Department of Economics and Finance – Chair of Money and Banking

THE NEGATIVE INTEREST RATE POLICY OF THE BANK OF JAPAN: A COUNTERFACTUAL ANALYSIS

Supervisor:

Prof. Paolo Paesani

Candidate:

Leslie Yvonne Pio

ID 214301

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Introduction

Japan's economy has been for several years now trying to revitalize its economy by pushing up inflation and trying to expand investments. Since its "lost decade" in the 1990s, the BOJ has adopted several measures to achieve its scope and eventually got to the point where it decided to experiment with unconventional monetary policy tools. One of the most recent ones which have been employed is the negative interest policy rate which is also one of the most controversial. The negative interest rate policy has been introduced in 2016 and the policy rate has been set to -0.1% and remained constant since then.

The question we aim to answer in this study is whether negative interest rates policies are really an effective policy tool or if its effects are hampered by the mistrust of its real efficacy or by other factors. In particular, we will test whether landing into negative territory was really crucial or if its effects could have been obtained by remaining on a less unconventional territory as zero-interest rates.

The decision of exploring this topic comes from an interest in the effects of these tools which seem to become more and more appealing to different economies: the Fed, the ECB, the BOE, and many more Central Banks have experimented with negative rates as well as quantitative easing and forward guidance.

Negative interest rates seem to go against the basics of economic knowledge and reasoning, but they are one of the most interesting instruments even if the knowledge and data we have on their functioning are still very limited to assess much on their mechanisms and their validity.

Thus, the importance of answering this question lies in determining if the policy that Japan has decided to pursue is bringing the desired results and if it will eventually cause a significant change in the economic environment. The answer will also tell us more about the current status of its economy, on how well its agents' responses fit the expectations of the BOJ and give us an idea if it should continue to follow this policy.

To do this we will first analyze how well different unconventional tools have worked in the Japanese economies at different times and we will compare their effects in Japan with those in other Countries. We will also explain the theory behind how negative interest rates should work in theory through the different transmission channels.

We will use an econometric model based on a time-series regression, specifically an Autoregressive Distributed Lag model (ARDL), which will make us able to explore a counterfactual scenario in which instead of a negative rate we will simulate the effects of a zero-policy rate.

Firstly, we will draw the actual pattern that economic variables as the inflation rate and the bank lending growth and then we will compare it with the counterfactual outcomes at the zero-lower bound. Secondly, we will go deeper in the banking sector to see how the return on equity and the credit default swaps would respond instead. These indicators are claimed by Goodhart (2013) to be a more accurate estimator of how much a bank will be willing to supply for loans.

Apart from the graphs, we will also consider the t-statistic and the p-value of a test for the null hypothesis of the ineffectiveness of the negative interest rate.

The results we obtained do not reject the null hypothesis in any case but that of the return on equity. Also, by looking at the graphs, we will see that the effects of the policy will not differ much by the counterfactual in both the case of inflation and of bank lending growth whereas significant change will be found for the return on equity, especially after 2017 which shows a significant efficacy of the negative interest rates in raising this estimator.

Another interesting result is that of credit default swaps which shows an inversion in mid-2017, previous to which the NIRP line lies below the ZIRP estimate, whereas afterwards, it lies above. This indicator is negatively related to banks' supply of loans and thus this inversion yields interesting conclusions on the effectiveness of the policy which seems to have acted better in the first part than in the latter.

Overall, we will conclude that the effects of the NIRP have not sufficiently differed from those that a zero-interest policy would have obtained: even if some curious results can be observed through the comparison between the actual data and the estimation, statistical data and tests tell us that the impact has not been substantial on the studied variables.

This may be due to the already large extent of monetary policy expansion that the BOJ has implemented for so many years which might have weakened the effect of a negative policy rate. Another possible explanation for this is the adverse impact that this policy has on expectations of economic agents as many do not see it as a profitable and efficient tool. In fact, in many economies that experimented with negative rates, the results were not those which were expected and thus did not prove successful. The low efficacy of this tool may be due to both facts that are specific of the Country but also more generally related to a bias of the instrument per se.

Chapter 1. Japanese Negative Interest Rates History: Abenomics

1.1 Japanese Economic History in the last 20 years

The collapse of the financial bubble in 1990 marked the beginning of a significant period of economic crisis in Japan. It caused financial distress, economic stagnation, constrained lending and a problem of non-performing loans in the market which accounted for 10%-20% of GDP (1998).

After 1991, the inflation rate struggled to raise above the 2% level, succeeding only three times: after an increase in the consumption tax in 1997 in which it got to 3% to 5%, in 2008 due to commodity price hike but then dropping to -2% for a while in 2009, and in 2014 after another rise in consumption tax through which it reached a level in between 5% to 8% (Shirai, 2018).

The crisis characterized the 1990s which were thus defined as a "lost decade" for Japan economic and financial development. The economy had to deal with a weak real GDP performance with a growth rate just slightly above zero and then sharply turning negative in 1997.[1] This decline in potential growth rate is attributed to a corresponding decrease in total factor productivity growth and capital stock accumulation. Demographic factors such as labor hours and the number of workers employed did play a part in the 1990s, but their impact slowed down in the following years. Overall, the decrease in economic growth led to a deterioration in aggregate demand and difficulties in eliminating the output gap (Shirai, 2018).

The increase rate in CPI went through a continuous decline from 1998 as well as wages which had been worryingly decreasing by 10% in the past 10 years. [2]

To worsen the situation, the Bank of Japan found problems in implementing measures to target the crisis as its traditional policies were not adequate to the modern environment.

A turning point was when in 1995-1996 the Deposit Insurance Corporation was restructured by decision of the government, and at the same time the intention of adopting more aggressive policies was presented.

Late intervention for reconstructing the economy after the burst of the financial bubble, caused the Japanese economy to fall deeper into the financial crisis in 1997-1998, resulting in unemployment rising to 4.9%.

[1] "Towards the end of deflation in Japan? Monetary policy under Abenomics and the role of the Central Bank", Machito Uchida, April 1st, 2019

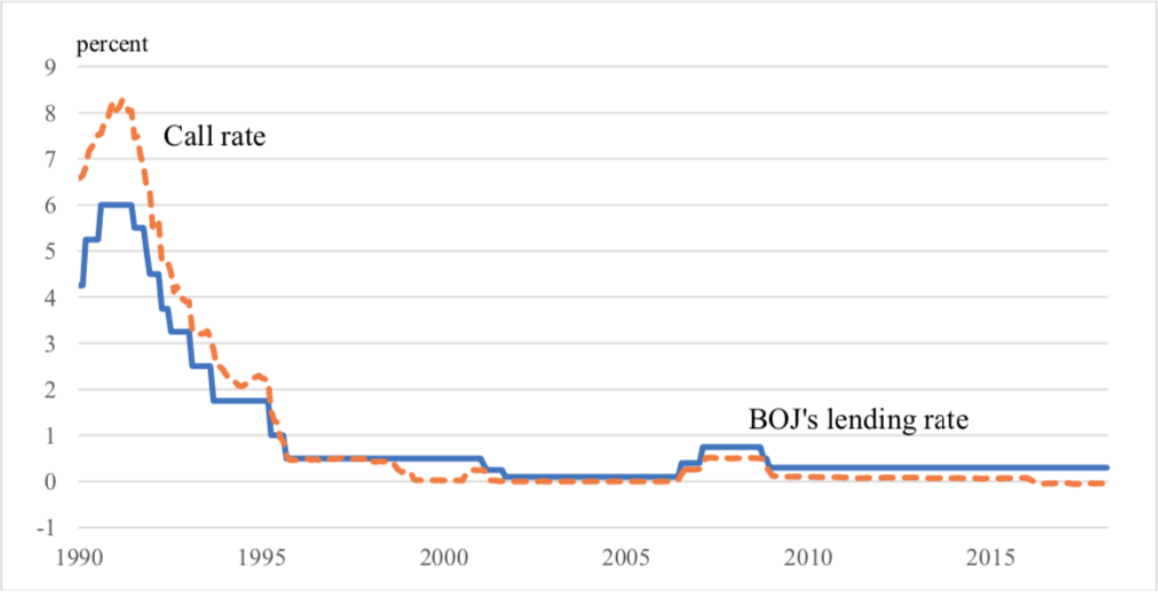
[2] "Towards the end of deflation in Japan? Monetary policy under Abenomics and the role of the Central Bank", Machito Uchida, April 1st, 2019

While real economy was not in a collapsing situation in the 1990s, financial distress was much serious and was causing a state of near panic. The percentage of non-performing loans was around 10% to 20% of GDP, and the number of insolvent institutions was critically large (Cargill et al., 2000).

The economy fell even more deeply into recession as a consequence of the large rise in consumption in 1997. Real growth was about –0.4% and the impact fell not only on Japan but all Countries in the region suffered the effects of this crisis. As a response finally, interest rates were lowered to stimulate demand and government's fiscal expenditure was increased: a big fiscal stimulus was approved in 1998, which amount was 17 trillion yen (Sharma, 2003).

The ODR was lowered and set to 0.5%, causing the market rate to fall too, which meant virtually hitting the zero-lower bound. Its movements are shown in figure 1 and as we can see from the graph short-term rates both of the BOJ and of the market remained below 1% from that moment on and, though at times increasing, they never got back to their level at the beginning of the 1990s. In the inter-bank market financial conditions remained accommodative, meanwhile the yen depreciated against the dollar and stock prices remained low (Shirai, 2018).

Figure 1. BOJ lending rate and short-term market interest rates (1990-2017)



Source: The Bank of Japan [3]

A new act, which concerned the introduction of reforms regarding the BOJ, was promulgated in 1998 and demanded for autonomy and transparency: it is still considered by many the major institutional change in Japan's Central Bank since 1942 in terms of responsibility and objectives.

One of these important changes was that it created the Financial Supervisory Agency which guaranteed the central bank independence from the Ministry of Finance (Cargill et al., 2000).

[3] "Historical Evolution of Monetary Policy (Goals and Instruments) in Japan: From the Central Bank of an Emerging Economy to the Central Bank of a Mature Economy", M. Shizume, March 7th, 2019

BOJ roles now were precisely defined, namely: issuing banknotes and ensuring the settlement of funds in monetary financial institutions.

The Law specified two main goals: the "maintenance of an orderly financial system" in Article 1, and price stability in Article 2. Currency and monetary controls were established with the Governor, the Vice Governors and other board members forming the Policy Board which was the decision-making body held responsible for monetary policy.[4]

Two large-scale capital injections to the banking sector were then planned for the years 1998-1999 in order to decrease financial risk and increase banks' profitability.[5]

The first of the two was planned for March 1998: it was directed to the 21 major banks and its total value was of JPY 1.8 trillion. In the end, it was not as effective as it was thought and thus had a negative response in the market.

One year later the second capital injection was tried out, based on a framework identical to the one of the previous: banks requesting funding, had to demonstrate positive net worth and a viable plan in the long run. It addressed the major 15 banks for a total of JPY 7.5 trillion[6] and its implementation was much different: standards for securing public funding were raised, the net worth's definition was clearly stated and there were several classifications of loans.

This new measure was far more effective than the previous as it also helped with the liberalization of equity markets and consolidation of financial institutions.[7] Furthermore, measures to deal with the problem of failing banks were introduced: in example, through the creation of the Financial Revitalization Commission, an appointed administrator would determine whether a failing bank should be liquidated or if its business should be transferred to a public bridge bank. [8] A bridge bank's function is in fact to undertake control over the business of an insolvent bank.[9]

Although, the measures imposed by the two laws were meant to be only temporary and terminated in March 2002, when it was presumed that all banks would have been sound and financial distress only part of history.

A series of unconventional monetary policy measures were set in order to operate through innovative methods under the new zero lower bound.

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[4] "Historical Evolution of Monetary Policy (Goals and Instruments) in Japan: From the Central Bank of an Emerging Economy to the Central Bank of a Mature Economy", M. Shizume, March 7th, 2019

[5] "Evaluating Bank Recapitalization Programs in Japan: How Did Public Capital Injections Work?", Kiyotaka Nakashima and Toshiyuki Souma, May 6th, 2019

[6] "Lessons from Japan's Banking Crisis, 1991-2005", Mariko Fujii and Masahiro Kawai, May 6th, 2019

[7] Cambridge Dictionary, White Knight, https://dictionary.cambridge.org/dictionary/english/white-knight , March 10th, 2019

[8] "The monetary, regulatory and competitive implications of the restructuring of the Japanese Banking Industry", Haruyuki Toyama, May 7th, 2019

[9] Business Dictionary, http://www.businessdictionary.com/definition/bridge-bank.html, March 10th, 2019

The first Zero Interest Rates Policy (ZIRP) in Japan was introduced in 1999 with the declaration by Governor M. Hayami that it would continue "until deflationary concerns were dispelled". This informal announcement may be considered as a kind of forward guidance as it was a signal that this unusual rate would have been kept on the market by more than normally expected.

This record discount rate was maintained when the economy was further into recession, and the yield curve was virtually flat due to the decline in the 10-years government bond yield (Cargill et al., 2000). The initial level was set at 0.15% through the provision of larger short-term funds against pooled collateral, and then the BOJ provided for its further decline (Shirai, 2018).

It was then abandoned when in 2006 deflation pressures decreased and favorable developments in the economy were achieved (Hausken and Ncube, 2013).

In August 2000 deflation seemed to be no longer an uncoverable concern: growth reached the level of 3% after that real GDP growth had been positively solid since 1999, industrial production improved, and exports were leading the economy. These changes led to the decision of leaving the ZIRP to set a policy rate, the uncollateralized overnight call rate, at 25 basis points. [10] Justification for this decision was that the downward pressure on prices from low demand had greatly decreased. Even so, the decision raised many oppositions and so in February 2001 the rate was reversed to 15 basis points.

The burst of the information technology bubble in the United States had evident negative effects on the Japanese economy, leading to a fall in exports and production as well as a fall in the CPI index below zero. As a response to this, the Quantitative Easing Policy (QEP) was so introduced in March 2001, consisting of managing interest rate expectations, changing the relative supply of securities by modifying BOJ's balance sheet composition, and expanding its size to set the short-term policy rate at 0%. The economy was in fact falling back to recession.

The operating target wasn't anymore the uncollateralized overnight call rate, which was kept around 0.001%, but became the current account balance of the BOJ, so it became reserve targeting. The initial amount was raised from 5 trillion to 35 trillion in three years as a result of the deterioration of the economy but then it was maintained (Shirai, 2018).

During the period between 2001 and 2006 exports' volume of Japan grew, allowing the economy to approach a recovery phase in 2002 where, despite a rise in crude oil and commodity prices, corporate profits grew as well as production capacity. From 2002 therefore the recovery was stable thanks to exports which were clearly the main engine. This moment was further supported by a favorable worldwide economic growth and a depreciation of the JPY compared to the USD.

[10] "Overview of Japan's Monetary Policy Responses to Deflation", Linda Kole and Robert Martin, May 7th, 2019

In 2005 CPI returned above zero and wages saw an increase too together with a decline in the unemployment rate. Given these positive considerations, on March 9th, 2006 the BOJ decided to conclude the QE policy and to increase interest rates to a positive level of 0.25% in July and then 0.5% in February 2007. Even so, it must be noted that BOJ's assessment of the CPI level in 2005 was actually mistaken as the rate of change in core CPI was still below zero, thus Japan shouldn't have exited QE, as many believe.

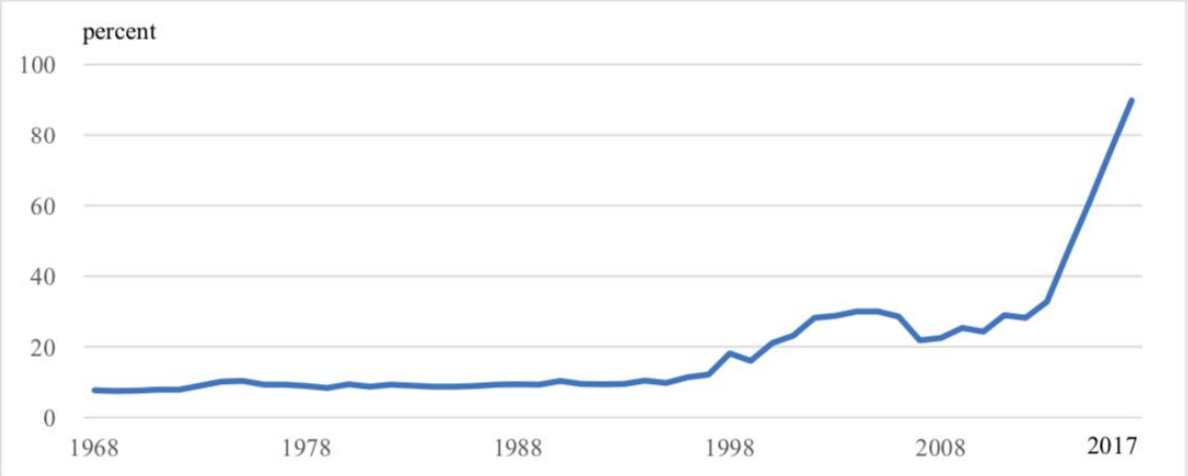
In 2008 the economic conditions worsened as a result of US and European problems in their financial systems, causing Japanese exports to decrease and the JPY to appreciate. An accommodative monetary policy was employed: some of the measures were a decrease in the policy rate, which reached 0.1% in December 2008, together with other measures to decrease the long-term interest rates in the money market, to ensure stability in financial markets and facilitate corporate financing.

Through collective monetary and fiscal policies, jointly employed by major economies, after the Lehman Brothers' failure there was a temporary recovery, which then slowed down during 2010. In Japan the yen continued to appreciate, and recovery progressively decreased its pace.

From 2010 to 2013, under Governor Shirakawa, the Comprehensive Monetary Easing (CME) was adopted.

On December 20th, 2012 the BOJ decided to increase the size of its asset purchase by 10 trillion yen, and in January 2013 it announced the decision of targeting 2% CPI inflation (Shirai, 2018).

Figure 2. BOJ balance sheet/ GDP ratio



Sources: The Bank of Japan (1986b), pp.272-304; the Bank of Japan [11]

[11] "Historical Evolution of Monetary Policy (Goals and Instruments) in Japan: From the Central Bank of an Emerging Economy to the Central Bank of a Mature Economy", M. Shizume, May 7th, 2019

Finally, in April 2013, Quantitative and Qualitative Monetary Easing (QQE) was introduced as an extension of the CME, and nowadays it is deemed to be the most unconventional measure ever adopted, as far as it concerns its size, considering Central Bank's balance sheet and national economy. The magnitude of this aggressive monetary easing is displayed in Figure 2, which shows the highest and unprecedented increase in the balance sheet to GDP ratio starting from the year of the QQE implementation, which can be seen as evidence of the magnitude of its impact.[12]

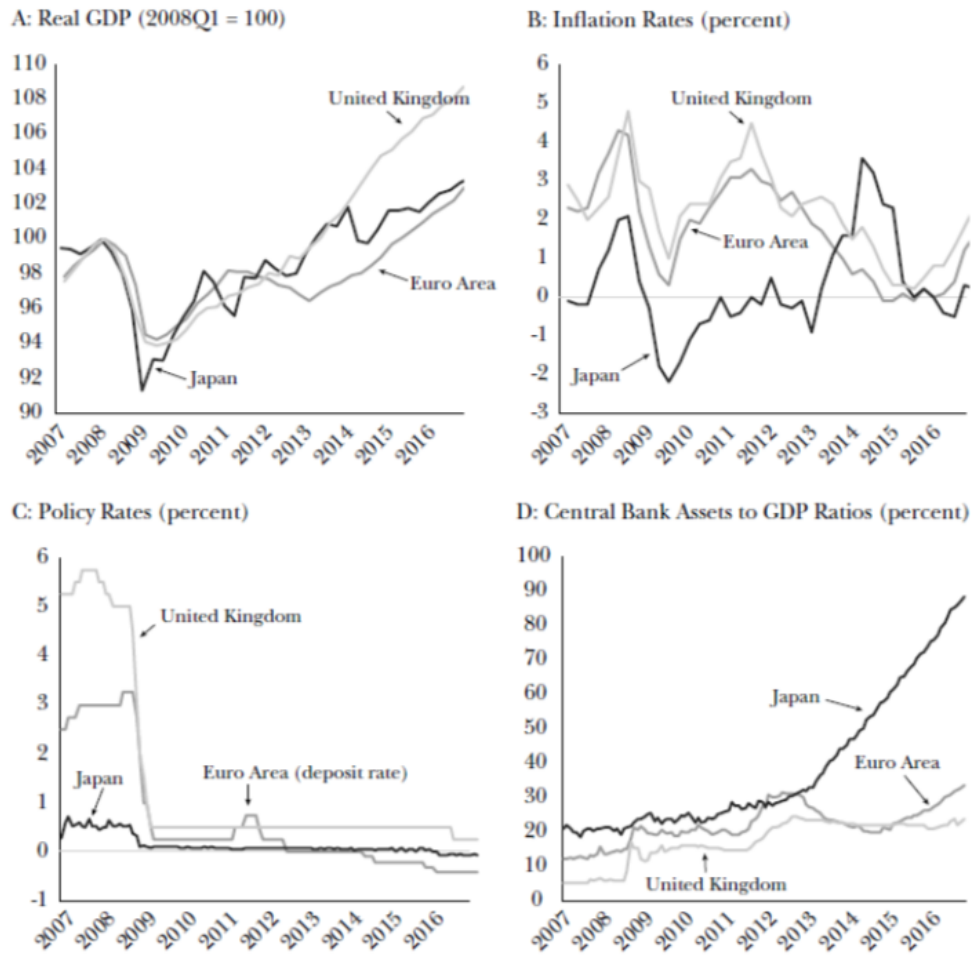
[12] "Historical Evolution of Monetary Policy (Goals and Instruments) in Japan: From the Central Bank of an Emerging Economy to the Central Bank of a Mature Economy", M. Shizume, March 7th, 2019

1.2 Unconventional Monetary Policy

Since when the global financial crisis hit the various economies, Central Banks in industrialized countries have started to implement different monetary policies rather than the conventional ones, with the aim of restoring market stability. This may be probably due to the fact that once an economy is in deflation, the effectiveness of conventional monetary policy is reduced. Many central banks experimented with the new unconventional measures following the crisis in 2008, in particular the Bank of Japan, the US Federal Reserve, the Bank of England (BOE) and the European Central Bank (Hausken and Ncube, 2013).

In the following paragraph we will deal with how the BOJ implemented the unconventional monetary policy tools and then we will compare its case to the one of the BOE and of the ECB.

Figure 3. Real GDP and central bank assets in the euro area, Japan and the UK



Source: CEIC, Haver Analytics, and authors' calculations.

[13]

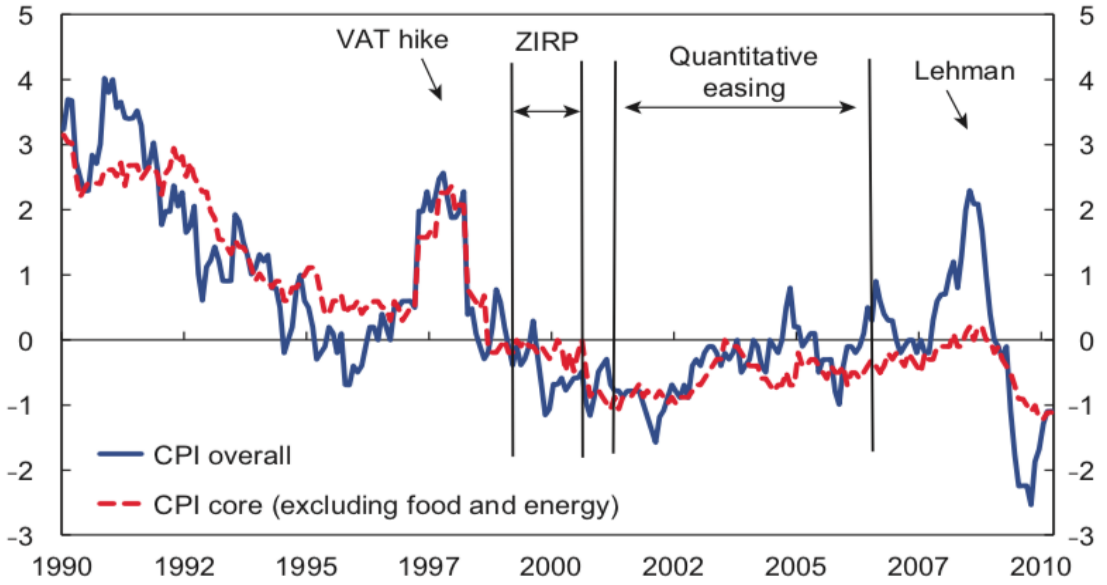
[13] "Unconventional Monetary Policies in the Euro Area, Japan, and the United Kingdom" Giovanni Dell'Ariccia et al., April 2nd, 2019

In the picture above are represented the changes over time of real GDP, inflation, the policy rate and the Central Bank's assets to GDP ratio. As we can see, the lowest policy rate has so far been the Euro Area deposit rate which was set at -0.20 % in 2014 and kept being lowered until today, -0.40 %.[14] The Japanese policy rate has instead been set at -0.10 % and has been kept rather constant until today.

Central Banks' assets have generally increased after 2009, with the greatest difference found in the case of Japan. This reflects the intent of increasing the liquidity available for supporting banks.[15]

There were several reasons why intervention was needed as Raghuram Rajan pointed out in 2017, during his speech[16] for the Adam Smith Award: "Clearly, markets were broken after the financial crisis [...] stabilizing the market was important at that time. So, the first rationale for why central banks began experimenting with unconventional monetary policy is not hard to fathom. The second reason to intervene was to affect yields or prices [...] The third reason for intervention was to signal commitment to a bank's particular monetary policy". Furthermore, he states another non-trivial reason: the problem of how to increase inflation.

Figure 4. Inflation and Deflation in Japan, 1990-2010 (Percent)



[17]

[14] https://www.ecb.europa.eu/stats/policy_and_exchange_rates/key_ecb_interest_rates/html/index.en.html

[15] "Unconventional Monetary Policies in the Euro Area, Japan, and the United Kingdom" Giovanni Dell'Ariccia, Pau Rabanal and Damiano Sandri, April 1st, 2019

[16] "Unconventional monetary policy and the role of central banks" Raghuram Rajan, April 1st, 2019

[17] *Can Abenomics Succeed? Overcoming the legacy of Japan lost decades*, Dennis Botman et al., April 2nd, 2019

Japan by that time had been trying to push up inflation for more than a decade, with a real GDP that had contracted by 9% [18], an economy that had been struggling since the crisis of 1990 and plus the Great East Japanese Earthquake in 2011 which didn't help the reconstruction.

Japan's long-suffering economic instability motivated the central bank to introduce unconventional monetary tools, from the zero-interest rate policy to the quantitative easing.

Thus, increasing inflation was not an easy target: expectations of the public play a major role in the process and it is hard to codify and know how to influence them.

As Rajan said "monetary-financed fiscal expansion is as subject to Ricardian equivalence as debt-financed fiscal expansion in an environment of high public debt and low interest rates".

A big change for Japan's monetary policy happened when the Prime Minister Shinzo Abe was elected in December 2012: his particular macroeconomic policy is known as "Abenomics" and comprehends a series of unconventional monetary policy measures adopted only by few countries before.

It is important to underline the peculiarity of unconventional monetary policy: since it comprehends measures that are innovative, we don't have as many historical cases on which we can base our studies and our reflections.[19]

Abenomics' new monetary policy followed the so called "three arrows": the first entails the BOJ conducting "Bold Monetary Easing" in order to achieve the inflation percentage target of 2%, the second is government's expansion of public investment to generate real demand and unemployment, and finally the third which is a "Growth Strategy Program" Built by the government to promote private investments setting several targets for different sectors.

His policy was expected to work following four transmission channels: the long-term interest rate channel, the channel to stock prices and real estate prices, to portfolio adjustments and, finally, to inflation expectations (Botman et al., 2015).

The first channel was expected to reduce borrowing costs of firms and households, while the second would increase their capital and investments of the former and consumption and net exports of the latter. The third channel would shift investments in government securities to banks' credit and risk assets investment, while through the fourth there would be a decrease in real interest rates to support spending.[20]

[18] "Unconventional Monetary Policies in the Euro Area, Japan, and the United Kingdom" Giovanni Dell'Ariccia, Pau Rabanal and Damiano Sandri, April 1st, 2019

[19] "Quantitative Easing and Unconventional Monetary Policy – An Introduction", Michael Joyce, David Miles, Andrew Scott and Dimitri Vayanos, April 3rd, 2019

[20] "Towards the end of deflation in Japan? Monetary policy under Abenomics and the role of the central bank" Mahito Uchida, April 2nd, 2019

Three main forms of unconventional monetary policy tools have been implemented, which are the Forward Guidance, Quantitative Easing and Negative interest rates. These can lower and at the same time flatten the yield curve by reducing the gap and the size of interest rates both long and short-term: they should in fact lower borrowing costs for firms, increase credit, aggregate demand and raise both inflation and output as Giovanni Dell'Ariccia, Pau Rabanal and Damiano Sandri argue in their article[21].

In the following pages we shall analyze the functioning of these three measures and discuss their positive and negative effects.

1.2.1 Forward Guidance

The Forward guidance is an unconventional policy tool consisting of providing market participants with information on the future intentions of the Central Bank on the policy rate. In fact, by increasing transparency the guidance enables to reduce uncertainty in the market, thus reducing interest rate volatility and risk premia.[22]

It may be employed in two ways: either by the central bank clarifying the future of monetary policy according to expectations on inflation and economic activity, or alternatively by expressing the commitment to maintaining low interest rates despite positive future conditions.

Its targets may have a time limit ("calendar-based") and its statement may be distinguished into qualitative or quantitative ("threshold-based"). An example of qualitative guidance is the BOJ announcement in 2010 that it would keep "price stability in sight", whereas a threshold-based guidance is BOE 2013 announcement of keeping rates low until the "unemployment rate has fallen to a threshold of 7%".

The well-functioning of the forward guidance may be compromised by several factors: an example may be the failure to influence expectations, or in case the announcement stays unclear it may actually lead to a reaction opposed to the one desired.[23]

Japan has been on the lead in the use of forward guidance with experimentation starting from 1999. On October 5th, 2010, under the Comprehensive Monetary Easing policy, the BOJ announced its decision to keep the "virtually zero interest rate policy until price stability is in sight on the basis of the understanding -meaning in a positive range of 2% or lower, with 1% as the midpoint- of medium

[21] "Unconventional Monetary Policies in the Euro Area, Japan, and the United Kingdom" Giovanni Dell'Ariccia et al., April 2nd, 2019

[22] "Forward Guidance at the zero lower bound", Andrew Filardo and Boris Hoffman, April 2nd, 2019

[23] "Unconventional Monetary Policies in the Euro Area, Japan, and the United Kingdom" Giovanni Dell'Ariccia et al., April 2nd, 2019

to long term price stability" (Botman et al., 2015) and until there were not any substantial financial risks. It also announced the purchase of assets accounting for 5 trillion Yen.

Then, in February 2012 the BOJ restated its decision to make it last until inflation reached the goal of 1% in so far it didn't cause extreme financial risks: " The Bank of Japan will pursue powerful monetary easing by conducting its virtually zero interest rate policy and by implementing the Asset Purchase Program […] with the aim of achieving the goal of 1 percent" (Shirai, 2018). This second statement proved to be clearer than the previous, as well as more powerful, first of all as it used the world "goal" rather than "understanding" which stressed the uniform consent of the choice, and secondly by precising the value of the price stability target rather than setting it "in a positive range of 2% or lower".

The particular choice of a target of 1%, instead of the more common 2% target, was due to consideration made by the Policy Board that this particular target was more achievable in the medium- to long-term than the latter, also by taking into account past price movements (Shirai, 2018).

The responses to the two forward guidance announcements were different as well: the 2010 guidance caused a small decrease in government bond yields (of 10 basis points at 10-year maturity) but deflation persisted, inflation was not expected to rise much, and exchange rates didn't depreciate. The poor response was explainable given the low credibility the BOJ acquired in the last decades, furthermore the high deflationary pressures were another cause of the ineffectiveness of forward guidance.[24]

The lack of credibility at that time of the BOJ may have been connected with the decreasing effectiveness of the monetary easing under the Asset Purchase Program: as the maximum maturity for JGBs extended purchase was of 3 years, it was difficult to flatten the yield curve more than a certain level. One possible solution was to extend the maturity but by the early 2013 expectations that it would reach the 5 years maturity had risen had were fast reflected in the yield curve. Thus, a deeper policy transformation was necessary for a wider effect (Shirai, 2018).

Later, in January 2013, the decision to target 2% inflation made a big change in terms of public expectations: it eliminated doubts on the intention of overcoming deflation and overtime, BOJ became more and more clear and transparent on its policies and thus the use of forward guidance changed drastically. The transmission channels are impaired whenever the financial system is weak, and it is in these cases in which communication becomes increasingly important.

In April 2013, a Public Statement was released, setting two descriptions on the monetary accommodation that was planned through the introduction of the QQE program: "The Bank will

[24]"Unconventional Monetary Policies in the Euro Area, Japan, and the United Kingdom" Giovanni Dell'Ariccia et al., April 2nd, 2019

achieve the price stability target of 2 percent […] with a time horizon of two years" and then "The Bank will continue with QQE to achieve the price stability target of 2 percent, as long as it is necessary for maintaining that target in a stable manner. It will examine […] risks to economic activity and prices" (Shirai 2018). These announcements took into consideration the expectations of market participants who anticipated the effects of monetary easing but even so, this announcement was far more effective on the market and led to a reduction of 11 to 14 basis points on long-term yields.[25]

Within the Euro Area, forward guidance was implemented on July 4th, 2013 with ECB President Draghi announcing the Governing Council expectation of interest rates remaining at "present or lower levels" for a long period. Its decision was motivated also by a recent raise in euro area rates expectations which was "inconsistent with the subdued outlook for inflation and broad-based economic weakness"[26].

The ECB announcement had a negative impact on future rates at the one-year horizon of 7 basis points, and at the two-year horizon of 8 basis points.

It is also showed that the ECB introduction of the forward guidance helped it isolating its economy from the Federal Reserve announcement of a decrease in the size of its quantitative easing program.

In the UK, forward guidance was announced in August 2013, when the BOE informed the public that it would keep policy rates low and not reduce the number of bonds purchased through quantitative easing until unemployment had declined below 7%.

Three criteria were given for implementation: a quantitative threshold for inflation projections of 2.5%, 18 to 24 months ahead, a medium-term inflation expectation and the absence of financial instability risk. Then an additional forward guidance was given as the economy was still below the optimal level of production so interest rates would have continued to be kept low.

Findings regarding the effectiveness of this monetary policy instrument in the UK are limited even if it seems to have reduced volatility of expected future interest rates on government bond yields and to have kept interest rates low, regardless of 2014 GDP sustained growth.

Other studies[27] found that futures rates didn't drop after the August 2013 announcement, though the two-years futures had fallen when in July of the same year there had been concerns on the appropriateness of expectations on future rates.

The Federal Reserve Bank has experimented with forward guidance too, in particular it adopted at first a qualitative guidance, and then in 2011 a calendar-based guidance announcing that "economic

[25] "Unconventional Monetary Policy in the Euro Area, Japan and the United Kingdom", Giovanni Dell'Ariccia et al., April 3rd, 2019

[26] "Forward Guidance at the zero lower bound", Andrew Filardo and Boris Hoffman, April 2nd, 2019

[27] "Forward Guidance at the zero lower bound", Andrew Filardo and Boris Hoffman, April 2nd, 2019

conditions would warrant policy rates at their lower bound for at least three years"[28]. Since 2012, it adopted a threshold-based guidance: it announced that it would maintain the federal funds rate at its prevailing level conditional on quantitative thresholds which were an unemployment rate at 6.5% and inflation projections lower than 2.5%.

Compared with other central banks who adopted this instrument, Japan's experience is considered by some experts to be the most challenging and unique one as, adopted together with other unconventional measures, it aimed at reaching a target level of inflation in a deflationary environment with a relatively flat yield curve.

Overall the effects of forward guidance seem to have worked better and reduced more effectively volatility in the short-term rather than in the long-term, which suggests that the near-term intentions of monetary policy have been communicated more clearly. This is an important sign for the efficacy and reputation of the central banks as the clearer its statements are, the more it is likely that the public response will follow the intended direction. Furthermore, we shall keep in mind the importance of credibility for the effectiveness of forward guidance: only if people trust that the central bank's future intentions on monetary policy will be delivered, they can act accordingly, and their expectations will follow the path intended by the central bank.

1.2.2 Quantitative Easing

With the term "Quantitative Easing" we refer to the large-scale purchase of securities by the central bank, generally employed through the acquisition of long-term government bonds and financed by an increase in reserves. It is generally defined as "a policy that expands the central bank's balance sheet, in order to increase the level of central bank money in the economy"[29].

It works through the idea that when interest rates and short-term yields are low the central bank can provide a stimulus supporting long-term bond prices, thus lowering long-term yields.

It may consist, not only in the purchase of government securities but also in the acquisition of private securities such as corporate bonds, exchange-traded funds and real-estate investment funds, which for instance were bought by the BOJ[30] and by the BOE.

Quantitative Easing works by affecting different transmission channels and thus influencing interest rates. First, the announcement of securities purchase is an important indication of the future direction of monetary policy, and thus serves as a *signaling channel*.

[28] "Forward Guidance at the zero lower bound", Andrew Filardo and Boris Hoffman, April 3rd, 2019

[29] "The Financial Market Impact of Quantitative Easing in the United Kingdom", Michael A. S. Joyce et al., April 3rd, 2019

[30] "Unconventional Monetary Policies in the Euro Area, Japan, and the United Kingdom" Giovanni Dell'Ariccia et al., April 3rd, 2019

Secondly, there's the *portfolio rebalance channel:* the fact that central banks conduct quantitative easing, causes the supply of assets purchased to change. As base money issued and financial assets purchased are not perfect substitutes, financial investors need to reallocate assets in their portfolios, in particular, they will need to purchase assets that are close substitutes to the ones purchased by the central bank. This will increase prices of the close substitutes as well as the price of the assets purchased under QE.

The nature of this channel was also discussed *inter alia* by Tobin, Brunner and Meltzer: they discussed how central banks can influence yields on assets due to imperfect substitutability by altering the supply of financial claims of different maturities.[31]

Finally, by buying long-term securities and issuing bank reserves, central banks through QE increase liquidity. While some experts, such as Joyce (2011)[32], believe that this mechanism causes the fall of risk premium for illiquidity and consequently an increase in asset prices, other believe, in example Krishnamurthy and Vissing-Jorgensen, that it produces the opposite effect thus reducing the liquidity price premium of government bonds relative to other less liquid assets, thus increasing government bond yields. (Hausken, 2013)

The Bank of Japan has been experimenting with Quantitative Easing measures for a long time, since experiencing deflation in the early 2000s. One of the relatively more recent measures started in February 2013 when the BOJ announced the first round of "Quantitative and Qualitative Monetary Easing" (QQE1) which consisted in the open-ended purchase of ¥50 trillion government bonds and ¥1 trillion in ETFs yearly.

In April 2013, the first arrow was implemented through the qualitative and quantitative monetary easing framework. It consisted of four policy measures: first, an annual increase in the monetary base, which was actually the new main operating target, at a pace of ¥60 or ¥70 trillion; second, a monthly increase in government bonds (JGB) purchases, necessary to such a scale of monetary expansion; third, direct risky assets purchase such as EFTs and Japan Real Estate Investment Trusts (J-REITs) to lower the risk premia of asset prices, and finally the promise to continue as long as necessary to maintain a stable target.[33]

The increase in the monetary base is considered to be the most revolutionary point of the QQE as it meant a shift in the target for money market operations from the previous uncollateralized overnight call rate, which symbolizes the "quantity" priority of this policy.

[31] "Quantitative Easing and Unconventional Monetary Policy – An Introduction", Michael Joyce et al., April 4th, 2019

[32] "The Financial Market Impact of Quantitative Easing in the United Kingdom", Michael A. S. Joyce et al., April 3rd, 2019

[33] "Towards the end of deflation in Japan? Monetary Policy under Abenomics and the role of the Central Bank", Machito Uchida, April 3rd, 2019

In April 2014, QQE2 was enacted after a decline in households' expenditure caused by an increase in consumption tax: this, together with the fall in oil price and domestic demand, resulted in low inflation expectations and thus the necessity to further expand QQE1.

It consisted of the purchase of ¥80 trillion of JGB as the operational target was raised by 10-20 trillion yen, plus, in order to lower interest rates, the BOJ extended their maturity target from 6 to 8 years to 7 to 10 years. It also increased the purchase of risky assets, in particular J-REITs annual pace of purchases reached 90 billion, and ETFs reached ¥3 trillion (Shirai, 2018).

Regardless of these measures, consumer prices stayed flat through 2015.

The effects of QQE are hard to identify as part of the overall Abenomics program but there is some important evidence. The exchange rate, for example, has been steadily depreciating since November 2012, going from 80 to 100 yen to dollars in December 2013. At the same time the Nikkei average has risen from 9400 yen to 16300 yen. [34]

It may also have given firms an incentive to try and set higher prices which continued until the fall in oil prices in mid-2014. Although this rise came together with an increase in input prices, thus it did not result in a higher profit margin.

High growth was achieved during the first fiscal year of implementation (from April 2013 to March 2014), reaching a level of 2.6%, while real GDP growth rate was estimated to have reached 1.3%. This showed that the economy performed better than expected by the public and the market.

Both QQE1 and QQE2 failed to increase inflation substantially, and it actually fell to zero in 2015: prices remained in fact weak and the output gap below zero. Households and firms in fact, did not perceive the economic recovery to be strong.

In a report released in April 2015, the "Outlook for Economic Activity and Prices", the BOJ stated the effects of QQE. It emphasized that the rise of CPI of 1% in the past 2 years exceeded the estimates, as well as a change in the output gap which actually improved. The report though stressed the importance of continuing to pursue the 2% price stability target (Shirai, 2018).

The Bank of England, in fear that inflation would fall below 2%, undertook the first round of its Quantitative Easing program between 2009 and 2012, after the collapse of the Lehman Brothers in September 2008, in order to stop economic recession and support economic growth.

[34] "Towards the end of deflation in Japan? Monetary Policy under Abenomics and the role of the Central Bank", Machito Uchida, April 3rd, 2019

In 2009 (QE1), it announced the purchase of government bonds up to £75 billion, then increased to £200 billion.[35] It purchased both public and private securities in order to boost the amount of money in the economy to increase nominal spending thus ensuring to meet the CPI inflation target.[36]

Then a second round of Quantitative Easing (QE2) was implemented when in 2011 when despite inflation rising to 5%, the euro-area increase in debt crisis caused many concerns. In 2012 (QE3), another round took place bringing the total size of the QE measures to £375 billion. A final round (QE4) took place in 2016, when the United Kingdom voted for the Brexit. BOE announced the purchase of £10 billion worth of corporate bonds, expected to generate higher *stimuli* given the higher risks, and £60 billion of government bonds, to sustain economic growth.

QE1 had a remarkable impact on yields, causing a decrease of 50 to 100 basis points, whereas he following rounds seem to have had a less substantial impact, maybe due to the fact that market participants may have started anticipating new rounds.[37]

Several studies aim to demonstrate the impact of QE measures on the financial markets: an example is Gagnon's analysis on US Federal Reserves' purchases between 2009 and 2010 which proved a long-lasting effect on long-term interest rates and on securities. Another example is the previously mentioned study of Joyce, or the one of Meier: these proved the UK's purchases effect on gilt yields which were reduced by 35-60 basis point or also on corporate bond yields.[38]

There are though some questions associated with quantitative easing which are still unanswered: one is about the nature of the link between the volume of securities purchased and the efficacy of QE, another one is on whether there should be a limitation in the kinds of assets purchasable.[39]

In theory, Quantitative Easing should promote growth and inflation but in reality sometimes it actually decreases long-term inflation and contracts output.[40] The same fact that western economies have for so long remained weak despite QE for some experts means that, for such a strong recession, QE is not effective, should have been carried out on a wider scale or together with other measures.

Concerns and questions on the effects of this unconventional policy are now not the focus of many debates, probably once again due to the lack of historical information we are provided with now but are likely to become such in the future.

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[35] "Unconventional Monetary Policies in the Euro Area, Japan, and the United Kingdom" Giovanni Dell'Ariccia et al., April 3rd, 2019

[36] "The Financial Market Impact of Quantitative Easing in the United Kingdom", Michael A. S. Joyce et al., April 3rd, 2019

[37] "Unconventional Monetary Policies in the Euro Area, Japan, and the United Kingdom" Giovanni Dell'Ariccia et al., April 3rd, 2019

[38] "Quantitative Easing and Unconventional Monetary Policy – An Introduction", Michael Joyce et al., April 4th, 2019

[39] "Unconventional Monetary Policies in the Euro Area, Japan, and the United Kingdom" Giovanni Dell'Ariccia et al., April 3rd, 2019

[40] "Quantitative Easing is not as unconventional as it seems", Peter Sinclair and Colin Ellis, April 4th, 2019

Two are the major concerns. The first is the fact that even if QE improves the condition of the economy, it does not solve the problem of recovery which is still a fragile point after a financial crisis. The second concern is on the costs of this policy: a high level of bank reserves may decrease the size of interbank lending thus leading to market malfunctioning. The lack of evidence leaves little scope for considerations on these points.[41] We may rely in the future on more evidence on QE functioning to abstract more accurate information on its effects.

[41] "Quantitative Easing and Unconventional Monetary Policy – An Introduction", Michael Joyce et al., April 4th, 2019

1.3 Negative Interest Rate Policy in Japan

The general idea that agents would rather hold cash than deposit money in an account that pays negative interests is at the basis of the concept of the zero-lower bound. Although, by holding cash an agent incurs several risks such as theft and disruption, thus a mild negative interest rate shall not cause such a big impact in the economy.

With the surprise of many, as it was the first case for a major central bank after that of the ECB, on January 29th, 2016 the Bank of Japan announced that it would employ a negative interest rate policy. The objective of this decision was to increase inflation and, at the same time to provide for further monetary easing.[42] Since June 2015 several macroeconomic variables had been negatively affected by exogenous negative shocks from abroad, for instance the nominal effective exchange rate which had appreciated by 19.4% by June 2016, and the inflation rate which had been falling. Overall this caused the economy to become weaker than before.[43]

At the press conference the BOJ stated: "Policy Board decided to introduce Quantitative and Qualitative Monetary Easing (QQE) with a Negative Interest Rate in order to achieve the price stability target of 2% at the earliest possible time" [44].

To implement the new policy, in February 2016 the BOJ set the complementary deposit facility rate below zero. This, together with the QQE, caused the overnight uncollateralized overnight call rate to turn negative too.

1.3.1 The Multiple-Tier System of the Bank of Japan

A three-tier system for commercial banks was created by which the current account a bank held within the BOJ was divided into three categories, each charged a different interest rate. In a tiered system it is possible to further lower the policy rate as the impact on banks.

Jobst and Lin (2016) claim that "The exemption threshold should be as high as possible to minimize the banks' average cost of holding excess reserves while being sufficiently low to transmit the marginal policy rate to money markets" [45]. In fact, the first two tiers which were the ones holding the majority of reserves, were not charged a negative rate: in this way only a small fraction of reserves

[42] "Central banking below zero: the implementation of negative interest rates in Europe and Japan", Stefan Angrick and Naoko Nemoto, April 7th, 2019

[43] "The effectiveness of the negative interest rate policy in Japan: an early assessment", Yuzo Honda and Hitoshi Inoue, April 5th, 2019

[44] "Negative Interest Rate Policies. Sources and implications", Carlos Arteta et al., April 5th, 2019

[45] "Negative interest rate policy (NIRP): Implications for monetary transmission and Bank Profitability in the Euro Area", Andreas Jobst and Huidan Lin, May 17th, 2019

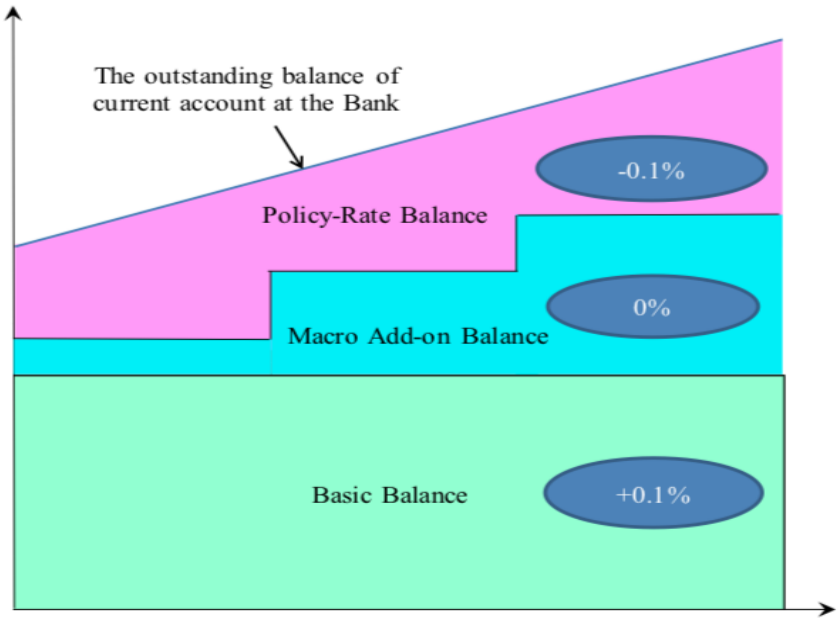
was affected by the policy and so the rate could be set at more negative values. This distinction is important for both how expectations react and thus on the overall impact for the economy.[46]

The first tier is the positive rate "basic" balance, which had a 0.1% remuneration so about 210 trillion yen and was calculated as the difference between the average outstanding balance during the benchmark reserve maintenance periods (from January 2015 to December 2015) and the amount of required reserves for the same period (Shirai, 2018). The difference is supposed to remain constant as the amount of required reserves is not expected to change much over time.

The second was the zero-rate "macro add-on" balance, unremunerated at 0%, 40 trillion yen which growth is closely dependent on the amount of assets purchased by the central bank and thus is expected to continue rising as aggregate current accounts continue to increase. This balance is calculated as the sum of required reserves held by financial institutions subject to the Reserve Requirement System, the BOJ's outstanding lending schemes to banks, such as the Loan Support Program or funds to support financial institution in disaster areas after the 2011 tsunami or the 2016 earthquake (all subject to 0% lending rate). These facilities were exempted as to not discourage their provision and later in March 2016 further preferential treatment was enacted for them.

Finally, the negative rate "policy-rate" balance with an interest rate at -0.1% accounting for 10 trillion yen, amount which is maintained through the use of the Benchmark Ratio.

Figure 5. The three-tier negative rate system



[47]

[46] "Central Banking below zero: the implementation of negative interest rates in Europe and Japan", Stefan Angrick and Naoko Nemoto

[47] "Key points of today's policy decision", Bank of Japan, April 7th, 2019

To avoid that financial institutions increased their amount of cash reserves rather than holding reserve balances, BOJ decided that increases in cash holdings would be deducted from Macro add-on balances, and if the increase was significant with respect to the maintenance period benchmark, from the Basic Balance too.

There are two reasons why the BOJ decided to employ a multiple-tier system, previously employed by the ECB and the Swiss National Bank: on the one hand it was meant to preserve the functioning of the money market, and on the other to mitigate the impact of introducing the negative interests in the banking sector though some exemptions. In fact, thanks to this differentiation, the weighted average of the three interest rates on the current account balance remained above zero after the introduction of the NIRP: before the introduction the weighted average was 0.096%, then it gradually declined to 0.07% and finally to 0.06% in November 2016.

A reason why the BOJ deemed that a deposit rate should remain positive, was for the functioning of interbank money markets: a positive rate served as connecting an uncollateralized overnight call market rate, the main operating target for market operations at the time, to the target level determined under the CME. Thus, the deposit interest rate formed a floor while a ceiling on call market rate was determined by the official discount rate. Before the implementation of the NIRP commercial banks would profit from the spread among the deposit rate (0.1%) paid by the central bank and the uncollateralized overnight call rate (0.07%) paid to nonbank financial institutions for borrowing. Commercial banks would therefore profit from this positive difference, and nonbank financial institutions would profit from the small but positive 0.07% rate on funds provided.

Thus, through these arbitrage opportunities, the deposit rate had the role of contributing to maintain interbank market functions between commercial banks and nonbank financial institutions. Even more importantly, when the QQE was introduced, the deposit rate became fundamental in sustaining market transactions as the amount of liquidity introduced tended to decrease the size of the money market as there were lower borrowing and lending incentives.

For this reason, the central bank held as a general rule to maintain the floor function of a positive rate of interest on the current account balance as there were expectations that the NIRP would have eliminated such transactions. (Shirai, 2018)

When the announcement was made, at the question whether the policy would be effective even if negative interest rates were applied so narrowly, the BOJ (Bank of Japan, 2016) answered: “Although a negative interest rate is not applied to the total outstanding balances of current accounts, costs incurred with an increase in the current account balance brought by a new transaction will be minus 0.1 percent if it is applied to a marginal increase in the current account balance. Interest rates and

asset prices will be determined in financial markets based on that premise" [48]. Though the negative rate was applied on a small fraction of reserves, it was sufficient to push down the yield curve and to not be an excessive burden on banks.[49]

In September 2016 the BOJ launched the "yield curve control" meaning that it would keep under control short and long-term interest rates, in particular keeping short-term interest rates at -0.1% and continuing the purchase of government bonds to maintain the 10-year yield at zero percent. The announcement led to a shift downward of the yield curve and of the 10-year yields going below zero. Plus, NIRP caused a decrease in deposit and lending rates, and put a constraint on many regional banks' profitability.[50]

In their article for the "Journal of the Japanese and International Economies", Y. Honda and H. Inoue analyzed the immediate effects on the market of the policy announcement. The research[51] finds that in general the introduction of the negative rates, as well as that of QQE and Yield Curve Control (YCC), had a positive impact on the Nikkei Stock Average within three days from the announcement. Although, there can be three possible types of reaction looking more closely at every industry, which are favorable, unfavorable or mixed.

For instance, the banking and insurance stock indices fell sharply and thus did not experience a favorable outcome, contrarily to the real estate industry in which the response was at first favorable, but then turned negative (see Figure 6). The Japan Real Estate Investment Trust (J-REIT) was lying right above the Nikkei Stock Average during the days immediately following the announcement.

As far as it concerns market interest rates, both long-term and short-term rates drastically fell after January 2016, with the 10-year government bonds falling by 50 basis points and turned negative. Long-term rates quickly recovered to 0% and stayed constant until in September they became the operating target of the BOJ.

The Japanese nominal effective exchange rate had been appreciating since June 2015, as previously said, mostly driven by capital inflows due to concerns on deflation risks raising real interest rates. This caused a weakening of Japanese firms and of macroeconomic indicators such as retail sales and production.

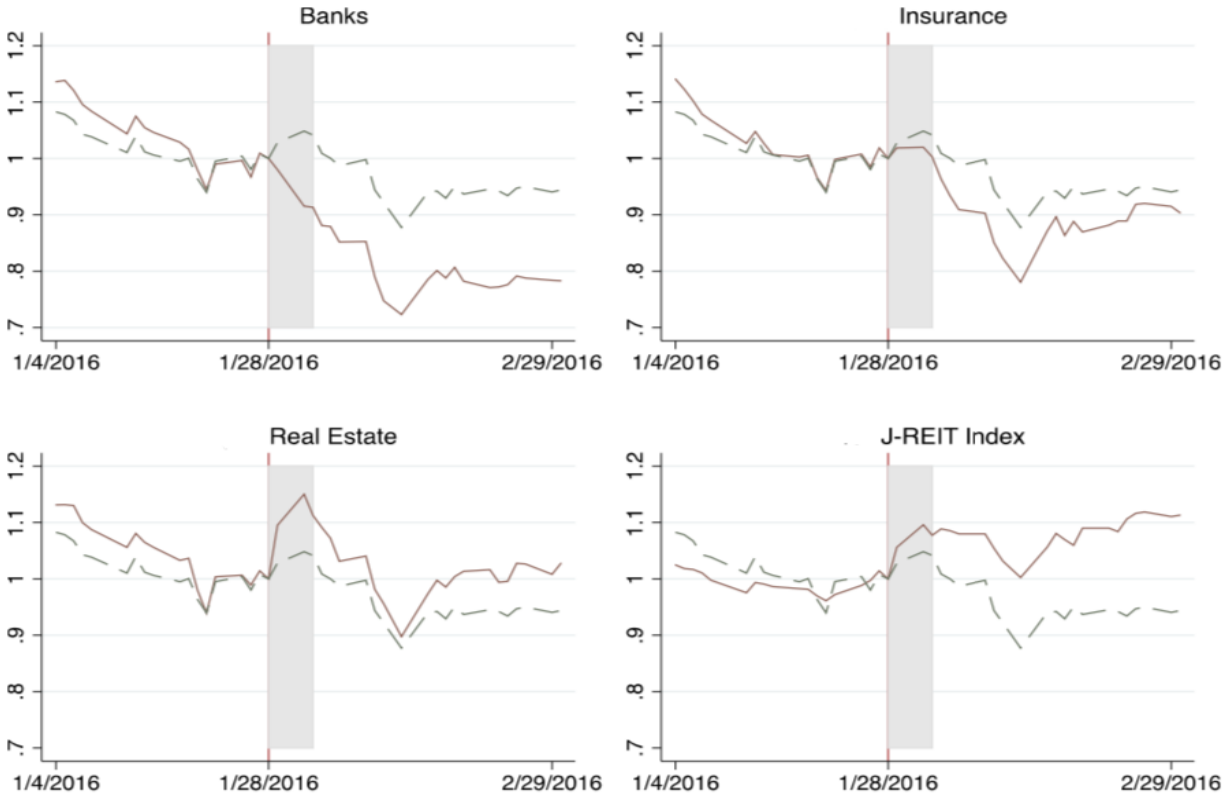
[48] "Key points of today's policy decision", Bank of Japan, April 7th, 2019

[49] "Central banking below zero: the implementation of negative interest rates in Europe and Japan", Stefan Angrick and Naoko Nemoto, April 7th, 2019

[50] "Unconventional monetary policies in the Euro Area, Japan, and the United Kingdom", Giovanni Dell'Ariccia et al., April 6th, 2019

[51] "The effectiveness of the negative interest rate policy in Japan: an early assessment", Yuzo Honda and Hitoshi Inoue, April 6th, 2019

Figure 6. Impact on the Stock Market



[52]

The introduction of negative interest rates induced insurance and pension funds to purchase more and more foreign securities as more profitable, thus stopping the appreciation of the yen which started depreciating in November 2016, probably due to Donald Trump's election and US Federal Reserve raising of the operating target.

Changes in the yen exchange rate directly affect the competitiveness of Japanese firms both in foreign and domestic markets, thus affecting industrial production. In fact, when the exchange rate appreciated in 2015, the industrial production declined, and when NIRP was introduced the decline halted.

As far as it concerns stock prices, their fluctuations seem to go together with those reported on nominal exchange rates.

The Tokyo Stock Price Index, which had been falling, arose in November 2016 while there was a rise in private residential investments of 3.3% and in nonresidential investments of 1.3%.[53]

[52] "The effectiveness of the negative interest rate policy in Japan: An early assessment", Yuzo Honda and Hitoshi Inoue, April 6th, 2019

[53] "The effectiveness of the negative interest rate policy in Japan: an early assessment", Yuzo Honda and Hitoshi Inoue, April 6th, 2019

1.3.2 A comparison with other Countries

Several banks have in the last years adopted Negative Interest Rates Policies (NIRPs), namely: Danmarks Nationalbank (DNB), the ECB, the Swiss National Bank (SNB), Swedish Riksbank. The general intent was to induce individuals to increase lending and purchase of financial assets, thus decreasing excess reserves.

Negative interest rates have been a phenomenon that has raised several concerns, such as the fear of compromising banks' profitability, a problem which is usually prevented by banks charging other non-interest fees as another source of income.

There are usually three major reasons why a central bank chooses to introduce a NIRP. The first is that when the economy is facing the risk of deflation, policymakers need to act aggressively and in time, monetary policy should be as expansionary as possible, even more than in a scenario of a zero-interest rate. Furthermore, NIRP is a signal of a long-term intention to keep interest rates low, thus shifting down the yield curve even more.

The second reason is that, given the programs undertaken by major central banks which expanded their balance sheets, the pool of eligible assets to be purchased has decreased. Measures like NIRP, are a tool of broadening the eligibility criteria in order to solve the problem of mismatch between supply and intended ECB's purchases. Finally, since it has been shown that the effects of QE may diminish and become less effective over time, NIRP is a useful method to follow the pattern of the effects QE was meant to create.

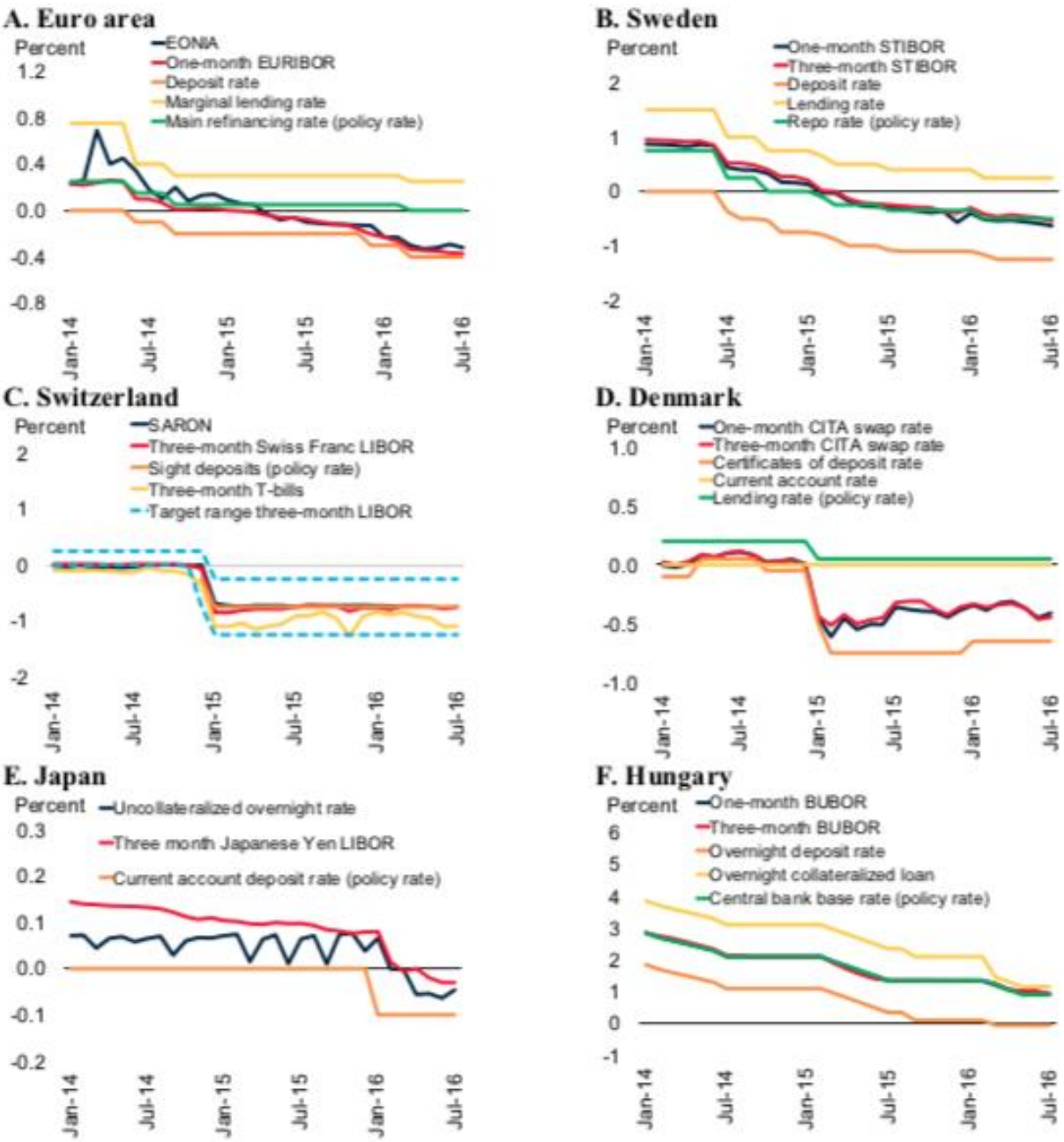
Though an unconventional tool, transmission channels of the NIRP work similarly to those of conventional monetary policies, in particular, NIRP affects the interest rate channel, the credit, portfolio, and exchange rate channel.

The prediction of the interest rate channel is that it should work by decreasing the rates at which financial intermediaries borrow and lend. Short term money market rates and bond yields shall become lower and, as a result of investors' arbitrage differences in risk-adjusted returns on debt-securities at different maturities, lower short-term interest rates shall cause long-term interest rates to decrease too. The effects of this channel may though be compromised if banks hesitate to impose negative interest rates on their customers, which may impede the pass-through to lending rates.[54]

[54] "Negative Interest Rate Policies. Sources and implications", Carlos Arteta et al., May 7th, 2019

Figure 7. Policy and Money Market Rates

Figure 5. Policy and money market rates



Sources: European Central Bank, Riksbank, Danmarks Nationalbank, Swiss National Bank, Bank of Japan, Central Bank of Hungary, Haver Analytics, Bloomberg, World Bank, Trading Economics.
Notes: Last observation is July 2016.
A. EONIA: Euro Over Night Index Average. Euribor: Euro Interbank Offered Rate.
B. STIBOR: Stockholm Interbank Offered Rate.
C. SARON: Swiss Average Rate Overnight.
D. CITA: Copenhagen Interbank Tomorrow/Next Average.
E. LIBOR: London Interbank Offered Rate.
F. BUBOR: Budapest Inter-Bank Offer Rate.

The expectations of this channel are also supported by the data which show the coincidence of decline in both deposit and lending rates together with the alteration of the policy rate: as figure 7 displays, in each graph there's a clear coordinated decline in the different rates before mentioned, including the different money market rates of each Country into consideration. We also notice that the interest rate corridor in most cases, where displayed, doesn't vary by much before and after the policy rate decline, except for example in the case of Denmark where we notice an increase after January 2015. The process is generally followed by a stabilization period, in which after the big decrease, rates do not vary by much (i.e. Denmark).

The credit channel, together with the interest rate channel, facilitates the amplification mechanism. It is triggered by the change in banks' willingness to extend credit and in households' and firms' external finance premium. In fact, NIRP can be considered as a tax on liquidity accumulation by banks, encouraging them to increase excess reserves to raise lending. Its effect may be compromised if banks increase their lending rates to compensate for the negative interest rate, and credit growth may be adversely affected. This effect is referred to as the "reversal rate" which is a point where increased cuts in the interest rate to provide for an accommodative monetary policy stop their function of a stimulus to the economy and constitute a constraint to Central Banks. [56]

Through the portfolio channel, a decline in short-term interest rates should be beneficial to high-yield assets such as equities, causing an increase in wealth by higher valuation and growth. This should work similarly with negative interest rates, though a threat for the risk of asset price bubbles.

Lastly, the exchange rate channel: when negative rates are employed, the currency depreciates and becomes less attractive relative to foreign rates, capital inflows are discouraged and net exports increase. This may not be true in case many Countries adopt NIRP, in which case the policy may lead to a "beggar-thy-neighbor" policies of competitive devaluations.[57]

There are other implications of negative rates, one of which is a possible redistribution of income: NIRP in fact, favors borrowers rather than savers and this may cause an increase in intergenerational inequality between the elderly who are mainly savers and the younger generations who are mainly borrowers. [58]

There have been different reasons that motivated the decision to move to NIRP, for instance, the ECB, the BOJ, and the Riksbank did it in order to stabilize inflation expectations and support growth.

[55] "Negative Interest Rate Policies. Sources and implications", Carlos Arteta et al., April 5th, 2019

[56] "The Reversal Rate", Markus K. Brunnermeier and Yann Koby, May 27th, 2019

[57] "Negative Interest Rate Policies. Sources and implications", Carlos Arteta et al., 2019

[58] "Negative interest rate policy (NIRP): implications for monetary transmission and bank profitability in the Euro Area", Andreas Jobst and Huidan Lin, April 5th, 2019

But there have also been different reasons, for example, the SNB and the DNB wanted to react to currency appreciation and pressures on capital inflow.

In Europe, the introduction of the NIRP was in June 5th, 2014 with a negative interest rate of -0.1% on its deposit facility, followed by another cut to -0.4% in March 2016 when the ECB communicated that it would continue cuts "to further ease financing conditions, stimulate new credit provision and thereby reinforce the momentum of the euro area's economic recovery and accelerate the return of inflation to levels below, but close to, 2%".[59] The effects of the NIRP in the Euro Area are hard to establish as during the same time policymakers undertook other measures, but evidence shows that the policy worked just as for policy rates cuts in a positive framework. Usually, cuts were followed by shifts downward of the yield curve, at first for Germany and then for Spain and Italy.[60]

The Swiss National Bank introduced negative interest rates of -0.75% in January 2015. In a Small Open Economy (SOE) such as Switzerland, the zero lower bound exerts a double constraint: on the one end, it represents the critical intertemporal trade-off as for the other economies, on the other, it is also the instrument of the SNB to maneuver the exchange rate. Although, SOEs in general also have a positive risk premium benefit as they are able to charge interest rates higher than those charged by other Countries on similar assets. The situation is though different for Switzerland which has a negative risk premium, as well as Denmark which is in a similar situation. The NIRP of the SNB is of particular interest because no other central bank has dared to push its interest rate this low, though the Swiss policy still prevents paper currency holding by the public by keeping retail depositors' rate at the zero-lower bound, together with an exemption threshold at 20 times required reserves. As showed below[61], the introduction of the negative rate set at -0.75% has been effective in guiding financial markets: it is clearly displayed how, even if at different maturities, all rates have been affected by the introduction of NIRP.

Despite the initial positive results, negative interest rates seem to be a tool that can be used only for a limited time. In fact, if protracted for long periods, or if too much below zero, they can cause problems like a diminishing of the profitability of banks. Furthermore, NIRP may also encourage excessive risk-taking, leading in the long term to the creation of asset price bubbles. It raises the question of how long they can be adopted before their distortions threaten financial stability.[62]

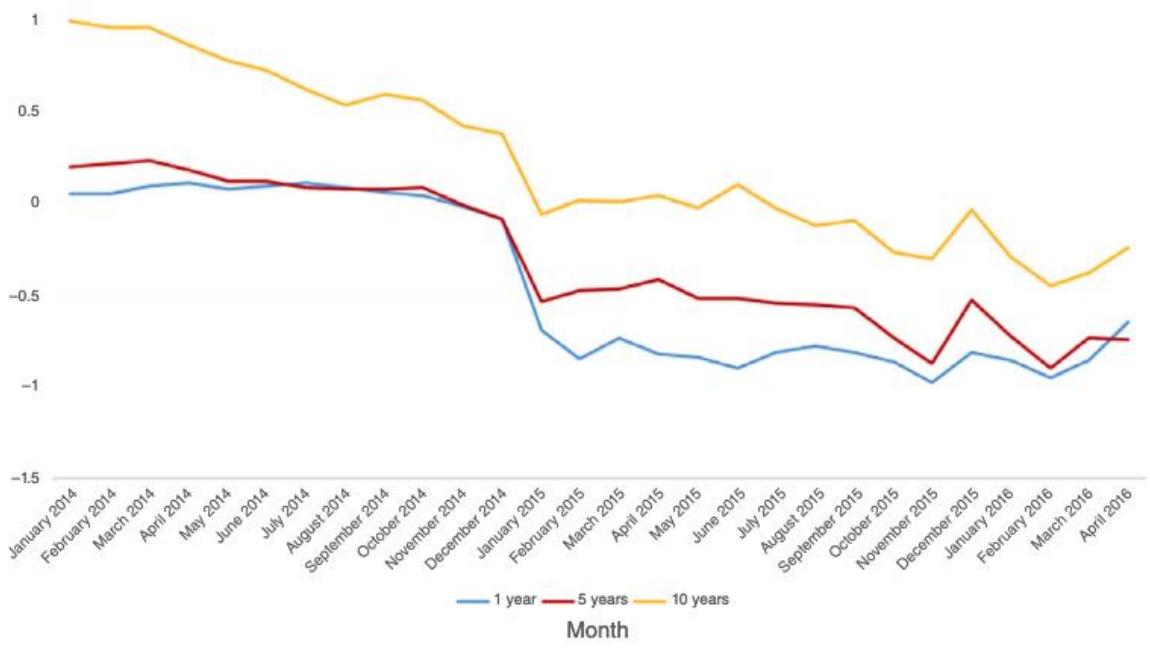
[59] "Negative Interest Rate Policies. Sources and implications", Carlos Arteta et al., April 4th, 2019

[60] "Unconventional Monetary Policies in the Euro Area, Japan, and the United Kingdom", Giovanni Dell'Ariccia et al., April 4th, 2019

[61] "Negative interest rates in Switzerland: what have we learned?", Jean-Pierre Danthine, April 5th, 2019

[62] "Negative Interest Rate Policies. Sources and implications", Carlos Arteta et al., April 5th, 2019

Figure 8. Swiss confederation bond yields 2014-2016 [color figure can be viewed at wileyonlinelibrary.com]



[63]

1.3.3 Concerns raised by the NIRP

Although it was not the first time that negative interest rates had been adopted on policy or money market rates, the NIRP's innovation is that it is an explicit announcement by central banks and requires a coordination at different policy levels to make the policy effective and stable.

The BOJ deems the results achieved by the introduction of negative interest rates a success but from other points of view, there are actually concerns and doubts on its benefits; there are in fact four major types of concerns raised by the policy.

First, there's the belief that it has deteriorated the function of the Japanese Government Bond (JGB) markets, as well as diminished liquidity. Introduced with the QQE, NIRP has aggravated these problems as more market agents have been discouraged to take part in transactions due to the negative rate, plus the lower amount of JGBs caused a decrease in monetary market activities.

Second, there are growing concerns over the financial stability of this system, essential for the effectiveness of monetary easing. As the Japanese financial system is dominated by banks, the BOJ has a particular interest in assessing the business operations, profitability, risk management and capital bases of financial institutions, as well as ensuring the ability of institutional investors to work successfully.

Commercial banks faced shrinking spreads between lending and deposit facilities since the introduction of negative interest rates, causing a decrease in their profitability.

[63] "Negative interest rates in Switzerland: what have we learned?", Jean-Pierre Danthine, April 5th, 2019

Some banks also suffered lower profitability due to a problem of maturity transformation: they would increase short-term funds and invest in long-term assets as the yield curve flattened. Some banks only could increase their super-long-term JGBs, lasting more that 10 years, to earn a positive yield and higher interest income. The result is an increase in interest rate risk and thus in the possibility of large losses due to changes in valuation of JGBs: volatility of interest rates amplified under the NIRP, creating chances for instability in the banking sector. (Shirai, 2018)

Related to this second point there had been also other concerns raised even by the Financial Services Agency (Financial Services Agency, 2016) in its report, in which it expressly stated to monitor "the sustainability of business models which lend/invest long with short term financing in the face of the continued interest rate decline, foreign currency liquidity management to address increase in overseas credit exposures and securities investments, downside effect of changes in the global economy and the financial market on banks' credit costs, interest rate risk as low liquidity and extraordinarily low term premium is observed in the JGB market, credit concentration risk to specific sectors, including lending to the real estate sector (e.g. apartment/house loans) though the loan growth is moderate compared to the past". [64]

Third concern is an adverse impact on the corporate sector pension funds and household sentiment: these received as a result of the policy, an increase in the present value of their pension liabilities which accounts for equivalent longer-term JGB yields and causing lower profits. While the liability side is increasing, there's no equivalent increase in the asset side.

Finally, BOJ's operational challenge and its balance sheet risk is another point raising concerns. NIRP raised doubts on the sustainability of JGB purchases: the program intended by the central bank in fact, meant that some existing investors have to renounce reinvesting redemptions of JGBs to allow the BOJ to continue the planned asset purchases. (Shirai, 2018)

As previously mentioned, the few historical precedents of the implementation of negative interest rates limit the possibility to asses more precisely their specific effects in the short-term as well as in the long-term. Only further experience with these policies will give us a more accurate analysis as well as evidence provided by more data.

[64] "Progress and Assessment of the Strategic Directions and Priorities", Financial Services Agency, April 7th, 2019

Chapter 2. A Counterfactual analysis of NIRP

In the previous chapter, we have described and analyzed several unconventional monetary policy tools. As mentioned previously, there are several doubts about the real effectiveness of these instruments and, in most cases, we do not have enough data to provide evidence for the claim that they certainly work. In this chapter, we will focus on negative interest rates and we will try to answer the question of whether their implementation has proved successful or not in both increasing inflation and foster economic growth, in particular from Japan's banking sector.

2.1 Pesaran and Smith's Counterfactual Model applied to NIRPs

The question on the necessity of the implementation of negative interest rates has been posed by many: in general policy makers tend to agree on the fact that a NIRP was indispensable despite the fact that few if any formal tests on its effects have been made yet.

As Goodhart (2013) highlighted, the effects of the introduction of negative interest rates may not cause the desired reactions on bank lending behavior from the supply side. We have discussed how economic agents may act against the intended policy direction in order to shield themselves.

In his study, Nektarios (2016) employs the model[65] developed by Pesaran and Smith (2016) of a counterfactual analysis to the decision of three central banks to implement the NIRP, namely the Danmarks Nationalbank, Swiss National Bank and finally the Riksbank.

In particular, the model focuses on ascertaining the effectiveness of the policy on inflation and on bank lending behavior. The counterfactual analysis considers a possible scenario that would have happened in the case a different action would have been undertaken. In particular, here we will try to answer the question of what would have happened to economic indicators, such as inflation and bank lending, if instead of a negative rate there would have been a zero interest rate.

R. Lucas (1976) in his Critique, expressed points that go against and question the validity of a counterfactual estimation: "Given that the structure of an econometric model consists of optimal decision rules of economic agents, and that optimal decision rules vary systematically with changes in the structure of series relevant to the decision maker, it follows that any change in policy will systematically alter the structure e of econometric models" [66]. The meaning of this is that whenever there is a policy change the model used changes as well, and thus the counterfactual analysis is flawed.

[65] "Counterfactual analysis in macroeconometrics: An empirical investigation into the effects of quantitative easing", M. Hashem Pesaran and Ron P. Smith, April 12th, 2019

[66] "Econometric policy evaluation: a critique", Robert Lucas, April 12th, 2019

Furthermore, the counterfactual analysis is purely quantitative and there are no ways to check its statistical significance.

In opposition to this consideration, A. M. Nektarios argues that a counterfactual analysis is "pursuing an ex post evaluation of a policy intervention […] where data are available both before and after the intervention" and this undermines Lucas' statement. In fact, "the computation of the proposed tests does not require knowing the post-intervention parameters" which makes the critique not applicable to this case since counterfactuals are obtained through pre-intervention parameter estimates.

After analyzing the findings of this research, we will apply the method to the case of the NIRP in Japan and see if the results differ or are similar to the ones of Nektarios' (2016) test.

2.1.1 Explanation of the model

Pesaran and Smith (2016) in their analysis showed that in multiple time-series regressions the focus on each coefficient's sign can prove misleading, thus we shall use a simple regression only including the regressor of interest and exclude other control variables.

As written in their research, to test the effects of a policy change first of all there is the need of a model capable of constructing counterfactuals for the target value in absence of the policy measure, and secondly, a method to determine if the difference between realized and counterfactual outcomes is larger than expected by change.

To do this they applied the Autoregressive Distributed-Lagged model (ARDL), method usually employed when working with time-series data. This model has proved to be robust to endogeneity and to the possibility of y_t and x_t having different degrees of stationarity.

We shall consider y_{it} as the target variable, w_{jt} as policy-invariant (control) variables, x_{it} as a policy variable and x_{jt} $(j \neq i)$ as variables which may be influenced by x_{it} and thus shall be excluded for the estimation. Thus, we are transferring on the policy variable x_{it} the effects transmitted by x_{jt} , for instance changes in exchange rates.

To obtain a robust estimate of counterfactuals we shall adopt a simple single equation specification: as written and mathematically demonstrated by Pesaran and Smith (2016) we may simplify to an infinite order distributed specification defined as:

$$y_t = c + \sum_{i=1}^{\infty} \lambda_i \, y_{t-i} + \sum_{i=0}^{\infty} \pi_{yx,i} \, x_{t-i} + \sum_{i=0}^{\infty} \pi'_{yw,i} \, w_{t-i} + \, v_t \qquad (1)$$

Given that we are now considering a stable dynamic model, the coefficients of the lagged variables decay exponentially, and thus the infinite order distributed lagged model can be approximated by

$$y_t = c + \sum_{i=1}^{p_y} \lambda_i \, y_{t-i} + \sum_{i=0}^{p_x} \pi_{yx,i} \, x_{t-i} + \sum_{i=0}^{p_w} \pi'_{yw,i} \, w_{t-i} + \, v_t \tag{2}$$

In particular, an ARDL (p_y, p_x, p_w) model in which p_y, p_x, p_w refer to the lag order of, respectively, the target variable, the policy variable and the exogenous variables. A lag order gives us a way to allow for any delays in the transmission of the effects of new monetary policy announcements.

Now we will explain how the policy ineffectiveness test was constructed.

We consider a policy change that takes place at time $t = T_0$ with effects from $T_0 + 1$ onwards.

In order to analyze the differences among counterfactual values and real values, Pesaran and Smith derived from equation (2) the benchmark specification model of an ARDL (1, 1, 0), defining pre- and post-intervention samples specifications, specifically equations (3) and (4):

$$y_t = c^0 + \lambda^0 y_{t-1} + \pi^0_{yx0} x_t + \pi^0_{yx1} x_{t-1} + \pi^{0'}_{yw} w_t + v_t \tag{3}$$

For t = M, M + 1, …, T_0 (T_0 being the period of policy intervention)

$$y_t = c^0 + \lambda^1 y_{t-1} + \pi^1_{yx0} x_t + \pi^1_{yx1} x_{t-1} + \pi^{1\prime}_{yw} w_t + v_t \tag{4}$$

For t = $T_0 + 1, T_0 + 2, \ldots, T_0 + H$ (H being the periods of the counterfactual forecast at T_0)

With $|\lambda^j| < 1$ for j = 0,1.

Thus, equation (3), the pre-intervention sample, includes data of periods before intervention, while equation (4), the post-intervention, includes observations from the period of implementation on.

Consider $\widehat{d_{(1)}}$ as the vector of policy effects, in which each element is defined as $d_{T_0+H} = y_{T_0+h} - y^0_{T_0+h}$.

Since y_{T_0+h} stands for the realization of the variable at hand at $T_0 + h$, and $y^0_{T_0+h}$ the counterfactual value of y at that time, we conclude that the difference between the actual and the counterfactual value is the effect from the policy change.

The vector of the policy effects is defined by $d_{(1)} = \mu_{(1)} + \nu_{(1)}$ with $\nu_{(1)}$ being the vector of errors.

Applying this to our dynamic specification we obtain the implicit null hypothesis of ineffectiveness,

testing whether there would have been significant changes if instead of the actual change the counterfactual took place:

$$\mu_{(1)} = y_{T_0}(\Lambda_H^1 \lambda^1 - \Lambda_H^0 \lambda^0)e_1 + \left[\Lambda_H^1 S_{(1)} \pi_{ys}^1 - \Lambda_H^0 S_{(1)}^0 \pi_{ys}^0\right] = 0 \quad (5)$$

and given that we also include other specifications valid also for the static case, the complete null hypothesis would be $H_0 : \mu_{(1)} = 0,\ \sigma_{0v}^2 = \sigma_{1v}^2, \lambda^0 = \lambda^1$

In the equation $\mu_{(1)}$ we shall clarify that:

- $S_{(1)} = [X_{(1)}, W_{(1)}]$ are the predictions of the policy values and the realized policy-invariant variables of the post-intervention sample
- Λ_H^0 and Λ_H^1 are given by the H x H lower triangular matrix:

$$\widehat{\Lambda}_H^0 = \begin{pmatrix} 1 & 0 \ldots & 0 & 1 & \ldots & 0 :::: \left(\hat{\lambda}^0\right)^{H-1} \left(\hat{\lambda}^0\right)^{H-2} \ldots 1 \\ \hat{\lambda}^0 & & & & & \end{pmatrix} \quad (6)$$

- π_{ys}^0 contains the estimated coefficients of $w_t \ and \ x_t$: $\pi_{ys}^0 = (\pi_{yx}^0, \pi_{yw}^0)$ [67]

When T is sufficiently larger than H, Pesaran and Smith (2016) show that the following t-statistics can be used to test the null hypothesis of policy ineffectiveness:

$$T_{d,H}^a = \frac{\sqrt{H}\ \widehat{d_H}}{\hat{\sigma}_{0v}\left(\frac{\tau_H' \widehat{\Lambda}_H^0 \widehat{\Lambda}_H^{0\prime}}{H}\right)^{1/2}} \sim N\ (0,1) \quad (7)$$

With $\hat{\sigma}_{0v}$ as an estimate of the residual variance obtained through the pre-intervention sample, and $\widehat{d_H}$ being the mean difference between actual and counterfactual values such that the following holds

$$\widehat{d_H} = \frac{1}{H}\sum_{h=1}^{H} \hat{d}_{T_0+h} \quad (8)$$

And

$$\frac{\tau_H' \widehat{\Lambda}_H^0 \widehat{\Lambda}_H^{0\prime} \tau_H}{H} = \frac{1}{(1 - \hat{\lambda}^0)^2}\left[1 - \frac{2}{H}\left(\frac{\left(\hat{\lambda}^0\right)^{H+1} - \hat{\lambda}^0}{1 - \hat{\lambda}^0}\right) + \frac{1}{H}\left(\frac{\left(\hat{\lambda}^0\right)^{2H+2} - (\hat{\lambda}^0)^2}{\left[1 - (\hat{\lambda}^0)^2\right]}\right)\right] \quad (9)$$

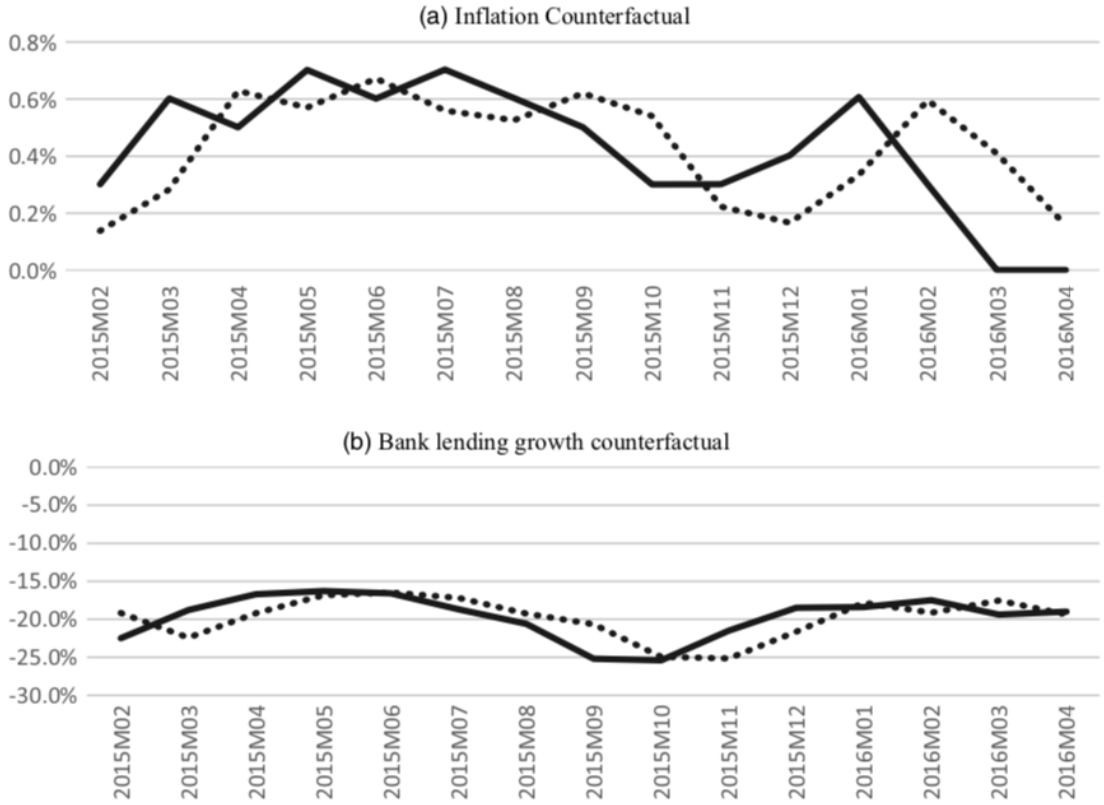
[67] "Counterfactual analysis in macroeconometrics: An empirical investigation into the effects of quantitative easing", M. Hashem Pesaran and Ron P. Smith, April 13th, 2019

In the counterfactual estimation conducted by Nektarios (2016), there's a distinction between the impact of negative interest rates on inflation and those on bank lending growth, thus two different equations are used on the basis of two target variables (y_t), namely the inflation rate and the change in bank lending. Meanwhile he keeps same policy (x_t) and same policy invariant (w_t) variables.
This analysis poses as the counterfactual to the implementation of negative interest rates, the maintenance of the interest rates at the zero-lower bound, thus not falling into the negative territory. This assumption may constitute a potential weakness of the test: a long-term zero interest rates can undermine their endogeneity to the economy, but not if the zero rate was considered binding.
Another crucial assumption is that no other significant policy change occurred in the analyzed period, or that it was ineffective.
As far as it concerns the analysis on Switzerland, the period tested ranges from January 1997 to April 2016, instead for both Denmark and Sweden it goes from January 2003 to April 2006.

2.1.2 Results

In the case of Danmarks Nationalbank (DN), when the NIRP was implemented there were no other major policy measures, except negligible intervention in the euro/krone exchange rate.
In Denmark the negative interest rate policy consisted of two different phases: the first from July 2012 to April 2014, in which the minimum rate reached was -0.20%, and the second from September 2014 to April 2016, which instead got to a minimum of –0.75%.
In figure 9 we see the actual, indicated with the black line, and the counterfactual path, the dotted line, for the two indicators taken into consideration: inflation and bank lending.
It is easy to notice how the path obtained through the hypothesis of a rate kept at zero does not significantly differ from the actual path obtained through the introduction of a negative rate, it only seems to delay to a small degree the effects.

Figure 9. Denmark's present and counterfactual estimation results.



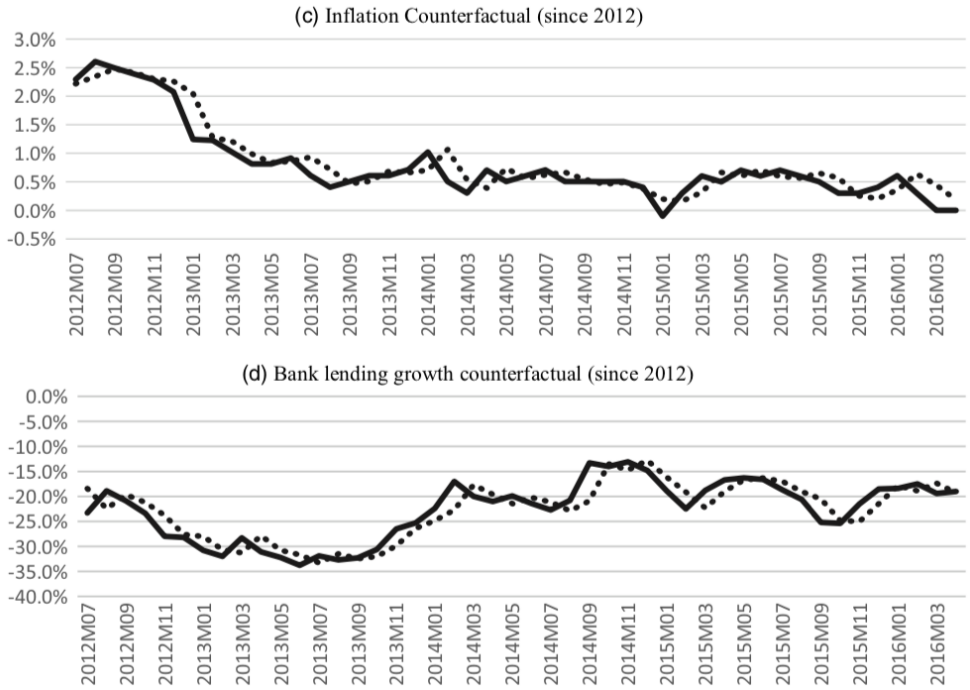
[68]

If we consider the same indicators' movements but in the case of Sweden (figure 10) we see a similar outcome: the actual and the counterfactual lines do not differ by much, especially for the case of inflation. The more noticeable differences in panel b may be attributed to the higher growth rates associated with bank lending which allow for more deviation.

In figure 11 we can see the results of the counterfactual estimation for Switzerland, which shows a similar result to the ones obtained on the other two countries. An exception is the case of bank lending which at first shows a different response (from December 2014 to January 2015).

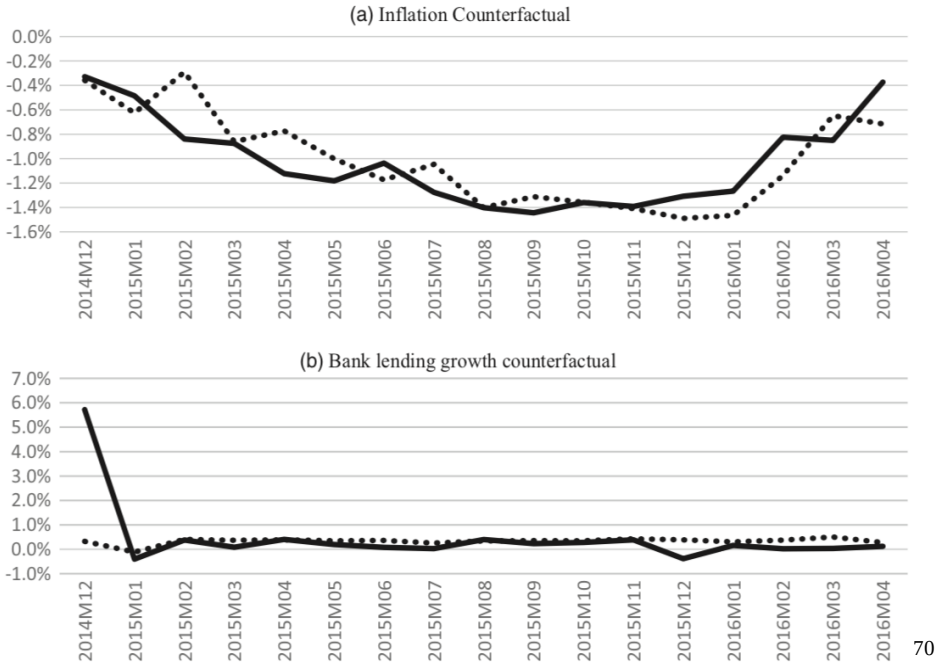
[68] "What if they had not Gone Negative? A counterfactual Assessment of the Impact from Negative Interest Rates", Nektarios A. Michail, April 16th, 2019

Figure 10. Sweden's present and counterfactual estimation results.



[69]

Figure 11. Switzerland's present and counterfactual estimation results.



[70]

[69] "What if they had not Gone Negative? A counterfactual Assessment of the Impact from Negative Interest Rates", Nektarios A. Michail, April 19th, 2019

[70] "What if they had not Gone Negative? A counterfactual Assessment of the Impact from Negative Interest Rates", Nektarios A. Michail, April 16th, 2019

Furthermore, to test the strength of the findings of this model, we shall consider the t-statistic values.

Figure 12. T-test values for the policy ineffectiveness test

Country/ dependent variable	t-statistic	λ^0
Sweden - Inflation	0.027	0.93
Sweden – Bank lending growth	-0.006	0.98
Denmark – Inflation since 2012	-0.086	0.94
Denmark – Bank lending growth since 2012	0.002	0.97
Switzerland - Inflation	-0.015	0.92
Switzerland – Bank lending growth	0.658	-0.10

λ^0 being the coefficient of the first lag of the dependent variable (see Equation 3). [71]

We see that the null hypothesis of ineffectiveness is not rejected in any case, plus the magnitude of rejection allows us to exclude the influence of some biases such that could cause a change in the results of the analysis.

We can further examine the robustness of the test by considering another T-test now examining the effects on a policy environment where in the pre-intervention sample unconventional monetary policy tools are not taken into account. The test thus is applied before the ZLB was binding and when the policy rate was not less than 0.50%

Figure 13. T-test values for the policy ineffectiveness test before the ZLB was binding

Country/ dependent variable	t-statistic	λ^0
Sweden - Inflation	0.237	0.94
Sweden – Bank lending growth	-0.188	0.97
Denmark – Inflation	-0.045	0.95
Denmark – Bank lending growth	0.013	0.97
Switzerland - Inflation	-0.148	0.91
Switzerland – Bank lending growth	0.737	-0.08

[72]

[71] "What if they had not Gone Negative? A counterfactual Assessment of the Impact from Negative Interest Rates", Nektarios A. Michail, April 16th, 2019

[72] "What if they had not Gone Negative? A counterfactual Assessment of the Impact from Negative Interest Rates", Nektarios A. Michail, April 16th, 2019

Once again, the results prove that the hypothesis of policy ineffectiveness cannot be rejected and at the same time the grounds for biases related to the Lucas critique are reduced.

The fact that the impact of negative interest rates on bank lending growth has not been significant may be explained thanks to Goodhart's (2013) argument that more than the rate on excess reserves, what really makes a significant change in the supply of bank loans is the influence of three combined main factors: the target return on equity, the marginal bank funding cost spread above the official rate and the perceived probability of default. These factors are inversely related to the amount of lending so the higher they are, the less a bank will lend, whereas if they are low a bank will increase the loan rate-official rate spread such that the latter will be constrained. [73]

As a result of this claim, QE and NIRP measures are constrained to have only a limited impact.

Except for the expected probability of default, it is possible to use estimates for the ROE and the marginal spreads of funding, which are respectively interest rate margins (IRMs) and Credit Default Swaps (CDSs) spreads. CDS are in fact an indicator of the market expectations of the possibility of default of the issuer of a security. Their spread is nothing else than their price.[74] Therefore, the higher this expectation the lower the quantity of loans supplied.

We may now see the impact of NIRP on these factors' proxies.[75]

In the case of Switzerland there are no data on IRMs publicly available, the 2016 Financial Stability Report of the SNB states that: "Remarkably, domestically focused banks' average interest rate margins on outstanding claims stabilized at a low level in 2015, after a seven-year downward trend. This occurred despite liability margins slipping further into negative territory […]" [76].

The same stabilization also occurred for Sweden and Denmark: see Figure 14 where the solid line represents the actual and the dotted the counterfactual.

Thus, the analysis on IRMs can be conducted only for Nordic countries. According to Goodhart's claim, the effect of the introduction of negative interest rates should be the increase of IRMs and the decrease of CDS spreads.

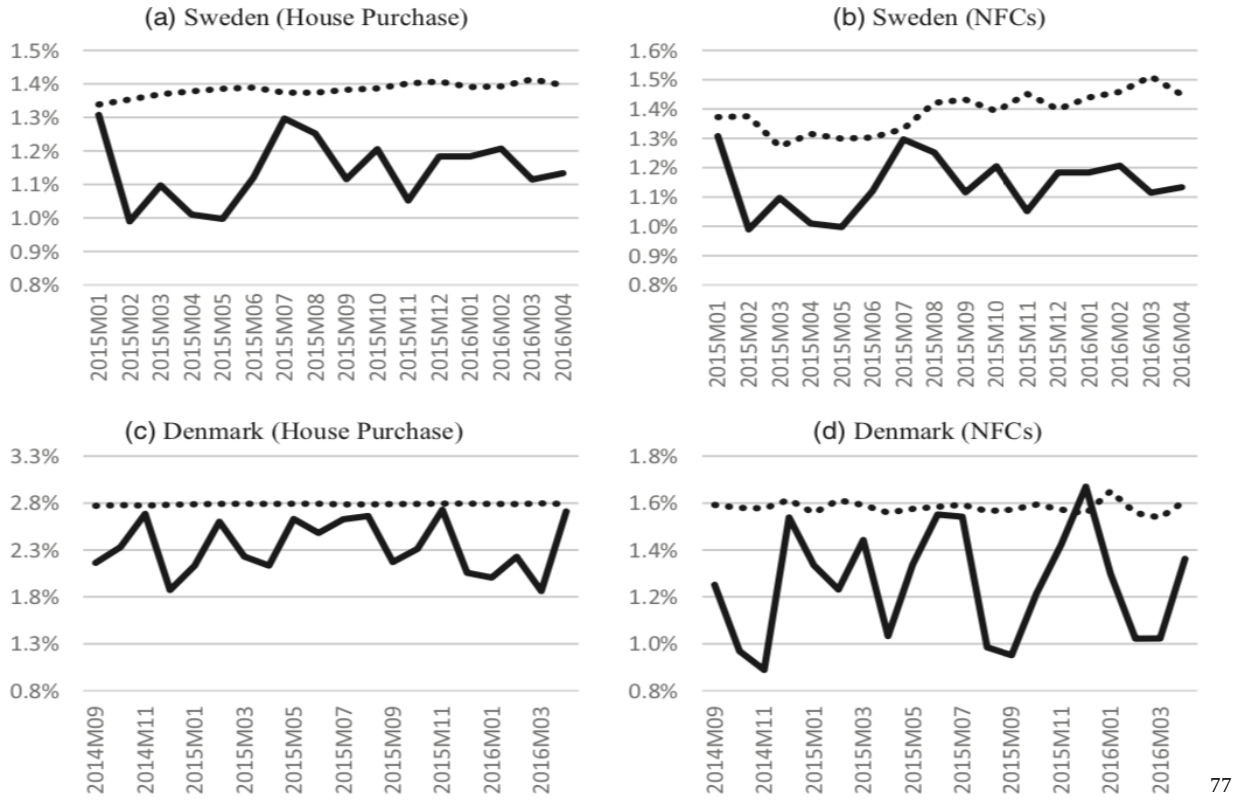
[73] "The potential instruments of monetary policy", Charles A. E. Goodhart, April 19th, 2019

[74] Definition by https://baselinescenario.com/2008/11/28/credit-default-swaps-bankruptcy-prediction/

[75] "What if they had not Gone Negative? A counterfactual Assessment of the Impact from Negative Interest Rates", Nektarios A. Michail, April 16th, 2019

[76] "Financial Stability Report", Swiss National Bank, April 19th, 2019

Figure 14. Interest Rate Margins



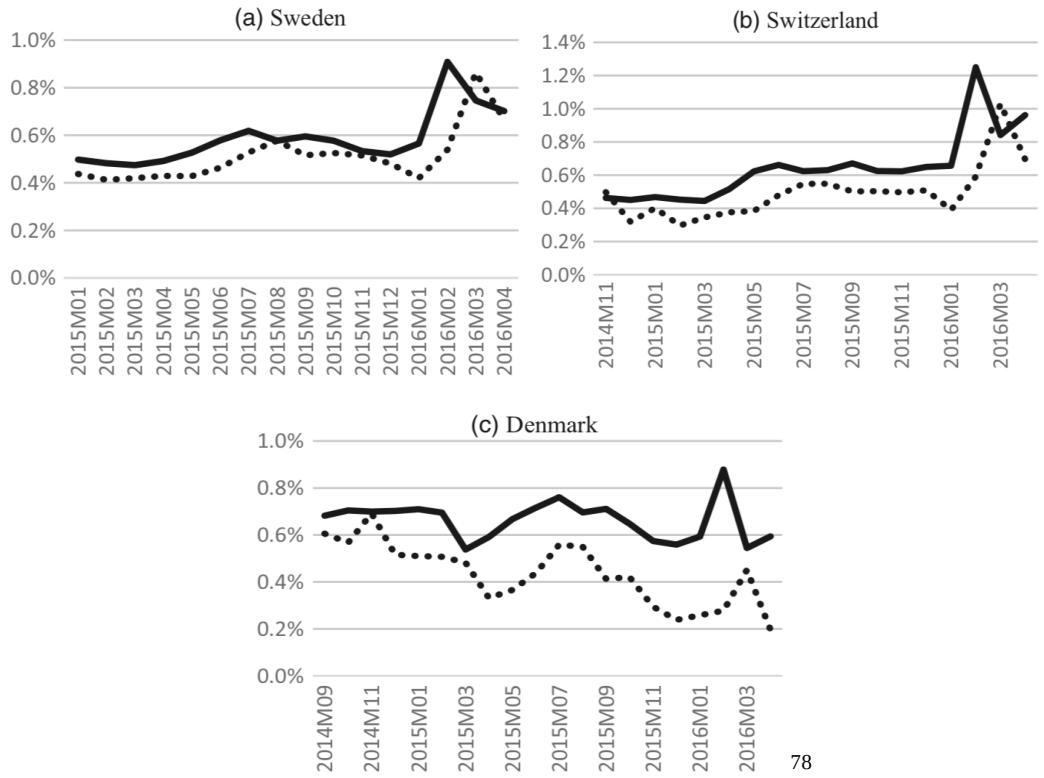
[77]

By Figures 14 and 15, we observe the estimation's results for IRMs and CDS spreads. As we see, Goodhart's prediction proves true: in the first picture, we can clearly see the counterfactual having higher IRMs than the actual scenario in all countries, whereas in the latter picture CDS counterfactual spreads are actually lower.

In Figure 16 we observe the values obtained for the test on the null hypothesis of policy ineffectiveness. As we see, the results substantially differ from those obtained before: now in the majority of cases the null hypothesis is rejected at 5% with two exceptions (in bold) rejected respectively at 10% and 6%.

[77] "What if they had not Gone Negative? A counterfactual Assessment of the Impact from Negative Interest Rates", Nektarios A. Michail, April 19th, 2019

Figure 15. CDS spreads



[78]

Figure 16. T-test values for the policy ineffectiveness test

Country/ dependent variable	t-statistic	λ^0
Sweden – CDS spread	**1.66**	**0.03**
Sweden – Net Interest Margin (NFCs)	-4.72	0.36
Sweden – Net Interest Margin (Households)	**-1.94**	**0.75**
Denmark – CDS spread	4.20	0.05
Denmark – Net Interest Margin (NFCs)	-3.28	0.38
Denmark – Net Interest Margin (Households)	-2.94	0.61
Switzerland – CDS spread	3.09	-0.15

[79]

In this estimation as well, we arrive to the conclusion that the overall impact of NIRP was not effective on bank lending growth.

[78] "What if they had not Gone Negative? A counterfactual Assessment of the Impact from Negative Interest Rates", Nektarios A. Michail, April 19th, 2019

[79] "What if they had not Gone Negative? A counterfactual Assessment of the Impact from Negative Interest Rates", Nektarios A. Michail, April 19th, 2019

2.1.3 Conclusions

In conclusion, we may say that the introduction of a NIRP in each of the three countries under study has not had the desired effect on inflation nor on bank lending growth.

The analysis carried out above, through the use of the ARDL model, shows how we cannot reject the null hypothesis of policy ineffectiveness on different grounds and usually by a substantial value of the t-statistics.

The test also proves to be immune to Lucas critique and is thus more reliable. As clearly stated by Pesaran and Smith in their research "the Lucas Critique is not an issue since the counterfactual […] will embody pre-intervention parameters, while the actual post-intervention outcome will embody any effect of the change in policy, the change in parameters, and the consequent change in expectations". [80]

Overall, the results obtained from the estimation seem to lead to the conclusion that bank profitability has been eroded through the use of NIRP, while its effect is not substantial nor considerably different from what would be obtained by keeping interest rates at the zero-lower bound. Outcomes usually attributed to the implementation of negative interest rates may have been extremely similar even without employing an unconventional monetary policy measure.

Although, the fact that unconventional monetary policy doesn't seem to have a significant impact on inflation or on bank lending, meaning that it is not a good incentive to modify bank lending behavior, may still leave space to the possibility that it may actually work by influencing the supply side of banking.[81]

[80] "Counterfactual analysis in macroeconometrics: An empirical investigation into the effects of quantitative easing", M. Hashem Pesaran and Ron P. Smith, April 19th, 2019

[81] "What if they had not Gone Negative? A counterfactual Assessment of the Impact from Negative Interest Rates", Nektarios A. Michail, April 19th, 2019

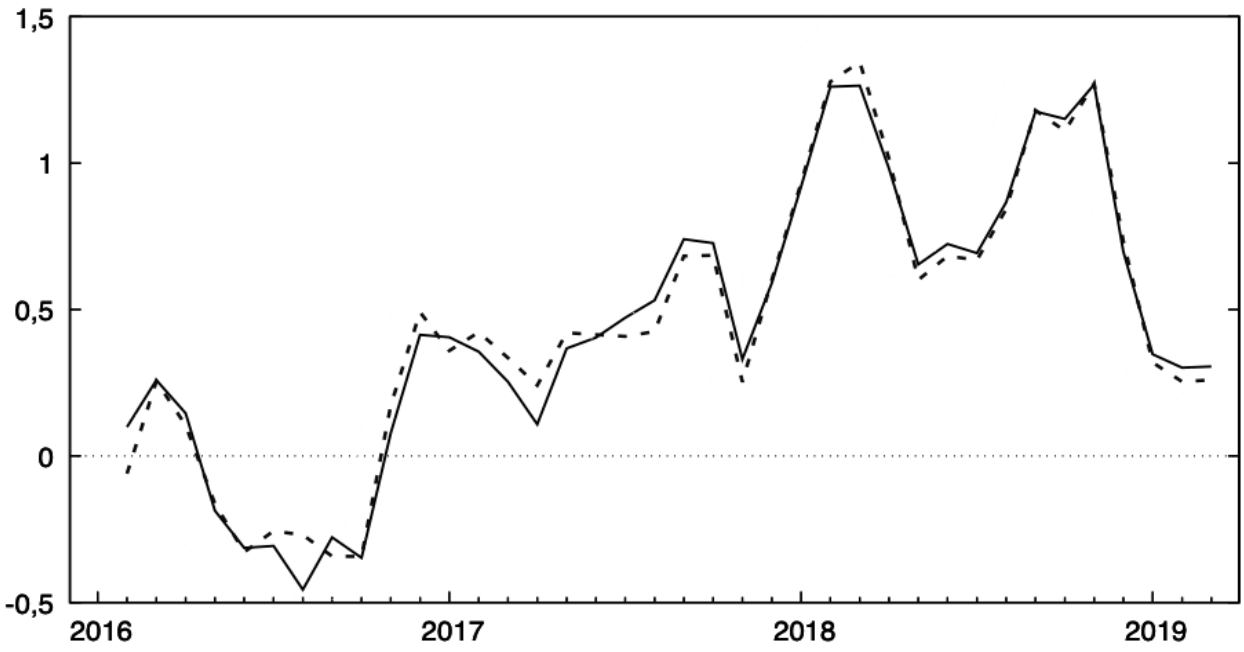
2.2 Empirical Analysis: the case of Japan

We will now carry an analysis based on that methodology but applied to the case of Japan's negative interest rate policy. For the purpose of performing the estimation and analyze the results on graphs, we will use *Gretl*, so that we will then be able to compare our outcomes to the ones observed for Denmark, Sweden, and Switzerland.

Firstly, we will carry out the estimation of Japan's inflation rate as the dependent variable, the short-term policy interest rate and the oil price growth rate as the policy variable and the policy invariant variable, respectively. The choice of the growth rate of oil price as the control variable is the same used in the model[82] taken into consideration before as an exogenous indicator.

The OLS regression has been realized by inserting data on the variables we mentioned above and, considering that we are applying the ARDL(1,1,0) model, we will use the lags of the dependent variable and of the policy rate to take into consideration some delay in the effects of the monetary policy. In the figure below are represented the results of the first regression.

Figure 17. Inflation Rate, Actual and Counterfactual estimation Results



[83]

The graph shows an outcome similar to the one obtained for Denmark in the period after 2012: generally, the zero-interest rate counterfactual scenario, represented by the dashed line, does not seem to differ greatly from the actual negative rate, the solid line, outcome. In some periods, such as in the

[82] "What if they had not Gone Negative? A counterfactual Assessment of the Impact from Negative Interest Rates", Nektarios A. Michail, April 19th, 2019

[83] Data on Inflation from https://ycharts.com/indicators/japan_inflation_rate ,
Data on Oil prices https://fred.stlouisfed.org/series/DCOILBRENTEU

first half of 2017, or the mid-2016, the zero-rate counterfactual seems to cause the inflation rate to be less volatile and higher than the level we see in the negative interest policy line. Although, this cannot be a generalization as in some cases the counterfactual line also lies below the actual one, such as in the mid-2018 or in the first months of 2019.

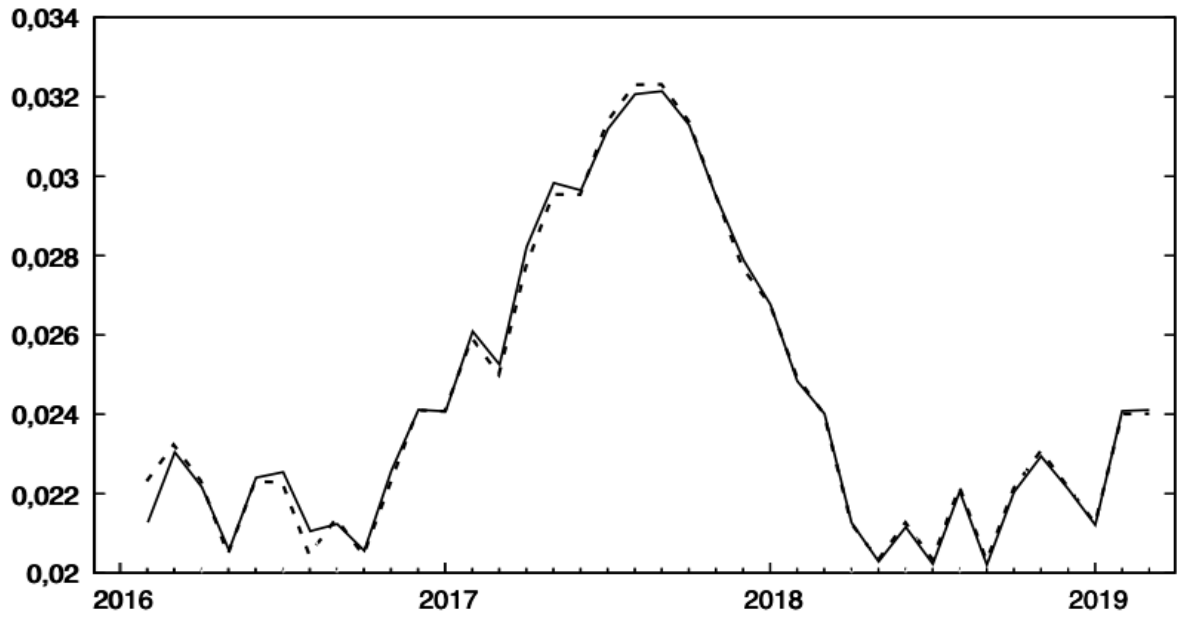
Overall, we may say that the impact of the NIRP was not so different than what would have been obtained by a Zero-Interest Rate Policy (ZIRP). To confirm what we deduce from the graph we look at the value of the t-statistic for the null hypothesis of ineffectiveness of the policy rate. As shown by the Table below, the t-statistic is too small to reject H_0 at $\alpha = 0.05$ (as we would reject for $t \geq 1.68385$), even though the null is not as strongly rejected as in the previous cases.

We may also look at the p-value (see the Appendix) for evaluating if there are reasons why we should believe that the null hypothesis does not hold and thus that the NIRP was effective. The p-value is equal to 0.2479 which does not allow us to reject the hypothesis of ineffectiveness.

	t-statistic	λ^0
Inflation	1.18	0.78

To analyze the results of the test in the case of the bank lending growth, we used as a parameter in the regression, instead of the oil price growth rate, the United States index of industrial production as the previous shouldn't be a driver of lending growth[84].

Figure 18. Bank lending growth, Actual and Counterfactual estimation Results



[84] "What if they had not Gone Negative? A counterfactual Assessment of the Impact from Negative Interest Rates", Nektarios A. Michail, May 13th, 2019

The outcome is similar to the one that was obtained before, though in this case the ZIRP shows most markedly a performance almost identical to the one of the NIRP with only some very small differences in the first period. The result is confirmed by the value of the t-statistic which marks a strong not rejection of the ineffectiveness hypothesis, confirmed by a p-value of 0.3007 (see the Appendix).

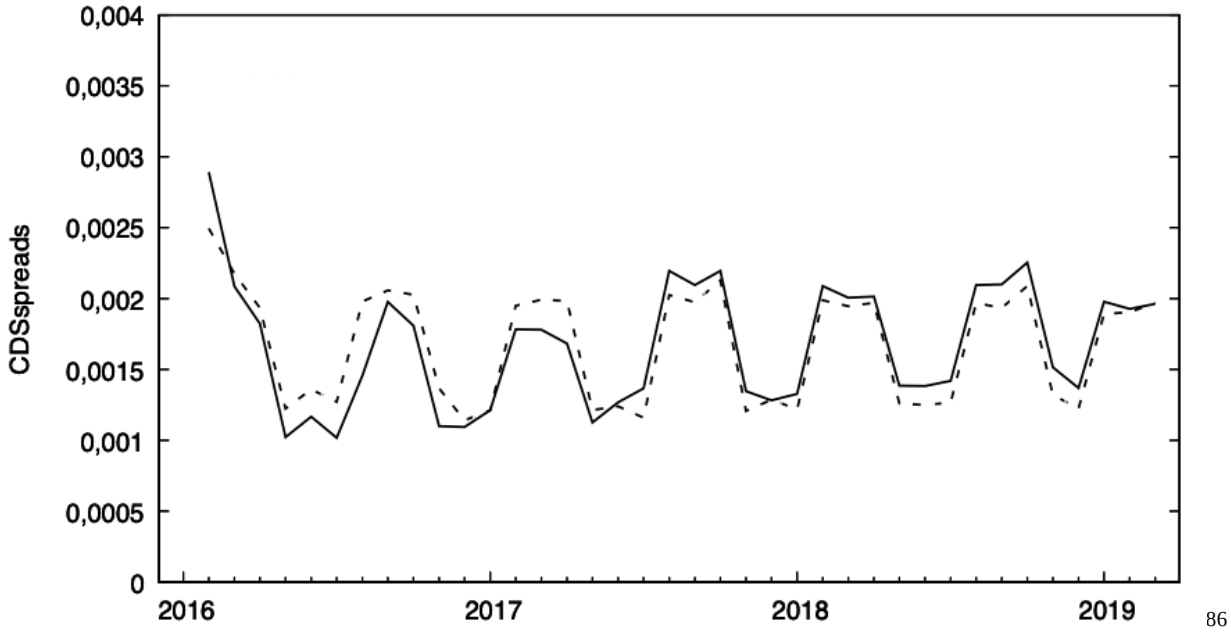
This result is crucial as it provides evidence for the claim that the original purpose of NIRP of spurring bank lending is in reality refrained by banks concerns on financial stability.[85]

	t-statistic	λ^0
Bank lending growth	-0.89	0.92

An interesting result is found by analyzing if there's any difference in the outcomes on CDS spreads and on IRMs as indicators. The outcome of the regression generated in Figure 15, a counterfactual line below the actual one with a significant margin of rejection of the null hypothesis at the 5% level, though one exception, Sweden, in which the null can be rejected only at the 10% level.

In Japan's case (Figure 19) until the mid-2017 the ZIR-line is above the NIR-line which goes against Goodhart's (2013) forecast that the former should have laid below.

Figure 19. CDS spreads, Actual and Counterfactual estimation Results



[86]

[85] "Progress and Assessment of the Strategic Directions and Priorities", Financial Services Agency, May 13th, 2019

[86] Data on CDS on https://www.datagrapple.com

In Goodhart's (2013) prediction, it is stated that the higher this spread, the lower banks' interest in to expand credit provision in the private sector. He furthermore says that moving to negative interest rates would increase CDS. The results thus suggest that until June 2017 the effect of the introduction of a negative policy rate was actually the opposite of the one predicted by Goodhart, and that actually moving towards the negative territory lower CDS spreads.

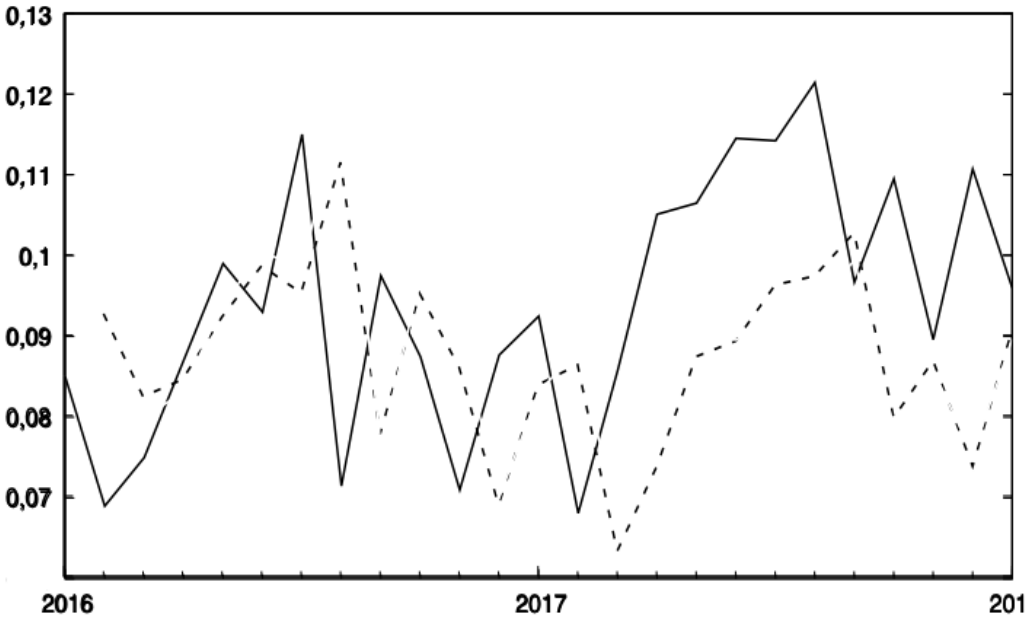
The second part of the graph though, sees an inversion of the trend and now the counterfactual of a zero-policy rate respects the prediction and lies below its negative rate counterpart. Even so, the departure from the actual values is not much significantly different compared to the results obtained in the other Countries' cases.

	t- statistic	λ^0
CDS spread	1.133	0.36

As a result, the t-statistic of 1.133 cannot be rejected neither at the 5% level nor at the 10% level and the p-value continues to have a vale small, equal to 0.265.

Due to scarcity of recent public data on IRMs for Japan, we will use for the final estimate data available on the Return on Equity (ROE). This regression will range from January 2016 to January 2018 as more recent data has not been publicly published.

Figure 20. ROE, Actual and Counterfactual estimation Results



[87]

[87] Data on Return on Equity from: https://www.ceicdata.com/en

We observe from the graph two strong differences between the counterfactual and the actual scenario: the first based on the timing of the movements in the two curves, as some events seem to be anticipated in the NIRP scenario and delayed in the counterfactual, the second on the value of the ROE, which especially in early 2016 and later in mid-2017 displays differences in the magnitude of falls and increases.

In this case too Goodhart's prediction is proved true after 2017 and, differently from the case of CDS, the divergence is substantial. In fact, differently from previous tests, now we can reject the null hypothesis at the 10% level of significance as the absolute value of the t-statistic is greater than 1.30308, even if not by a wide margin.

	t-statistic	λ^0
Return on Equity	-1.339	0.77

The results of our estimation overall, clearly cannot reject the hypothesis of ineffectiveness of the NIRP in any case, with an evidence which is even more strongly supported by the counterfactual analysis than in the cases of Switzerland, Sweden and Denmark.

As pointed out in the original analysis[88], this lack of effectiveness may be due to the fact that the negative interest rate should have been pushed further into the negative territory in order to cause a significant effect into the bank lending sector.

[88] "What if they had not Gone Negative? A counterfactual Assessment of the Impact from Negative Interest Rates", Nektarios A. Michail, May 13th, 2019

Conclusion

We have analyzed Japan's negative interest rate policy, starting from its particular three-arrow strategy to its immediate effects on the Japanese economy. Then we analyzed, through the estimation of a counterfactual zero-policy rate scenario, whether it was really necessary to go into negative territory and what would have been the results if the BOJ would have kept the interest rates at the zero-lower bound. The counterfactual analysis of Japan's rate effects on inflation and bank lending growth led to the conclusion that negative rates have not played a decisive role, or at least not a remarkably different role than a zero-rate would have played. The results conclude that a zero-interest rate policy would have been as effective as the NIRP, with only some differences in the timing and in the magnitude at different times.

In the case of inflation, sometimes a zero rate may have actually yielded higher levels than the results obtained in the negative real scenario but in some cases, it would have been the opposite too (i.e. around May-July 2018, see Figure 17). In the end, Japan would still have had the same problem that it has been facing for several years now of a low inflation rate. The target of 2% seems still to be a difficult task to achieve for a Country that has been trying so hard to reach it and through many expansionary monetary policy measures.

Even more strongly, results for bank lending show that the further expansion of monetary policy did not have substantial effects. This result may be a reflection of the fact that the Japanese economy has been experimenting for several years now with monetary easing and accommodative monetary policies and thus economic agents, in this case banks, are not that decisively shocked by the introduction of the NIRP as instead one would expect in a normal economy. The economic stimulus of a negative rate may have not been high enough to cause changes in banks' loan supply and thus the impact of a ZIRP might have worked just as well. Even if negative rates may reduce banks' willingness to hold reserve deposits this does not mean that they will necessarily increase their lending.

Another hypothesis is that the rate should have been lowered further but, though this strategy might have succeeded in creating a greater response, it might have increased problems in economic stability. We recall that implementing this kind of unconventional tools has many cons which create distrust and disbelief in the well-functioning of the economy under this policy. Distrust on financial stability

may have still prevented banks to increase their supply of loans and the results of the counterfactual estimation might have still been very similar.

The more specific analysis on the specific factors we considered for assessing if there were any more internal changes in bank lending, led to more interesting results.

For CDS, we could actually see an inversion of our predicted results which showed that before mid-2017 the negative interest rates did actually a good job in keeping this spread low and thus having a positive effect for lending. Although, the second part of the graph shows the opposite and the test for ineffectiveness is not rejected. Maybe other factors indeed caused this switch which we cannot still relate to the NIRP. This may in fact be confirmed by a poor R^2 of the regression (see Appendix, Figure 23). If this measure tells us how well our independent variable predicts the dependent variable, we see that here there's only a 18% for the value of R^2 which confirms our hypothesis that other factors may have determined the difference in the relation of the actual and the counterfactual lines.

In the case of ROE instead we are able to reject the null and also the graph shows a significant difference, particularly after February 2017. Before in fact we may recognize a delay in the changes on ROE related to the counterfactual line if compared to the actual line of circa a month. Even so, the negative-rate seems to have positively affected ROE which, being a measure of banks' performance, shows that the claim of a decrease in their profitability due to this policy is not necessarily true in this case. According to Goodhart's (2013) claim though, an increase in ROE erodes bank lending which does still gets us back to the conclusion that the NIRP was not effective for its scope. These results tell us that a zero-rate would have lowered banks' attractiveness for shareholders but may have performed better in increasing banks' loans supply.

Having said that, we need to acknowledge that none of the economies that have experimented negative rates has achieved successful results. In general, negative rates have not spurred investments nor economic growth, neither for banks nor for households. The problem of the low efficacy of their performance may be thus connected to an original bias of the system. In the future, through greater availability of data and a wider possibility of analysis we may be able to understand to which extent and in which cases this policy may be efficient and achieved its estimated targets. We may even be able to assess whether the magnitude to which the rates went into negative territory was not sufficient or whether the cons and worries raised by a NIRP are just to strong that they outweigh its potential benefits, making the policy really ineffective.

Appendix

Figure 21. OLS regression for Inflation Counterfactual

	coefficiente	errore std.	rapporto t	p-value	
const	0,00313386	0,00213111	1,471	0,1506	
JGB_2yearsinte~_1	1,16557	0,991363	1,176	0,2479	
OilPriceGrowth	0,0664538	0,620375	0,1071	0,9153	
InflationRate_1	0,777481	0,108426	7,171	2,72e-08	***

Media var. dipendente	0,004474	SQM var. dipendente	0,005446
Somma quadr. residui	0,000273	E.S. della regressione	0,002836
R-quadro	0,750822	R-quadro corretto	0,728836
F(3, 34)	34,14956	P-value(F)	2,29e-10
Log-verosimiglianza	171,0768	Criterio di Akaike	-334,1536
Criterio di Schwarz	-327,6032	Hannan-Quinn	-331,8230
rho	0,304888	Valore h di Durbin	2,526776

Note: SQM = scarto quadratico medio; E.S. = errore standard

Figure 22. OLS regression for Bank lending growth

	coefficiente	errore std.	rapporto t	p-value	
const	0,000794528	0,00195784	0,4058	0,6874	
JGB_2yearsinte~_1	-0,480800	0,457461	-1,051	0,3007	
IndustrialProduc~	-0,0683533	0,0536101	-1,275	0,2110	
Bankloansgrowth_1	0,939101	0,0672116	13,97	1,19e-15	***

Media var. dipendente	0,024368	SQM var. dipendente	0,004036
Somma quadr. residui	0,000088	E.S. della regressione	0,001610
R-quadro	0,853751	R-quadro corretto	0,840847
F(3, 34)	66,16023	P-value(F)	2,83e-14
Log-verosimiglianza	192,5842	Criterio di Akaike	-377,1684
Criterio di Schwarz	-370,6181	Hannan-Quinn	-374,8379
rho	0,062997	Valore h di Durbin	0,426683

Note: SQM = scarto quadratico medio; E.S. = errore standard

Figure 23. OLS regression for Credit Default Swaps Spreads

	coefficiente	errore std.	rapporto t	p-value	
const	0,00162102	0,000596832	2,716	0,0103	**
JGB_2yearsinte~_1	0,311079	0,274491	1,133	0,2650	
OilPricegrowthra~	-0,000587666	0,00217860	-0,2697	0,7890	
CDSspreads_1	0,356287	0,157931	2,256	0,0306	**

Media var. dipendente	0,001674	SQM var. dipendente	0,001035
Somma quadr. residui	0,000032	E.S. della regressione	0,000977
R-quadro	0,181417	R-quadro corretto	0,109189
F(3, 34)	2,511733	P-value(F)	0,075043
Log-verosimiglianza	211,5787	Criterio di Akaike	-415,1574
Criterio di Schwarz	-408,6071	Hannan-Quinn	-412,8268
rho	0,135440	Valore h di Durbin	3,654463

Note: SQM = scarto quadratico medio; E.S. = errore standard

Figure 24. OLS regression for Return on Equity

	coefficiente	errore std.	rapporto t	p-value	
const	-0,00986056	0,0170944	-0,5768	0,5681	
OilPriceGrowth	0,865262	6,69055	0,1293	0,8979	
JGB_2yearsinte~_1	-12,0352	8,98604	-1,339	0,1899	
ROE_1	0,768906	0,123076	6,247	5,31e-07	***

Media var. dipendente	0,066567	SQM var. dipendente	0,047018
Somma quadr. residui	0,030810	E.S. della regressione	0,031029
R-quadro	0,601804	R-quadro corretto	0,564474
F(3, 32)	16,12084	P-value(F)	1,46e-06
Log-verosimiglianza	76,06031	Criterio di Akaike	-144,1206
Criterio di Schwarz	-137,7865	Hannan-Quinn	-141,9099

Note: SQM = scarto quadratico medio; E.S. = errore standard

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