bound (ELB). In the first scenario a conventional monetary policy enacted by the CB would be reflected in income and employment according to IS-LM model, through the monetary transmission channels. For example, an expansionary monetary policy that increases the money supply, leads to a decrease in nominal interest rates (it becomes easier to get money, law of own price), causing, in turn, Investments (I) to rise together with Income (Y), and finally to an increase in the employment level too. When instead the nominal rate is at its ELB, even a violent monetary stimulation empowered by CBs does not affect the real economy and Liquidity trap phenomenon occurs. Now, the rate upon which CBs operate are the ones of current account deposits. Given a zero rate on current account deposits, savers may choose between bonds and paper money. Supposing that initially bonds' yields are positive, all rational investors are appealed by these securities that allow them to increase their capital. But with the demand for these assets increasing sharply, for the law of own price, their cost levitates implying their interests to fall. This process continues until investors are indifferent between holding bonds or money and given the perfect substitutability of bonds and money postulated by Keynes, when the rate reaches zero, bonds are replaced by money. Under these circumstances an increase in the money supply, no matter the magnitude, would be totally absorbed by the demand, because savers hoard the additional cash as paper currency instead of providing the economy with credit. As a result of this event, the ELB coincides exactly with the ZLB, according to the liquidity preference theory.

Different opinions about how to escape from the ZLB

There are different school of thought regarding the use of negative nominal interest rates (i.e., trespassing the ZLB). Among these, a first relevant opinion is given by Palley (2016). In his publication he gives a strictly Keynesian interpretation about the use of these rates, claiming that negative interest rates would not only not solve but also exacerbate stagnation concerns. In particular he based his studies on two pillars: Investment and savings. By cutting rates

(especially below zero), monetary authorities, expects current deposits to drop and investments to grow since it becomes cheaper to borrow money. In this way they are able to set in motion the recovery mechanism that would drive the economy out of stagnation. According to Palley's critique this shift towards investment would not occur because of non-produced goods. Suppose to consider a firm's balance sheet, in which on the asset side there are initial capital stock (K), that can be increased through investment (I) or held as liquidity (M), or as non-produced goods (G) (such as lands, buildings, copyrights, patents, etc.). A key concept upon which this theory is based, is that each asset follows its own pattern of marginal efficiency, and unlike marginal return on non-produced store of values, whose return is diminishing but always strictly positive, the Marginal Efficiency on Investment (MEI) may also become negative in his diminishing trend. More important money has a decreasing positive marginal return that has to be summed with interest rates, in the case in which interest rates are negative, though, the marginal return on money can become negative. On the liabilities side, the firm could be financed through Equity (E) and Loans (L). Given an equilibrium in the balance sheet and a natural level of interest already at the ZLB, a further cut on interest rates would imply a balance sheet's shift to maintain the equilibrium. On the liabilities' side the firm would shift from equity to debt finance which turned out to be cheaper (E↓, L↑) and, in the case of negative rates it would be a total shift to Loans. On the assets' side instead, there will be an asset shifting from Money holdings to Investment and non-produced goods. Keeping in mind that, despite the shift, the firm will continue to hold a portion of its money for liquidity return (increasing marginal return on money when liquidity drops) and will stop increasing investments as soon as the MEI becomes negative, continuing to convert cash into a long-term non-produced store of value (M↓ ,but > 0, I↑ < G↑).

The other pillar of Palley's critique is the impact of negative rates on household's savings. Lower rates are supposed to lower savings, but there are ambiguous effects between income and substitution effects. Clearly negative rates on savings induce households to consume now. On the other hand, lower rates reduce future income, that pushes households to increase savings to compensate for the income loss. Assumes for instance a household living for two periods, having an income (y) only for the first period, given a real interest rate r between the two periods. To satisfy optimal consumption condition the household would consume an equal amount in the two periods ($C_1 = C_2$) which is exactly

$C_1 = y(1+r) / (2+r)$ and he would save $S_1 = y/(2+r)$. By lowering the rate Consumption in the first period diminishes (C1↓) while savings increase (S_1↑).

Among those economists that instead believe on the effectiveness of Negative Nominal Interest Rates (NNIR), there is a further dichotomy between those who believes that NNIR must be accompanied with unconventional monetary policy and other that severely criticize the adoption policies outside the conventional scope. A key proponent of this latter movement is Kenneth Rogoff (2016). He strongly believes that NNIR policy has to be accompanied with adequate changes that allows the extensive use of those rates in periods of great recession, alleging that, by implementing only conventional monetary policy, CBs also preserve their independence from politics. He identified the banks' profit loss as the main problem that hinders the use of NNIR, and paper currency as the main responsible of this problem. In one of the latest interviews, Rogoff sustained indeed that expansionary interest rate policies work, although differently, even below the ZLB. As demonstrated by Campos (2020) Interest Rate Policies below ZLB (i.e., NIRP) are 60 % to 90% as effective as they are when operating above 0%. It is explained by the fact that, unlike policy rates, which may be dropped below zero, deposit rates applied by banks to their depositors cannot go below zero, otherwise the latter will move their deposits away.as a result of this banks will experience a squeeze in the interest rate profits. Another study, made on large deposits (i.e., firms' deposits), supporting this theory has been made by Altavilla et al. (2021) in which they sustain how the effectiveness of NIRP depends on wealthy banks' ability to pass negative rates on their depositors. More precisely they conclude that unlike in 'normal' times in which monetary policy is better transmitted thanks to weaker banks (due to a higher degree of freedom to which there are subdued), in periods of low or even negative interest rates the success of an expansionary policy depends on sound banks.

Indeed, the latter are better equipped to transfer negative interest on deposits without incurring big withdrawals, ensuring an optimum monetary transmission channel that makes NIRP successful. During periods of negative rates, a mechanism, designed by the authorities, that helps banks to preserve their profitability and intermediation capacity would be particularly desirable. To that end, several CBs began to implement various tiering schemes that allow a portion of banks' excess reserves (inside the CB) to be exempt from negative rates. They also increase, in this way, the number of healthy banks, which amplifies the

pass-through effect of negative interest rates policy to real economy. Sharing these theories, Rogoff added that, to be fully effective, NIRP requires legal, regulatory and tax changes. In his book *'the curse of cash'* (2016) he explains how the ideal monetary system is the one where there are no restrictions imposed by the ZLB, and CBs are free to apply negative rates without a specific limit, so that they are better able to drive the economy out of the deflationary spiral

and recession. Banknotes with high nominal value can be seen as 'zero-interest-rate bonds' and, with this in mind, a significant cash limit should be imposed, in order to discourage the use of high-value cash paper as store of value. Moreover, Rogoff discovered, in his analysis for the United States, that government losses in terms of seigniorage, resulting from the withdrawal of high-value banknotes, are estimated to be around 0.3 percent of GDP and are fully recovered by a 2.7 percent expected increase in GDP, which is due to a higher volume of taxable transactions that would occur with electronic money. Many economists proposed also a tax regulation mechanism to be pinned to paper currency (e.g., Mankiw (2009), proposed CBs to hold lotteries based on serial numbers on paper money, making the 'winners' a worthless piece of paper). Thanks to the availability of electronic money, never before in history has it been so easy to phase the cash out of the economy, or to implement a mechanism that allows the government to tax currency as well. The most important difference between electronic and paper currency is that the former is traceable and therefore also subjected to taxation and monetary policy measures. Taking this into account, Rogoff proposed a model of economy composed by two currencies, one electronic currency which is convertible in a second paper currency according to a fixed exchange that constantly decay in favor of the electronic currency. That is, if today it is possible to exchange one dollar of electronic money with a dollar of paper and the exchange rate is 3 percent, in one year time the paper dollar worth 0.97 of the electronic currency. This method allows CBs to implement NIRP, applying them eventually directly on electronic money, without completely eliminating the use of cash. Together with this, a second pillar of Rogoff's analysis implies a restriction on cash deposits, preventing cash hoarding also in current accounts. With these two alternatives taken off the table, a conventional monetary policy that exploits the potential of NNIR allows CBs to keep their independence from policy authorities, something that, according to Rogoff is instead hindered by unconventional policies such as Quantitative Easing (QE).

There is finally a third class of economists, who, as the latter, believe that NNIR is a useful conventional method, that together with a forward guidance and other unconventional measures, will drive the economy out of recession. These economists are the ones that in 2014 started the NIRP at the ECB. I will discuss more in detail in the next chapter the reason why the ECB adopted this behavior, but the logic behind its decision has been explained by Isabel Schnabel (2020). In her speech she explained how the European Targeted Long-Term Refinancing Operation (TLTRO) played a crucial role in the success of NIRP. Following the first feedback, and also as a result of empirical investigations on the impacts of European negative interest rate policy, the authorities identify the major problem in the profitability of

the private banking sector. The latter indeed, were reluctant to pass negative rates on their retail deposit account, shrinking in this way the interest rate margin that represent their main source of profit. With this awareness the ECB designed a mechanism which helps banks to mitigate the effects of NIRP on their profits. This mechanism is based upon two main policy measures: the first is the adoption of a two-tier system that exempt banks from negative rates for a portion of their excess reserves (as proposed by Altavilla et al.), and second the TLTRO, which allows banks to have access to credit with high favorable rates (i.e., investing on
long-term secure bonds), provided that they pass enough credit to the real economy.
Regardless of their different positions, in all three cases, the economists agree on the fact that, in the long-run, NIRP can be detrimental for the economy. This because they imply the inversion of the yield curve as a collateral effect. Negative rates on deposits indeed, push investors to consider short-term bonds (more liquid ones) instead. As the demand of the latter increase, their price will rise as well and in particular the price of bonds will rise until it is indifferent to choose between bonds and money (i.e., cross-price elasticity between substitutes goods). With skyrocketing prices of short-term bonds (paying therefore low or negative interest), long-term debt contracts started to become more attractive and portfolio adjustment toward long-term bonds occur. As previously mentioned, an inversion of the yield curve may be a prophecy of an imminent economic downturn, if the predicted outcomes are delayed, continuing on this road might be highly risky, with the possibility of further worsening the current situation.

This focus helps to emphasize the controversy of negative nominal interest rates. their existence as such should have no sense of being, since, for a rational investor, as soon as an asset (perfectly substitutable with cash) starts yielding a negative return, it is replaced by cash.

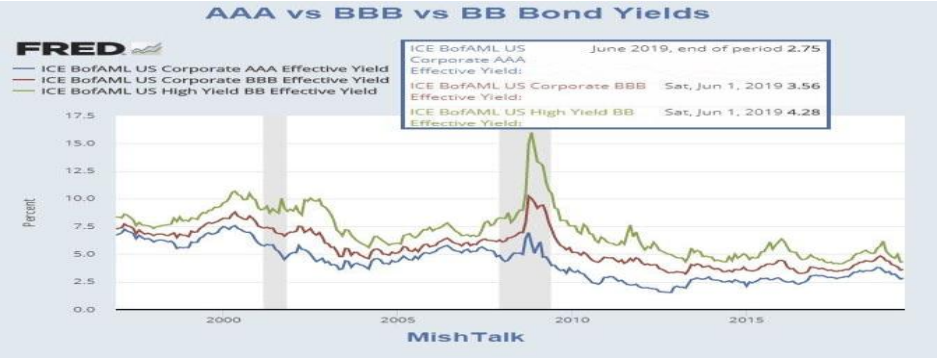
1.4 Negative returns on bonds

The debt market (market of bonds) has a worldwide volume equal to 105.9 trillion dollars according SIFMA. It is a massive amount of money, which derive from the trading of several types of bonds. For the purpose of the chapter it is necessary to classify only certain categories of bonds. Bonds are often classified according to the type of issuer: Treasury bonds are issued by the Treasury, municipal bonds are issued by state and local governments, and corporate bonds are issued by corporations.

1.4.1 Corporate bonds

Corporate bonds are long-term debt securities issued by corporations that promise the owner coupon payments (interest) on a semiannual basis. The minimum denomination is $1,000, and their maturity is typically between 10 and 30 years. The interest paid by the corporation to investors is tax deductible to the corporation, which reduces the cost of financing with bonds. This is a major reason why many corporations rely heavily on bonds to finance their operations. They can be issued through two different processes: *private placing* and *public offering.* The former way allows the issuing authority to incur in less transaction costs, since small amount of bonds are offered to private wealthy households or small groups of financial institutions. The debt issued through private placing is held by the owner until maturity and therefore cannot be traded in the secondary market. On the other hand, public offering implies higher transaction costs for the firm, but at the same time allows them to rise higher amounts of capital. Moreover, bonds traded in this manner can be sold in the secondary market. Owning corporate bonds means bearing credit (default) risk. The interests paid on bonds are reflecting this eventuality: higher are the interest offered on a bond, higher is the risk that the firm will default on its debt. When the economy is weak, indeed, there is the possibility that earnings generated by the issuing firm are not enough to finance the interest payments on its bonds. The more this possibility is perceived by investors, the more they are requiring, in terms of interest payments, in order to bear this risk. Actually, each corporation has a different default risk, indeed they hire rating agencies that are addicted to establish the credit risk on the base of specific parameters. The higher the rate assigned by agencies, the higher the prices of bons (i.e., the lower the interest that firms have to pay).

Figure 5 (Corporate bonds' yields)



https://www.investing.com/analysis/junk-bond-bubble-in-pictures-deflation-up-next-200441115

Negative-yielding corporate bonds

Due to credit risk, corporate bonds are less subjected to negative interest rates, with respect to government bonds. The latter, indeed, are considered "risk free" securities, since the probability of default of a sovereign country is considerably smaller than the one of a corporation, generally. There is indeed a spread between corporate and government bonds called credit spread. This spread consists in a premium offered to the investors for bearing higher credit risk. It is possible, then, to find negative yielding corporate bonds in those countries that are issuing sovereign debt at negative rates. According to Bloomberg Barclays Euro Corporate Bond index almost half (46%) of bonds are carrying a negative yield.
As reported by Il Sole 24 Ore (2019) France trades the highest amount of negative corporate bonds.

Figure 6 (Negative Corporate Bonds)

https://www.ilsole24ore.com/art/bond-negativi-ecco-l-identikit-francese-emesso-una-banca-scadenza-2-anni-ACg1Tmp

Moreover, the first company that issued negative rates bonds in the primary market has been the French Sanofi in 2016. In august 2019 a well-known company Nestlè has been able to obtain a negative yield on three-year bond. The main clue that can be deduced from this heading is that investors are ready to tolerate a negative rate on riskier investments as long as their funds are secure. Moreover, as it possible to notice from Figure 5, there are some countries in which there are corporations issuing negative yielding securities, even though their sovereign debt is traded at positive rates (see Italy for instance).
This is a sign that investors perceive private companies as safer than their own country.

1.4.2 Government bonds

Usually occurs those fiscal policies enhanced by government requires more funds than the government itself receives from taxes. So, as companies do, also countries have the need to borrow some funds. The price of a treasury bond is always a multiple of 100, and this is true for all developed countries. The minimum price instead may vary across nations. The issuing process varies across jurisdictions, but in every country, there is a public auction, that ends when the funding demand from the state is fulfilled. All the securities, then, can be traded in the secondary market until they reach the maturity date.

US government bonds

Even though US government bonds do not pay negative interest, I will use them as a comparison, since they have a structure that is extremely similar to that of other industrialized countries, with just a few minor variations.

A first important distinction arises with maturity date:

Treasury Bills (T-bills): they have the shortest terms of all. They're issued with maturity dates set at 4, 8, 13, 26, and 52 weeks. T-bills are auctioned off to investors at a discount to par or face value. The investor's return is the difference between the par value and the discount price paid at purchase.

Treasury Notes (T-notes): their maturity ranges from 2 to 10 years, and they show a different cash-flow structure. Indeed, unlike bills, T-notes generate interest payments every 6 months, called coupon payments.

Treasury Bonds(T-bonds): They are often referred to as long bonds, because they take the longest to mature of government-issued security. They are offered to investors up to 30 years to maturity.

Purchasers of T-bonds, like T-notes, receive a fixed interest payments every six months. They pay the highest interest rates of the three types of government securities because they require the longest term of the investment. For the same reason, the prices at which they are issued fluctuate more than the other forms of government investment.

This classification shows that the cashflow structure of a bond change together with maturity. Indeed, for all those securities with a maturity date longer than one year, a six-months coupon

payment is provided. The gains deriving from a T-bill, instead, are represented only by the difference between the purchasing price and the face value reimbursed at the maturity.

TIPS

Another important kind of government securities are Inflation-Indexed bonds. These bonds provides a semi-annual interest payment tied to an inflation adjusted principal. For this reason they are named TIPS (Treasury Inflation-Protected Securities). The principal is estimated every six months all over the life of the bond, according to the registered level of inflation. The interest rates linked to TIPS are usually lower than the ones of other securities.

Example:

Suppose to be the owner of a 10-year TIPS with a face value of $1000 and an interest rate of 2%. If, after the first six months the inflation rate is 3%, the new principal, according to which the coupon payment has to be made, is equal to $1030 (0.03 x 1000). So, the coupon payment is equivalent to 1% (half of the yearly interest rate) of $1030: $10,30.

TIPS are particularly requested by those investors that want to hold a sovereign debt of a country with high levels of inflation, such as Venezuela, Brazil, Turkey etc.

However, for those developed counties that are experiencing a contractionary economic growth (low inflation), these securities are not frequently used since, in addition, they are offering negative interest payments.

In particular, in EU the main objective of the monetary policy is to keep an inflation level that lies stably under 2%. As a consequence of this, inflation expectations are anchored to this threshold.

Negative yielding government bonds

compared to corporate bonds, government ones are considered "Risk-free" securities, assuming their probability to default to be nearly null. It actually has happened, over time, that some countries defaulted on their debts: Mexico 1994, Russia 1998, Argentina 2001 are among the most recent and important in terms of magnitude. A defaulted country, that is decided to re-enter in the market, has to offer very high interest rates in order for the investors to be attracted again by those "risky" sovereign bonds. Interest rates, in particular not only rises after a crisis occurs, but also before. Indeed, if a certain event is supposed to happen the interest rates of that country sharply increase as a result of massive sales of that securities. We can think of interest rates, then, as a measure of riskiness of a nation: lower the rates, safer the nation.

It is according to this logic that strongly risk-averse investors, which main objective is to preserve capital, begun to consider bond with negative yield.

There are only few countries that are considered enough safe to render the investors willing to accept a negative interest rate for their savings.

the historical countries with negative yields on their debt are Denmark, Germany, France, Switzerland, Sweden and Japan outside the EU. Even though recently BOJ are offering slightly positive rates, the coronavirus pandemic has brought other European nations to offer negative rates on their bonds: according to Tradeweb, indeed, Portugal has broken the wall of zero interest rates last December. On the report of Anna Hirtenstein (2020) for the 'Wall Street journal', it is sustained that when Portugal went negative, it represented a symbol of cohesion from EU. Indeed, this event not only means that there is a high demand for sovereign bonds in Europe (strongly enhanced by ECB Purchasing Program), but also that one of the most hindered countries in the 2008's financial crisis has been able to converge towards the healthier European nations.

Chapter 2
Negative yielding bonds

In the last section of the previous chapter, it is illustrated how various types of bonds are dealing at negative rates, this chapter instead tries to address two questions.
First, how bonds with nominal negative yield, mentioned above, has been originated from NIRPs and why are traded in the market. Second, why, despite what the liquidity preference theory sustains, is there such a high demand for those particular assets?

2.1 why are there negative yielding bonds?

2.1.1 the origin of negative yielding bonds

It is of fundamental importance to distinguish between Negative interest rates applied by CBs and negative yields on bonds. It is undeniable, though, that these things are highly interconnected, it is possible to affirm indeed, that negative yielding on bonds is the consequence of NIRP. When a CB decides to implement a NIRP, depositors that stored their wealth in the CB are actually paying it for holding their money. This measure is aimed at deterring depositors from save in order to stimulate investments. What happens after this decision is that depositors shift their wealth from deposits accounts to short-term bonds market. This phenomenon is due to the cross-price elasticity law between bonds and deposits accounts that, as already mentioned, are perceived as close substitutes. This law provides that if the price of a good rises, the quantity demanded of the substitute good rises proportionally since market participants would easily replacing the two goods. In particular, since deposits accounts and bonds are substitutes, as soon as the price of deposits accounts rises (i.e., interests paid by deposits decrease and become negative), market participants would switch to bond "consumption", leading the demand for this good to rise. For the law of own price as the demand of good rises so do its price, but as price of bonds increases their yielding falls. And since investors continue to prefer bonds as long as their yielding is higher with respect to the interest rate paid by deposits, their demand will increase up to the point in which they would be indifferent between the two goods, that is when bonds' yields are negative. Another important contribute to negative yielding has been given by the dramatic conditions that world's economy was living at the time of NIRP. When ECB first implemented NIRP the

world's economy was living a period of strong uncertainty caused by the financial crisis of the previous years. This lack of trust in future growth prompted savers to shift their investments from equities to bonds, which are perceived as a much safer asset. This phenomenon boosted the demand for bonds further, contributing to a higher increase in their price and, as a result, a reduction in their yields. So, the combination of these two factors made the negative yielding bond market a huge reality after the financial crisis, which in 2019 reached a volume of 18 trillion dollars.

Central Banks policies' that caused the negative yield on bonds

The appearance of these securities in the market has to be attributed to the monetary policy enhanced by Central Banks in the period following the financial crisis of 2008. Their aim was to break the spiral of uncertainty that the crises had generated, through the implementation of both conventional, and unconventional, monetary policy tools. Interest rates is established by Central Banks that, in order to stimulate recovery has to lower them to render convenient for an investor to invest "today" rather than "tomorrow". The issue was that rates were already close to zero following the crisis, so any further drop would have pushed them into negative territory. Never before interest rates have been pushed below the zero threshold, consistently with the zero lower-bound theory. As explained in the previous section, this theory deals about the effectiveness of interest rates policy as they approach zero, and the risk of a liquidity trap. For the Neo-Keynesian Paul Krugman (1998) a study of the '90s Japan's financial crisis, the interest rates cannot become negative. According to him, the limit situation where money supply increases in such a way that its intersection with IS curve would give negative nominal interest rates cannot happen. That's because otherwise cash would dominate bonds as a store of value, since no rational investor would purchase negative yielding bonds rather than holding a zero yielding asset such as cash. In this situation consumers would carry more cash in their poket than the one required for transaction purposes, and the MM curve is no longer significant and would render meaningless any expansionary initiative from money issuing authority. The purpose of this thesis is to understand why facts demonstrated that Krugman's theory didn't apply in practice. But first, let analyze in detail why some national banks started to implement this unconventional monetary policy expansion. What happen when an expansionary policy is implemented is the following: interest rates fall, their decrease led interbank rate to fall as well, the nominal exchange rate to depreciate and bond yield for short-term papers to decrease for substitution effect. As a result of this investors are drawn away from money market.

Denmark

The first country that cut the repo rate (rate used by Central Banks to inject and withdraw money from the economy) was Denmark in 2012, whose main objective according to Turk (2016) was the one to penalize capital inflows and deter speculators. In 2012, fears of an intensification of distress in the euro area drove sizable capital inflows into Denmark, requiring large foreign exchange purchases by the national bank to maintain the peg. To moderate these inflows and contain the volume of purchases, Denmark cut the policy rate and set the negative interest rate on certificates of deposit. This policy has been reinforced in 2015 when ECB announced the massive APP (Asset-purchasing program). Large capital inflows in Denmark, which, in turn, implemented a huge foreign exchange rate purchases in order to preserve the Peg. The main reason why Denmark had adopted this policy is then to depreciate the nominal exchange rate of Peg *vis-à-vis* euro in order to be more attractive for investors.

ECB

Four years later the subprime crises of 2008 the situation was even possibly worse. There were five peripherical countries whose economic conditions were particularly dramatic due to the aftermath of the 2008's crisis. According to analysts, these nations, known as the PIIGS (Portugal, Ireland, Italy, Greece, and Spain), had a good likelihood of defaulting on their own debts. If all of the PIIGS default on their debt, the European Union will break up together with the monetary union. It was in this context that at the time president of the ECB made his famous speech in London of 2012. With the entire financial sector ready to heavily attack PIIGS and the Euro currency, Draghi said: "within our mandate, the ECB will do whatever it takes to preserve the Euro. And believe me, it will be enough." With these words the president of the ECB implicitly told to investors that the CB would provide enough resources to stabilize the crisis. Indeed, the value of stocks and sovereign bonds recovered following the speech, and the financial situation somewhat stabilized. These ECB messages contributed to a stronger sense of unity among EU nations and laid the groundwork for the development of an unified monetary policy two years later. In 2014 in fact, the ECB decreased the marginal deposit facility rate for excess reserves below zero, so that a bank that wishes to deposit money with the ECB overnight must pay the central bank. They ended up this way because all conventional monetary policies have already been pushed to the limit and were yet to lead the expected result. So, as reported in the speech of Draghi (2014), the ECB responded in an unconventional way, but in a manner that is far from unorthodox. Indeed, together with the lowering of deposit

facility rate to the efficient lower bound (below 0%), they ease monetary conditions, to influence more directly the term structure of interest rates, by introducing forward guidance. This guidance is the result of Targeted Long-Term Refinancing Operation (TLTRO) that allowed to achieve policy rates to stay low for a long period. These two actions both working in the same direction: lower the rates and keep the inflation expectations anchored. In order to avoid any threat to this, a third step became necessary: broad-based weakening of aggregate demand.

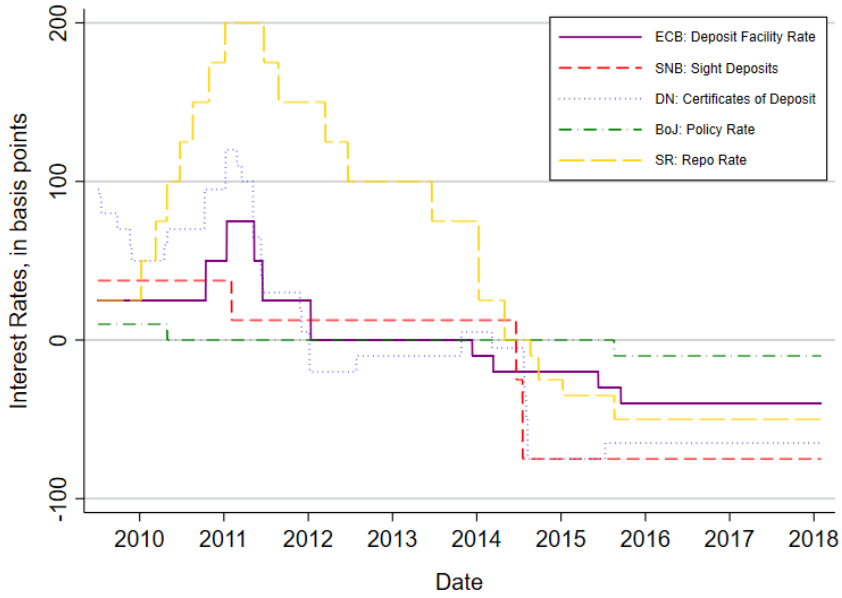
And this is the point the ECB has reached with the Governing Council's decision to initiate purchases of asset-backed securities (ABS) and covered bonds.

Following the ECB's trend also Switzerland, in 2015 implemented such a policy, but, as Denmark, their main objective was to preserve their currency from appreciation.

Japan

The Bank of Japan (BOJ) in April 2013 implemented the QQE (Quantity and Qualitative Easing) policy with the aim of pursuing its objective of a financial stability (i.e., bring back inflation expectations at 2%). Through large-scale purchases of Japanese government bonds (JGB), the impacts on the main transmission channel are expected to put downward pressure on real interest rates by decreasing nominal ones throughout the whole yield curve. the effect on bonds has been achieved, with negative rates on bonds maturing in 17 years. Due to the lower oil prices at international level, though, BOJ has been forced to take further actions to achieve its target. Being Japan the third consumer of crude oil in the world, macroeconomic variables are strictly linked to the oil's fluctuations. When the price of oil decreased it became cheaper for producer to have raw materials and therefore to produce (i.e., AS curve shifts right) and also the consumption of oil derivatives has increased (i.e., AD shifts to the right too). After this movement in the AD-AS curves due to oil price decline the equilibrium level of inflation has fallen, sterilizing the QQE proposed in 2013. For this reason, in 2016 a new maneuver, announced by the president of the BOJ Haruhiko Kuroda (2016), has been implemented. The new "QQE with a Negative Interest Rate" adds to the previous monetary framework of 80 trillion Yen annual purchasing of JGB, negative interest rates charged on deposits in order to favor lending. Notice how, in the space of two years, two of the world's three most important central banks, facing similar economic scenarios (i.e., financial depression, economic stagnation, and operating in an almost deflationary environment), adopted the same unconventional measures introduced for the first time in history to stimulate their respective economies.

Figure 7 (CBs' Facility rates in the world)



https://www.frbsf.org/economic-research/files/wp2019-21.pdf-Figure 1: Negative rates experience

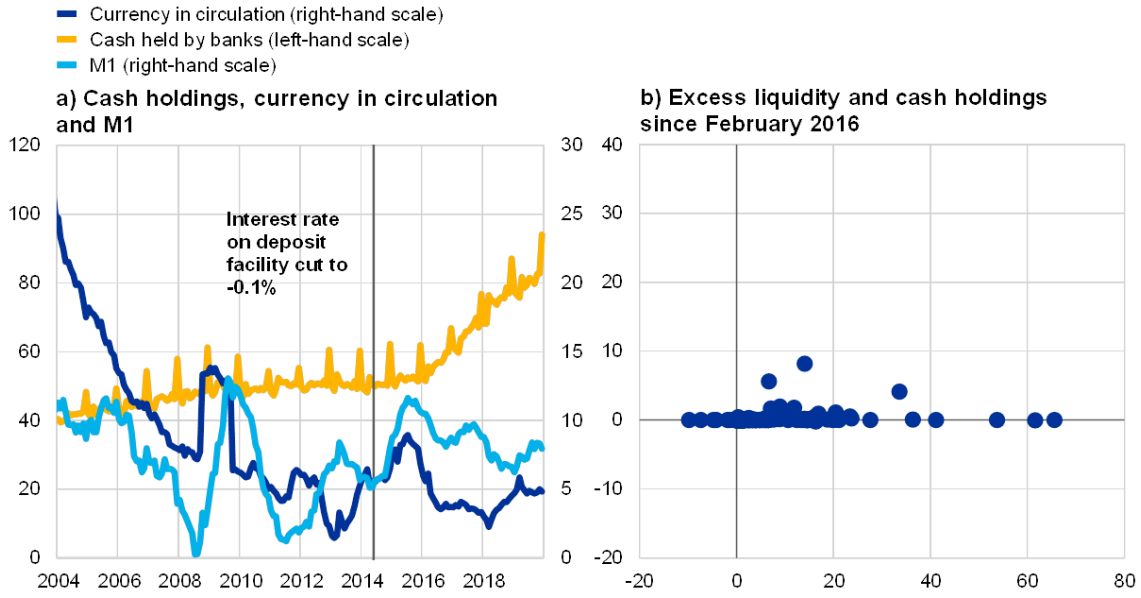
Then, independently from their motivations, whether to protect currencies or deter money hoarding, many central banks are currently imposing a negative interest on cash deposits. In this way cost of money is no longer zero but has become a positive amount. Since money as a store of value has some rivals, they might be subjected to substitution effect. Now, according to Krugman as soon as nominal interest rates touch the negative territory a smart investor should switch to money holding, and he is clearly right, but he is starting from the assumption that money held in deposits, is a "zero interest" asset. After monetary policies discussed so far, this assumption doesn't hold anymore. So conversely from what expected by Krugman instead of leaving bonds for money they do the opposite, and since interest rate on bonds falls as bond's price rise, the extremely high demand for government's bond leads their yield to be negative. The investor's choice depends on which rate, between the two, is "less negative" and therefore more convenient. It is indeed clear that, even if both choices represent a negative return, the investor would be relatively better off by investing on bonds if their yield is -0,1% and the one on deposit is -0.3% instead.

But still, why don't simply hold cash in the matrass instead of holding them in a negative yielding current account?

2.1.2 Limits of cash as Store of Value

With negative rates charged on their account deposits, savers may think to hoard cash rather than rebalance their portfolios towards longer term or riskier assets. Despite this, various surveys performed by the ECB revealed no substantial signs of "leakages." In favor of paper currency. This idea lies on the fact that deposits and cash are perfect substitutes, making in this way the ZLB as the effective one. The reality is that they are not, deposits indeed have numerous characteristics that make them a more efficient storage of value and more convenient for performing payments. These features have an intrinsic monetary value that render savers more willing to accept a less convenient rate on their money. As witness of that, the following graph shows how, even after 2014 cash demand did not increase significantly.

Figure 8



https://www.ecb.europa.eu/pub/economic-bulletin/articles/2020/html/ecb.ebart202003_02~4768be84e7.en.html

The panel a) shows that starting from 2014, although not significantly, Banks started to buy banknotes instead of deposit at negative rates at the CBs. About inflation instead, bonds tend to be preferred to cash money because they are better able to keep pace with inflation rate. Although both are denominated in nominal terms, in the long run, while a banknote of 1$ will still have a nominal value of 1$, bonds' prices have the time to adjust according to inflation's fluctuations.

2.2 Demand for negative-yielding bonds

The impressive demand of negative rate bonds derives from different classes of lender. Yet an important distinction has to be made, on the basis of the volume of wealth each class

possess and is able to move. There is indeed a high-value, low-volume class that invest in the negative bond market for certain reasons, and a second high-volume, low-value group of savers which are engaged in this market for other motivations. In this sense the following headings describe each component of negative yielding bonds' demand.

2.2.1 monetary financial institutions

This category comprehends commercial and central banks whose business is the one to collect deposits from savers, grant access to credit (make loans) and make investments in securities.

Central banks

CBs carry out several functions and among them they are the bank of their respective states, and, as such, they help the government to manage its debt. Generally, each central bank has a set of conventional tools that applies in case of need and in order to achieve its goals, but the aftermaths of financial crisis required the use of unconventional tools. Let consider in particular the ECB behavior. In order to fulfill their final objective of price stability, they decide, from January 2015, to implement an expansionary policy that implies the use of unconventional tools such as Quantitative Easing (QE). This asset purchases provide monetary stimulus to the economy in a context where key ECB interest rates are at their lower bound. They further ease monetary and financial conditions, making access to finance cheaper for firms and households. This helped to support investment and consumption, and ultimately contributes to a return of inflation rates towards 2% (ECB's final target inflation-level).

The programme comprehended the asset-backed securities purchase programme (ABSPP) and the covered bond purchase programme (CBPP3). Combined monthly purchases amount to €60 billion.

So, The ECB has bought bonds issued by euro area central governments, agencies and European institutions in the secondary market against central bank money. The magnitude of this operation has been huge and provoked the Europeans' government bond yields to fall sharply. In particular, since the distribution criteria applied to this quantitative easing were linked to each nation's GDP, some countries had benefit more from it. So that governments

like Germany, whose rate were already low, has been allowed to offer a negative return on their bonds.

Commercial banks

Another function of central banks is the one of bank of the banks, so that the latters may deposit or ask for money from the formers. By playing this role, central bank also establishes indirectly the rates at which commercial banks lend and borrow between them, by providing a ceil (rate at which commercial banks borrows from CBs) and a floor (rate at which commercials deposit to CB). Rate cuts performed by Central banks inevitably had consequences on commercial banks. Acting on bank lending channel CBs were confident that increasing bank reserves also automatically increases the quantity of bank loans available and that these loans transfer to investments and spending. This policy will be more effective when there are no substitutive fund sources for bank lending, so the effect should be less potent in economies with market-based financial systems and larger share of big businesses that gain funding from stock and bond markets instead of banks. In markets like the European one, this channel can be described as the narrow credit channel, which highlights banks' role as the generator of loans even though other external sources of funding are available. In second stance, interest rate adjustments affect the profitability of businesses. Indeed, by lowering or increasing the total interest costs, firms may benefit or not in terms of Present Value of their investments: a heavy cut on rates make firms' investments cheaper and then firms themselves better off. As a consequence of this, the agency costs related to the information asymmetry decreased, causing in turn, banks to increase the quantity of loans. CBs' expectations after acting on these two channels, were to rise the amount of loans made by commercial banks. The empirical results collected by surveys on European commercial banks after NIRP's policies had been controversial. After the introduction of negative interest rates by ECB on deposit facility, commercial banks started to move in the same direction, but all of them were reluctant to apply negative rates on saving deposits, for the main reason of fear to experience massive withdrawals from their customers. This choice, however, shrank the profit margin earned by banks on loans (i.e., by deciding not to drop rates below zero, implied higher interests paid on deposits, which meant the reduction of the differential with interests earned on loans (which had dropped as well), that represents banks' main source of profit). Jobst (2016) raised the concern of bank profitability in a negative rate environment, and he concluded that although overall effects were somewhat positive, there were heterogeneity among banks. Especially in the smaller ones the amount potential credit expansion required to offset the declining lending

spread has been constrained by capital buffers. In general, moreover, he presents that by expanding the time horizon the increased aggregate demand for loans would not be enough to compensate profit's losses from each single loan. The studies carried out by Turk (2016) on Sweden and Denmark's central banks, confirmed partially the results of Jobst. He found that the banking sector registered negligible losses also thanks to cost-cutting policies and increased fees. They also agreed that negative rates may represent a problem in the long run. In addition, a study from Rostango et al (2016) found that this downward pressure exercised by NIR made banks more likely to turn excess reserve into lending and bond purchases. So that on one side loans had increased but the same happened to bank's holdings of government debt. In this scenario, a transition to negative yields on public bonds means an additional loss for commercial banks.

2.2.2 Non-monetary financial institutions

Institutional investors such as insurance companies and mutual or pension funds often hold portfolios composed mainly by government bonds in pursuit of stable, risk-adjusted returns to meet long-term obligations. Under persistently low or even negative yielding bonds, these investors, according to Arteta et al (2016) may struggle to generate the adequate returns and, in addition, equity returns, and solvency of these institutions may be increasingly dependent on the interest rate policy. A determinant in this sense may be tax regulation applied to these kinds of institutions, that may allow them to be less sensitive to interest rate shifts. More important, a way out is proposed by Nieder (2016) that after a study on the Japanese life insurance companies, indicates a more efficient allocation of their resources on a differently composed portfolio. In particular he finds out that Japanese such companies shifted significantly their investments into USD bonds in order to avoid losses deriving from investments on domestic debt and started to look for investment possibilities abroad. As reported by the same research, Germany as well experienced a shift in the investment strategy of their life insurance companies, which have been usually conservative (87.3% of their wealth in national bonds). They passed to more riskier investments to rise their return and, in particular, to longer term investments to take advantage from liquidity premium, such as infrastructure projects.

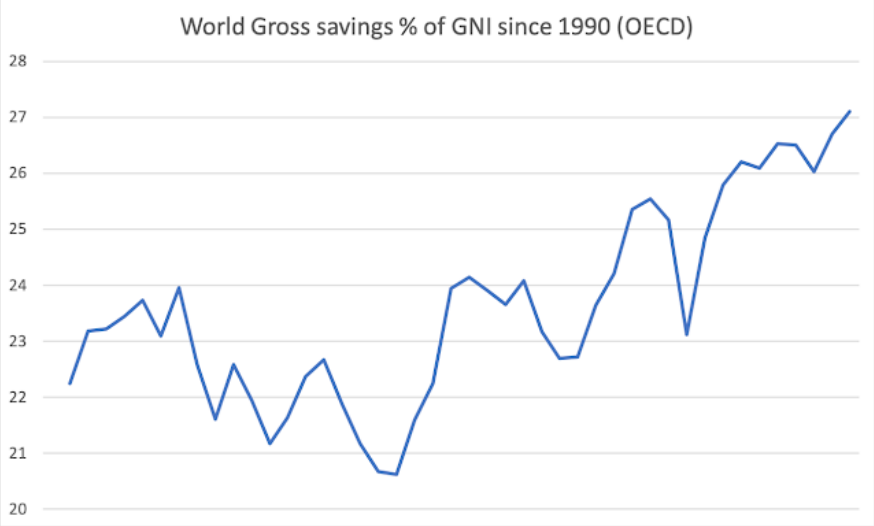
2.2.3 households

Although this category may seem to affect less the prices of bonds due to lower value of their transactions (with respect to financial institutions), a sudden huge increase in savings accounts allowed retail investors to play a crucial role in affecting bond prices. Moreover, understanding households' behavior in a negative rate environment could theoretically more relevant with respect to MFI which may be victim of government-imposed pressures.

Increase of Savings accounts

The OECD data on saving rates (percentage of a region savings relative to its GDP), showed in the Figure 7, tells how they continue to move higher since 1990s (the red dot), until they reached 27% of GNI.

Figure 9



https://1.bp.blogspot.com /savings.pn

Different studies help to understand the dynamics behind this increase in the saving rate. A first key factor, as Carvalho et al. (2016) explains, is given by the demographic developments that major economies are currently undergoing. The result of their work shows how each individual saves more at all stages of their life cycles, in order to finance consumption over a longer time horizon. This is due to an increased in life expectancy of each individual, and according to Carvalho, the demographic development is the is the main channel that affects real interest rates and a natural explanation of their steadily declining trend. They conclude that this transition in the demographic sector contributed to a reduction of real interest rates from a

third up to a half of their decline since 1990s. This phenomenon has been accompanied by advanced economies' pessimism about future expectation growth over the next decade as found by Gordon (2016). He analyzed how after productivity growth that characterized the period from 1990 to 2004 the US economy experienced first a slowdown, then, starting from 2010, also a diminishing return. The great difference between US productivity after the peak reached in the '90s (due to computer production) and the one after 2010, allowed Gordon to confirm his thesis of low correlation of productivity between consecutives decades on the same regions. For what concern firms, instead, in the last 30 years, global Labor share has diminished in favor corporate savings as found by Karabarbounis et al. (2012). In this study they found that progressively the labor share, which is an important macroeconomic variable, has been replaced in corporations' preferences by capital savings. The latter represent represents generally the largest component of the national savings, so that an important ferment of this component drove savings rates up in the years. The existence of these three variables at the same time has unavoidably caused global savings accounts to rise. With an increasing amount of money that has to be preserved the demand for safe assets increased as well. In periods of uncertainty, explain Jeanne et al. (2012), private savings dry up and the main source of safe assets is supplied by public authorities. In their conclusions they sustain that supplying the market with the sufficient level of safe assets is crucial to avoid financial instability, caused by the research of alternative, less safe, store of value. From these works, it is easy to observe how, as a result of numerous forces working together, global savings have risen in recent decades, as has the need for secure assets to keep the acquired wealth.

Speculation on negative yielding assets

Although buying a negative nominal yielding asset may appear not to be a great choice in absolute terms, purchasing a negative yielding bond may result in an overall positive inflow. Actually, there are many ways in which speculators and risk lover investors may gain some profits trading on the negative market.

Coupon payments

Although a bond with a price higher than its face value represent a loss for what concern the principal amount it can be still a good deal for the investors if the coupon payments, he receives during the life of the asset overtake this price gap.

1st case: 1-year Nestlé bond 2016.

This bond at the end of 2016 reached a slightly negative yield as result of QE policy in Europe. It was trading at -0.004% of its face value (i.e. buy at 100,004€ and receive 100€ at maturity) but it was also offering a 0,75% of coupon payment. In this case even if a loss in the principal occurs, that loss is compensated by the cash inflows generated by coupons (-0,004€ + 0,75€ = +0,746€ profit for each bond).For a similar investment, the loss perceived on the principal can be seen as a premium fee to pay in order to have a future profit given by the allocation of his/her wealth.

2nd case: 2-years German bond.

For these securities the price varies according to the coupon payment required by the buyer, so that it is possible to distinguish two types of investments on the same security:
Requiring a coupon payment of 9% a year implies a price of 119,63€ against 100€ of face value. If a similar choice is made the coupon payments are no longer sufficiently high to compensate the loss in capital: -19,63€ + 18€ (9% of 100€ received for two years) = -1,63€.

Even if the investor decides to give up coupons in order to lower the price, the situation doesn't change that much. These bonds are currently offered at a price of 101.44€, given a coupon payment of 0.00%. The cash-flow of such investment is negative, and it is represented only by the difference between the face value received at maturity and the price paid at inception (100 – 101,44 = -1,44€), since it is like no coupon payments are made during the life of the asset.
Note that investing in a treasury note that not provides coupon payments is very similar to investing in government discount paper (T-bills).

3rdcase: 12-months German bill (Bubill).

These discount papers are offered at a price of 100.657€ and promise a payment of 100€ at maturity.
As before, the loss is given by the spread between the price and the face value of these securities: 100€ – 100,657€ = -0,657€

In the last two cases it is no profitable for the investor to purchase certain bonds and hold them until maturity, but there are still some reasons that pull investors in the market of negative yielding bonds.
Another interesting feature arises by looking at discounting paper of case 3 and the 2-year German bond with 0% coupon of case 2. Generally, everything else being equal, longer the

maturity of an asset higher the return that this generates. That is given by the fact that investors prefer assets that can be easily converted into liquidity, and short-term bonds are more liquid. The spread between two assets of different maturity is called liquidity premium and corresponds to the amount of money necessary to render the investor willing to buy the long-term asset instead of the shorter one. This is also the reason why the yield curve, in normal periods, has an increasing trend. So, investing in a longer-term bond should yields higher, in this case "less negative", returns. What we actually observing here is instead the opposite: investing in a 12-months German paper yields -0,657€, while investing in a 2-year one would lead to a bigger loss (-1,44€). This phenomenon is called inverted yield curve, where investing in short-term asset implies higher returns than long-term ones. Harvey Campbell (1986) sustains that yields curve are useful forecasting tool to understand the trend of an economy. In this paper he alleged that all the economic recession in US (1960,1980) has always been preceded by inverted yield curves. That's because this curve is the consequence, as explained by Campbell, of massive purchasing of 10-year government bonds, widely recognized as the safest possible asset to buy in periods of uncertainty (flight to safety. As a result of this 10-years bonds' returns decreased and in particular they decreased up to a point where shorter-term bonds guarantees a higher return. What this study observed is exactly what is happening now for German bonds.

Decreasing rates

Since negative rates were expected to be only a passing phenomenon at the beginning, an investor, when facing those yields, used to hold cash and waiting for their up turn into positive territory. However, given the trend of German bonds (with maturity up to 5-years) in the last decade (steadily below the threshold of zero interest rate) some investors start to believe that speculative opportunities may arise, since instead of growing, rates could also decrease starting from a negative base. For this reason, they started bulling the German debt, expecting the price of newly issued bonds to grow even further in the future. In this way, they were able to realize a profit from selling their bonds in the secondary market for a higher-than-purchasing price. They are indeed offering, to other investors, the possibility to buy a security with the same degree of safety of new bonds, but with a shorter (residual) maturity and a higher return.

Currency moves may offset the loss on the rate

By considering the international market of bonds, it is possible that some investors outside Eurozone may find attractive investing in German bonds due to favorable movements in the

exchange rate. For example, if an American investor decided to buy a 10-years home bond the second quarter of last year would have earn 0,7% of interest payment this year, while investing in the corresponding German bond would yield an interest of -0,5%. Apparently, it would be a mess to choose the German debt, but euro/dollar exchange rate registered an appreciation of euro *vis-à-vis* dollar in the last year, so that a euro used to buy 1.10 dollars at the end of the first quarter of 2020, while now it buys 1.17 dollars. In this way, the 1,2% loss incurred on the investment of German bond (instead of the American one) is by far offset by the 6% appreciation of euro against dollar. More generally, if the interest rate paid by home bonds is *i,* the one of foreign is *i** and the exchange rate *e* is the price of 1 unit of foreign currency in terms of home currency; the investor would invest in the foreign asset whenever $1 + i$ (return given by home investment) is smaller than $(1 + i^*)/e$ (investment on foreign asset denominated in home currency).

Deflation

In periods of strong uncertainty and recession may happen that instead of falling the purchasing power of money increase, so that instead of inflation the economy experiences deflation. And whereas inflation erodes earnings brought by positive interest rates, negative inflation alleviates losses brought by negative interest rates. In deflationary periods is still convenient investing in a German bond that yield -0,5% if inflation during this period is estimated at -1%, since the purchasing power of money received at maturity is 0,5% greater than the one of those paid at inception. The world economy is actually experiencing a period of low but positive inflation, but the recent Coronavirus pandemic add further uncertainty to the markets, and some investors may have bet on appreciation of the currency. The following table reports, in percentage, the inflation levels of some developed countries in the last five years:

country	**2016**	**2017**	**2018**	**2019**	**2020**
United Kingdom	1.00	2.60	2.30	1.70	1.00
Germany	0.49	1.51	1.73	1.45	0.51
Italy	-0.09	1.23	1.14	0.61	-0.14
Japan	-0.12	0.47	0.98	0.48	-0.02
United States	1.26	2.13	2.44	1.81	1.23

Table 1. own production

Households' wealth allocation depends on its magnitude

All of these factors may push an investor to consider, for speculative purposes, negative yielding bonds. But still, it would be more profitable for them to hoard cash instead. Indeed, in periods of deflation it is true that investing at a rate which is less negative than the inflation one would be profitable, but by holding cash as such the benefit would be even higher (no negative return on the bond). The same concept applies to exchange rates, exploiting a currency appreciation by simply buying foreign currency at the right moment would leave higher margin of profit for the speculator with respect to a forex market investment on negative bonds. In other words, we should be in an economic situation that Krugman would describe as liquidity trap, in which investors' preference for money is nearly infinite. Why then, some savers rather preferer German bonds to cash?

To answer this question, first of all it is important to distinguish from which part of the money demand these money come from. In other words, if a capital is used for speculative purposes, negative yielding bonds may be bought for some of the reasons written above, but on most of these cases holding cash can be more profitable, if instead the purpose of a capital is to be preserved, then the main determinant to take in consideration is its safety.

As claimed by Andell (2020), the main threat of cash holding is inflation, that, even though low in this period, is expected to rise due to expansionary monetary policy enacted by central banks to rise it back to below 2%. The author, then suggests a more structured allocation of wealth that reduces both opportunity and explicit costs of holding money, claiming, paradoxically, that a riskier allocation (stocks etc.) would be safer. This article helps to understand how money are not actually a costless asset, but inflation is a threat not only for money but also for government bonds, so inflation pressure cannot be a determinant for switching to bonds. At this point another important variable kick-in: magnitude of the capital. Pursuant to this purpose "We Wealth" (2020) realized a survey on a sample of 10 banks to understand which of them started to apply negative interest rates on deposit. It has been found for example that a bank has applied, in turn, the -0,50% of the ECB on costumer's deposits that exceeds 1 million euros, the same rate has been recently applied from another bank for deposit only greater than €50 000,00, a third bank introduced a fee of €33 per €100 000,00 of average monthly deposits. This approach of commercial banks in the euro area draws a line between the average household and a firm or a wealthy investor. This second category, indeed, owning capitals that exceed such thresholds finds more convenient to allocate its wealth to more profitable government bonds that guarantees the same degree of risk against 'fewer negative returns'. Such solution, as claimed by the author of the article, has been proposed by banks

themselves in order to offer their clients even a slightly positive interest on their deposits (by allocating their money in some positive yielding government bonds) and deter them to withdraw their deposits.

Risk factor relevance in depositors' behavior

Interest rate relative convenience is not the only determinant of Households' choice about their wealth, for what concern precautionary motive indeed the risk factor plays a prominent role. Again, Households may choose among time deposits or bonds to store their wealth (we have seen in section 2.1.3 that cash is not an optimal store of value). In this sense the study carried out by Artavanis et al. (2019) on deposit withdrawals in periods of both "stability" and uncertainty, helps to understand how households' choices changes when facing periods of economic turmoil. Their objective was the one to distinguish between the three types of reason why a household may withdraw from its deposit (i.e., Liquidity motive, fundamental motive and strategic motive) in different periods of economic stability. They started to collect data from Greek most important bank in a period of relatively good stability in 2014, before political elections. This event was seen as a source of uncertainty by households because, if a party won, there was a concrete possibility of Greece leaving the EU. What they found is that after a political shock, prices of short-term Greek sovereign bonds more than doubled and the early withdrawals (i.e., in time deposits early withdrawals are the one made before the expiring date fixed in advance) probability quadrupled. In particular they attributed two-thirds of this increase to direct political uncertainty (i.e., fundamental motive), and the remainder to the influence wielded by other households' withdrawals (i.e., strategic motive). This article highlights how bonds (especially short-term ones) are perceived by households as flight-to-safety assets in case of economic turmoil. Moreover, there is also a parallelism between 2014 Greek's elections and 2012 EU financial crisis. It is also true that not all bonds inside the Eurozone are equally secure; as the sovereign bonds European crisis has demonstrated, German bonds are the assets regarded to be the safest in Europe. In 2011, for instance, just before Berlusconi's ouster, Italy demonstrated to investors its inability to repay its balance-sheet deviation on time, and the spread with the German BUND skyrocketed. The difference between these two countries' securities has nearly hit 600 basis points before returning on the pre-crisis levels, suggesting that the Italian government faces a considerable danger of being unable to fund its debt. German bonds are the safest investments on the European market due to country's timeliness in repaying its debts. As a result, households' searching for safe store of value invested on German debt, making the national yield on securities to be the first to fall in

negative territory. Another important factor that investors consider when investing on European countries' debt, is that in case of euro default nominal values of securities are converted into that nation currency before euro adoption. That is, purchasing a German bond means, even in the worst-case scenario, holding something convertible into a strong currency such as the German Mark. This is an advantage over sovereign bonds, which would be converted into a volatile currency like the Italian lyra. Although nowadays this is a far eventuality, at the time of the financial crisis the possibility of the Italian default and a consequent exit from EU was tangible, and with Italy all the Euro Area was at risk.

Conclusions

After having analyzed all the available opinions regarding liquidity trap escapes, among the alternatives, the one adopted by the ECB and BOJ seems to be the more viable in terms of both effectiveness and feasibility. To be fully efficient, though, NIRP requires a strong sound, banking system to be able to pass-through the effects of NIRP on the real economy. The critic point in this process is that ECB should ask itself whether all the necessary banks all over the Eurozone are sound enough to pass efficiency the policy proposed in a homogeneous way in the Union. Recent surveys conducted by the ECB demonstrate how Banks' response to this policy has been positive until now, but it would be crucial to understand whether before which NIRPs become detrimental (as agreed by most economists), is enough for Banks to transmit the policy. An eventual failure won't lead only to a general worsening of the economic condition in Europe, but also to widen the economic differentials among EU's countries. The Rogoff's proposal to work with deeply negative interest rate on the other hand, can be equally efficient, but requires particular economic conditions such as an almost cashless society, which are difficult to achieve. In northern European countries though, where cash transaction represents only a tiny percentage, the use of deep negative interest rates is favored (e.g., Sweden overnight deposits at -1.1%). A second important observation is that most of the demand for negative government bonds derive from central banks' QE programs that provides important purchasing of national debt. Moreover, their monetary policy decisions implied a negative rate charged on excess deposit in the CB. This measure set in motion a mechanism that gave life to negative yielding bonds. Indeed, Financial and Non-financial institutions that were holding lots of their reserves in the central banks shifted their money into sovereign debts, driving national bonds' prices above the face value (interest below 0%) furtherly inflating negative bond yielding phenomenon.

Moreover, from Households' behavior on capital allocation it is possible to notice that there is a distinction between different values of capital. For the average household (low value, high volume) there is a cash preference *vis-à-vis* Negative yielding bonds since their deposits are not charged of negative rates. whereas, for those customers with a higher wealth (high value, low volume) there is a preference towards government bonds.
Finally, we observed how some sovereign bonds are preferred over others thanks to a higher perceived degree of safety. This is due not only to timelines with which certain debts are repaid with respect to the others, but also because in case of unitary currency default bonds that would be denominated in stronger currencies are favored. That is why, for example, German bonds are carrying negative rates unlike other EU countries having a disadvantageous currency conversion such as Italy for example.

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