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“Spillovers of ECB’s Unconventional Monetary Policies in Nordic Countries”

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To my family, my brother Almeraldo and my daughter Asleyah!

Abstract

In Chapter 1, under the supervision of Prof. Luca Riccetti, we have done a review of all quantitative easing announcements taken by ECB from 2008 to 2018 which includes public speech, conferences and press speech. Further, we have done a literature review on the empirical studies which use autoregressive conditional heteroskedastic models and event studies. The results of the event study show that the sign effect of the communications has a significant impact on long-term government bonds of Nordic countries.

In Chapter 2, we have done a review of macroprudential policies applied in Nordic countries. Further, we have estimated the impact of unconventional monetary policies in a set of financial variables such as long- and medium-term government bonds, exchange rate, credit default swaps and corporate bond indices. The results indicate a heterogeneity among countries however, the financial connection of the region with the EU is high no matter the proximity.

In Chapter 3, with my supervisor Prof. Luca Riccetti we have estimated the impact of non-standard measures in equity markets. The findings show that using an Exponential Generalized Autoregressive Conditional Heteroskedastic model, the findings confirm the impact of monetary policy surprises in Nordic stock returns. Second, the results indicate that a positive monetary surprise is associated with a decrease of the yields in the distressed countries and a decrease of the domestic government bond yield, increase the stock market prices.

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All errors are and remain my own.

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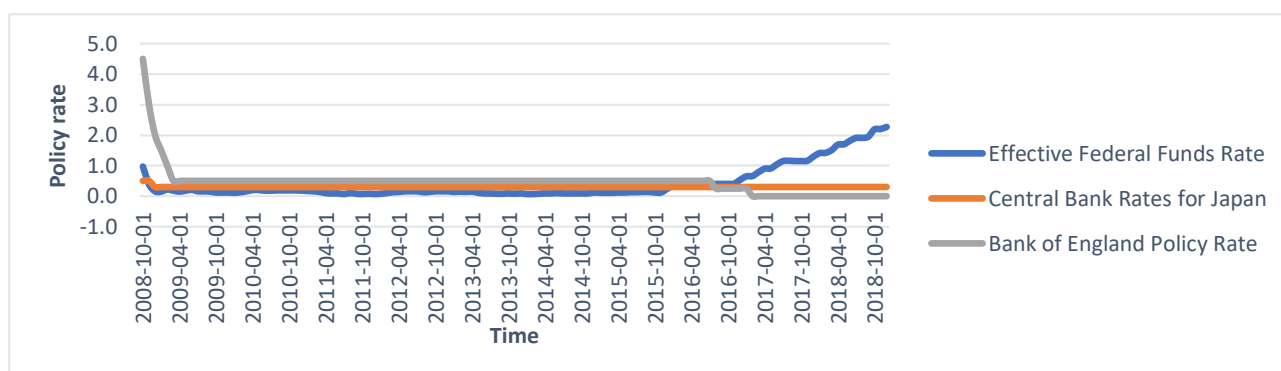
CHAPTER 1

UNCONVENTIONAL MONETARY POLICIES IN EURO AREA: A LITERATURE REVIEW AND AN EVENT STUDY APPROACH

1.1. Introduction

The subprime crisis began in the United States with market turnovers decreasing drastically while the risk premia increased. The value of investments in mortgage-securities and the house prices collapsed, which influenced the other securities that were packed and structured in residential mortgages. The turbulence reached Europe in summer 2007 as financial institutions had these structured loans in their balance sheets. Central banks had performed sensitivity tests which proved the reliance of their financial systems while investors underpriced the risks in the markets and the wave that was coming ahead. The Central Bank of England (BOE) provided emergence liquidity to the first victim, the Northern Rock which was the first bank to run in 150 years in the UK while in the United States was Bear Stearns, an investment bank which later had to be merged with JP Morgan. The milestone of the global crisis was the investment bank Lehman Brothers which went bankrupt. The collapse of Lehman Brothers brought lack of confidence among institutions, increased the uncertainty and made the banks vulnerable. Thus, the economies experienced drawdowns as the agents had the tendency to reduce their exposures. The last financial crisis witnessed the significant role of central banks in tackling the crisis and increased the awareness of the interdependence among banks in the banking system. The authorities had to undertake various initiatives such as changing the regulations, the legal structure of the financial system and the tools available to pursue monetary policy. The recent upheaval assigned the institutions with new roles. The escalation of the crisis proved how fragile and unprotected the financial system was. Banks started to find difficulties to ensure liquidity and the Icelandic financial system collapsed in October 2008. Central banks reacted to the consequences using the only instrument available (the policy rate) and all rates (see *Error! Reference source not found.*) were brought close to zero. Bank of England had a sharp drop comparing to other central banks.

Figure 1. 1 Policy rates of main central banks

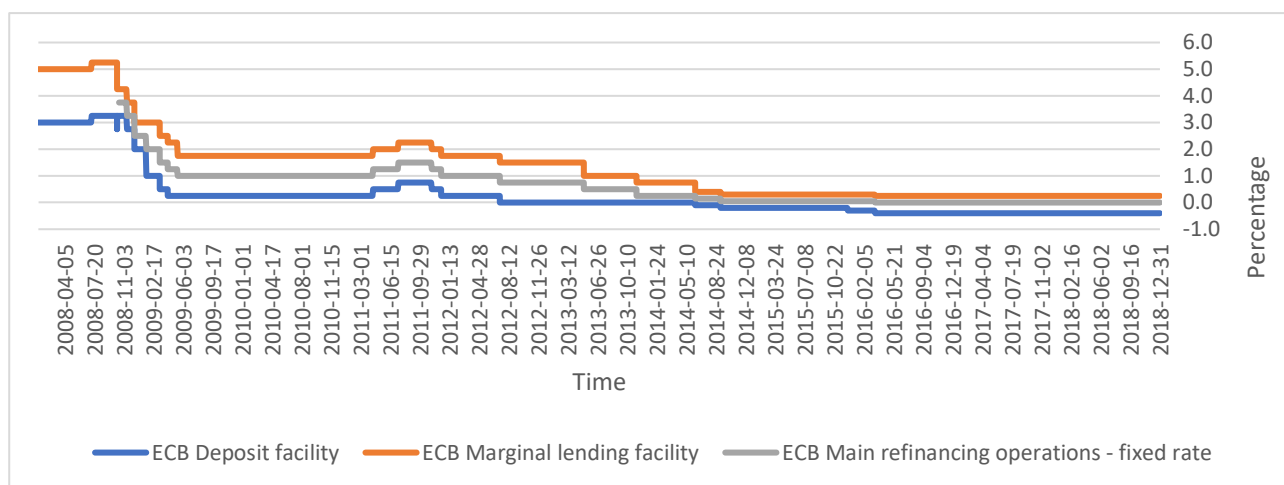


Source: Federal Reserve Bank, Central Bank of Japan and Central Bank of England

European Central Bank's main rates are available in *Error! Reference source not found.* which shows that it experienced a high reduction until the rates reached negative territory. Central authorities extended their cooperation by being involved in swap facilities through which banks injected liquidity to the banking system. The decrease of the rate only smoothed the tension in the financial system, but

the central banks had to implement other tools to supply liquidity to the entities that went through liquidity shortage. Therefore, the ECB announced the full allotment that gave the banks the right to request credit as much they want with a rate which was equal to main refinancing rate having the appropriate collateral. In the meantime, the ECB extended the list of securities which could be used as eligible collateral. The ECB began to provide banks with credit in longer maturities than before. Even though the financial system continued to operate, and no meltdown occurred in 2008, the global crisis hit with full force in 2009 which led the economies in deep recession. Gross domestic product came to a halt and trade reduced, aggregate demand and investment decrease and several countries were in a

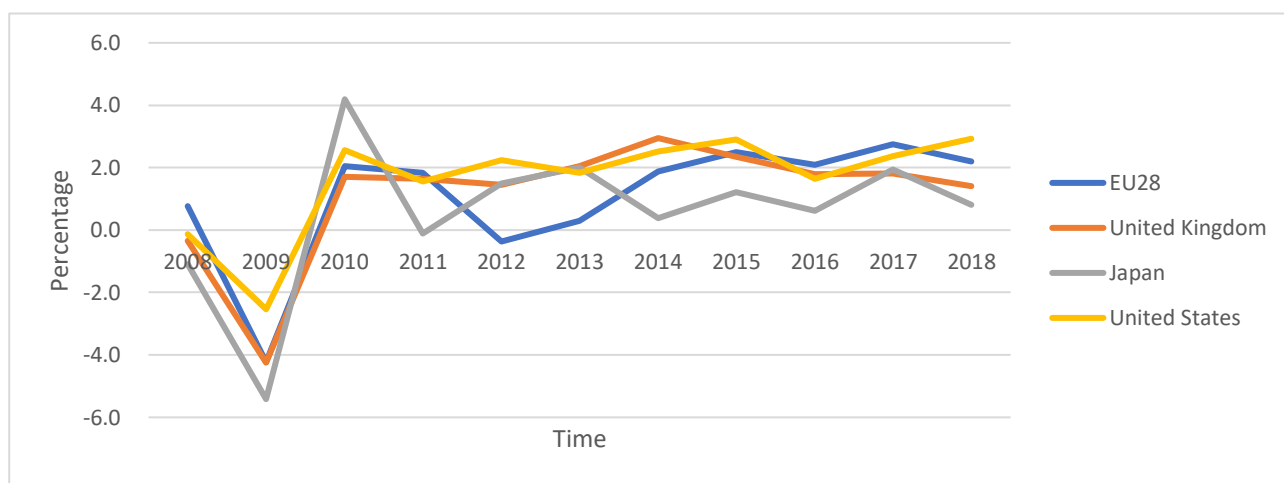
Figure 1. 2 Evolution of ECB policy rates



Source: European Central Bank

shows that all countries experienced negative levels of their annual growth in 2009 with Japan leading the group with a reduction of 5.4 percent. Again in 2011 and 2012 the Euro area and Japan had a reduction of 0.1 and 0.4 percentage respectively. Governments implemented fiscal policies which were not for too long as the government deficit was increasing.

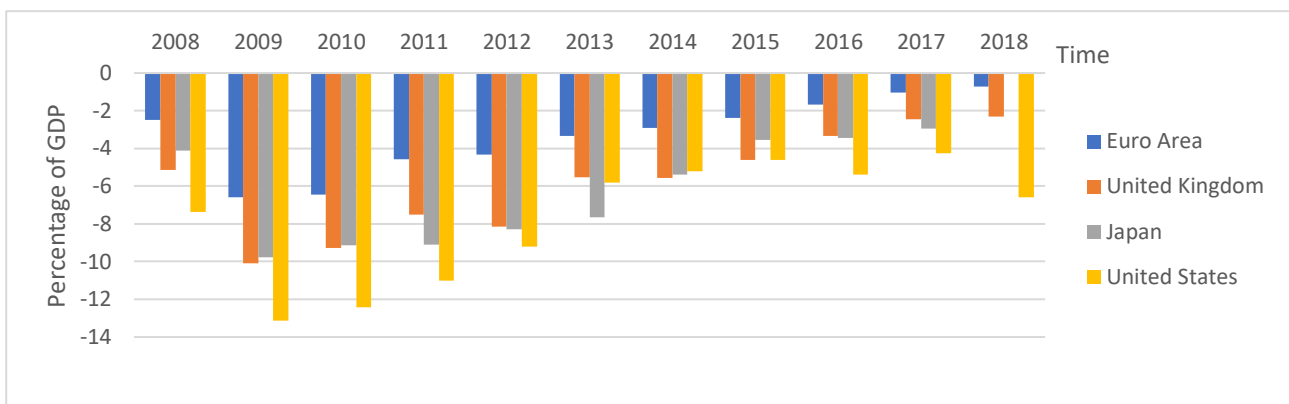
Figure 1. 3 Real GDP growth rates



Source: OECD

Error! Reference source not found. indicates that the deficit increased especially in 2009 and 2010 for all main countries. However, by 2018 the level of deficit is decreasing for all countries except of US which level remains still high. The first countries which found themselves in difficulty were Greece and Ireland where the government debt reached excessive levels. The sovereign debt crisis reached Europe in spring 2010 with high level of debts for Greece which made the confidence in the euro market to evaporate. The monetary decisions taken by the ECB were not fully transmitted within the euro area due to the heterogeneity of the economic developments, fiscal policies implemented and credit risk which diverged among states. The financial markets were highly fragmented, and the ECB had to implement various initiatives to alleviate the pressures in the markets. Agents restricted their exposure due to loss of confidence leading to frozen interbank markets; the interbank rates were increased therefore ECB had to perform Covered Bond Purchase Programme 2 (CBPP2) and supplementary long-term refinancing operations (SLTRO) in order to improve the situation.

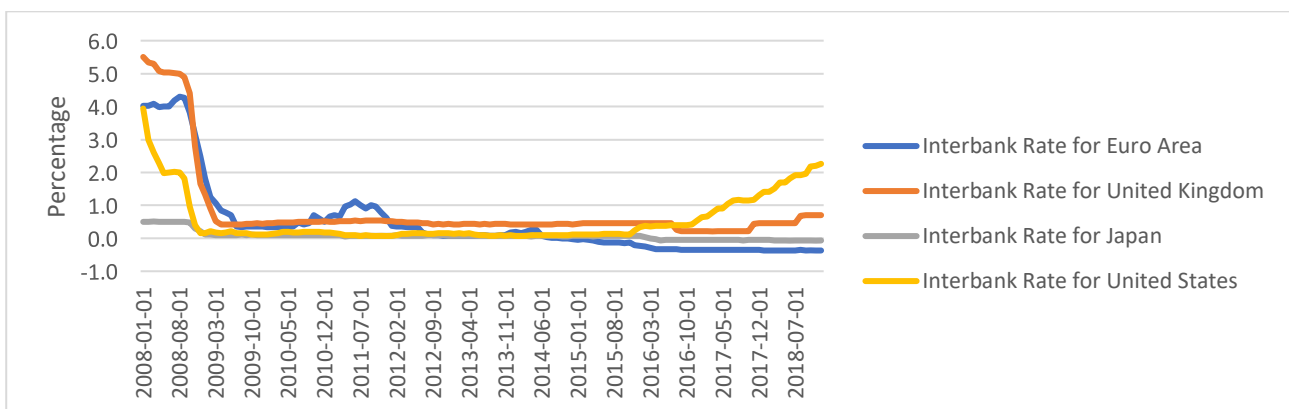
Figure 1. 4 General government deficit



Source: OECD

Note*: General government deficit is defined as the balance of income and expenditure of government, including capital income and capital expenditures. "Net lending" means that government has a surplus, and is providing financial resources to other sectors, while "net borrowing" means that government has a deficit and requires financial resources from other sectors. This indicator is measured as a percentage of GDP ¹

Figure 1. 5 Interbank rate for main central banks



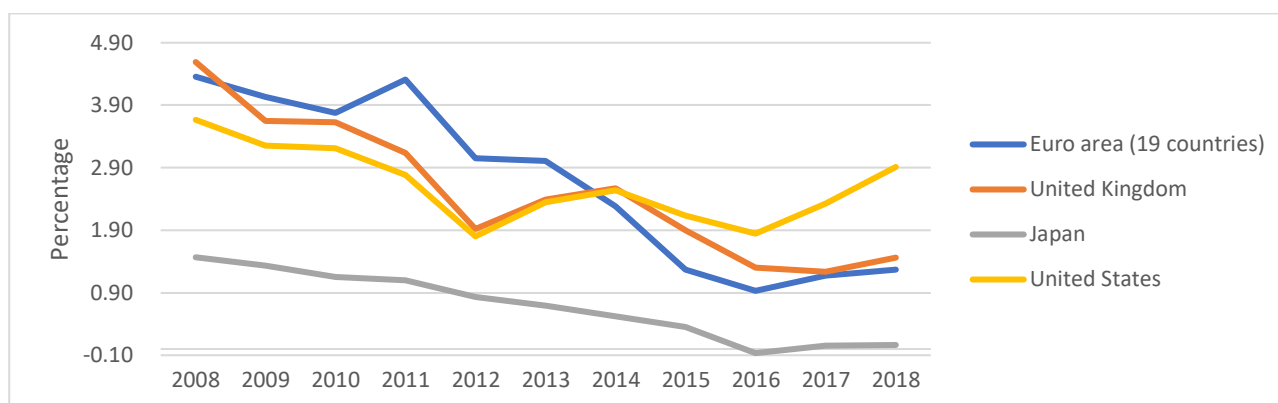
¹ OECD, <https://data.oecd.org/>, Accessed in 14 January 2020

Source: Federal Reserve (not seasonally adjusted)

Hence, in 2010-2011, EU interbank market experienced a slight increase of its rate which corresponds to CBPP2 implementation and SLTRO indicated in *Error! Reference source not found.*

The programme aim was to purchase government bonds in the dysfunctional markets. In summer 2012, the tension in the bond markets reached the peak and the agents due to the severe sovereign bond markets especially in Italy and Spain, began speculating that one or more countries could exit the monetary union to take care of “their own roof”. Countries within European Union had to witness the fragmented markets and weak integrity which put the central banks in doubt on the importance of a single monetary policy stance. Long-term rates in *Error! Reference source not found.* were reduced drastically while short-term rates in *Error! Reference source not found.* had a mild reduction.

Figure 1. 6 Long-term interest rates



Source: OECD

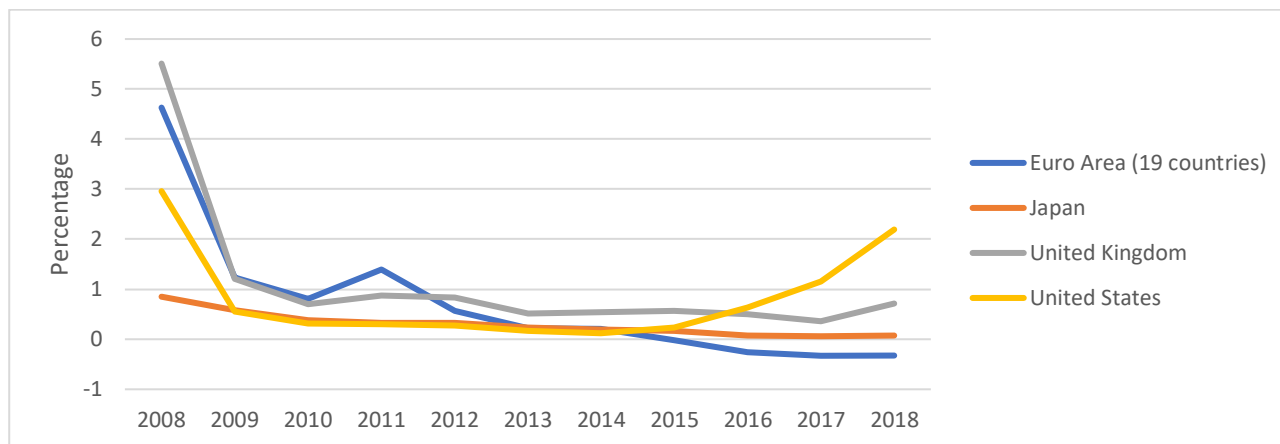
Note*: EMU Yield 10-year government bonds, GBR Yield 10-year central government securities JPN Yield 10-year interest-bearing government bonds, USA Yield 10-year federal government securities. Long-term interest rates refer to government bonds maturing in ten years. Rates are mainly determined by the price charged by the lender, the risk from the borrower and the fall in the capital value. Long-term interest rates are generally averaging of daily rates, measured as a percentage. These interest rates are implied by the prices at which the government bonds are traded on financial markets, not the interest rates at which the loans were issued. In all cases, they refer to bonds whose capital repayment is guaranteed by governments. Long-term interest rates are one of the determinants of business investment. Low long-term interest rates encourage investment in new equipment and high interest rates discourage it. Investment is, in turn, a major source of economic growth.² Short-term interest rates

All countries had a significant reduction in 2012 and 2016 with Japan that experienced the highest reduction. Hence, ECB had to implement unconventional monetary policies within the union. Unconventional monetary policy brought changes of policy tools, together with a change in banking regulations and in the overall structure of the banking system. Policy rates were less effective when the central banks reduced their rate close to zero. Banking regulators change their tactic from bail out to bail in. Bail-out increased the stability of the system but it has generated adverse effects which placed the whole union under criticism (Giuliana 2015). The Monetary union had to ensure the

² OECD, <https://data.oecd.org/>, Accessed in 14 January 2020

financial stability of the system and reduce the taxpayer’s costs therefore, in 2012 it was designed and in 2014 it was approved the Bank Recovery and Resolution Directive.

Figure 1. 7 Short-term interest rates



Source: OECD

Note*: Short-term interest rates are the rates at which short-term borrowings are affected between financial institutions or the rate at which short-term government paper is issued or traded in the market. Short-term interest rates are generally averaging of daily rates, measured as a percentage. Short-term interest rates are based on three-month money market rates where available. Typical standardized names are "money market rate" and "treasury bill rate".³

Banking regulators within the bail-in mechanism have to input its losses to its unsecured liabilities and equity before any default and any possible injection of public funds while its secured liabilities remained intact. There is still available the option of public support, but the capital and the unsecured debt holders should cover part of the losses. Hence, this is considered a “regime shift” for European banks (Cappiello 2015) and (Hadijemmanuil 2015). Further, the Single Supervisory Mechanism (SSM) was announced and the ECB was the main body to lead. Meanwhile, “Outright Monetary Programme” (OMT) was announced which aim was to purchase government bonds. However, the announcement of the OMT programme relaxed the markets and there was no need to implement the programme. The financial crisis extended the tools of ECB monetary policy, as already said: extension of eligible list of collateral, full allotment and longer long-term refinancing operations. Forward guidance is the most recent tool that aimed at anticipating the monetary policy rate to enhance the efficiency of macroprudential policy. After the Single Supervisory Mechanism, the Banking Union set up the lines for a common supervision at European level. However, these measures led to significant increase of balance sheets of the central banks beginning of 2011 up to 2018 which are available in *Error! Reference source not found.*

Table 1. 1 Balance sheet of central banks

Banks	ECB	FED	BOJ	BOE
2008	2.075.107	2.239.457	122.8	238.940
2009	1.903.024	2.234.067	122.5	237.694

³ OECD, <https://data.oecd.org/>, Accessed in 15 January 2020

2010	2.002.210	2.420.570	128.7	246.906
2011	2.733.270	2.926.095	143	290.246
2012	2.962.613	2.907.300	158.4	410.381
2013	2.273.287	4.032.575	224.2	401.729
2014	2.208.240	4.497.660	300.2	406.582
2015	2.780.112	4.486.587	383.1	419.494
2016	3.661.423	4.451.451	476.5	490.004
2017	4.467.611	4.443.718	521.4	583.890
2018	4.702.733	4.075.636	552.1	608.447

Source: European Central Bank, Federal Reserve Bank, Central Bank of Japan and Central Bank of England

Note*:European Central Bank balance sheet is measured in Eur million; Federal Reserve Bank balance sheet is measured in U.S million, Central Bank of Japan balance sheet is measured in JPY billion and Central Bank of England balance sheet is measured GBP million.

The Global Financial Crisis is a reminder of the dangers and costs that a systemic financial crisis somewhere can impose to the financial institutions and public authorities all over the world. Hence, macroprudential policies that were designed to prevent and build-up resilience of financial systems have been implemented for years in emerging and advanced economies (Cerutti et al., 2017 ; Akinci and Olmstead- Rumsey, 2018). In the first part of this paper we indicate a literature review on ECB's unconventional monetary policies from 2008 to 2018 which includes public speeches, press conferences and press releases reported in ECB's media websites. Secondly, we do a review on all current studies which investigate impact of ECB's non-standard policies using autoregressive models and event-study approach. Yet, to our understanding there is no current literature which considers impact of unconventional monetary policies in Nordic countries. The growing literature on macroprudential policies tends to focus mostly on how these policies helped to sooth the impact in credit and housing markets (e.g., Lim et al., 2011; Dell'Araccia et al., 2012; IMF, 2012; Crowe et al., 2013; Claessens, 2014; Cerutti et al., 2017). Most of the studies focus on the literature review before or afterwards the financial crisis of 2007-2008. This study contributes to the current literature in several ways. First, our paper set a new framework in the current literature of unconventional monetary policies done by European Central Bank before and afterwards the crisis focusing in Nordic countries. Most of the studies focus in emerging markets and advanced economies while literature on Nordic region is scant so far. Second, we follow the work of Faliagarda et al. (2015) and Faliagrada and Reitz (2015) and investigate the impact of non-standard policies in government bond yields using an event study approach. Different from the studies mentioned above we extend the time framework and consider the sign effect too. The findings show that there is a slightly increase in the volatility in 2010, 2011 and 2012 in event days in comparison to non-event days. In the lenses of event study, the results indicate opposite findings when we consider, and we exclude the impact of the sign in the event window. The results without the sign effect show limited effect of ECB communications in the Nordic spreads whereas counting on the sign effect the cumulative effect is really significant. When

considering the significance of the events, there seem to be similar results. As a matter of fact, event study reveals opposing results hence, a formal analysis would be more preferable.

The remainder of the paper is organized as follows. Section 1.2 introduces ECB's unconventional monetary policies. Section 1.3 and 1.4 represent the literature review on event study. Section 1.5 shows the transmission channels while section 1.6 investigates the impact of non-standard measures on bond yield in the lenses of event study approach. Section 1.7 is the robustness check while section 1.8 concludes.

1.2. ECB unconventional monetary policies

European Central Bank started its interventions in August 2007, when it was announced the conduction of a supplementary liquidity-providing longer-term refinancing operation (LTRO) with a maturity of three months for an amount of EUR 40 billion to support the normalization of the euro area money market. This operation was additional to the regular longer-term refinancing operations. Another decision was taken in September 2007, for another supplementary longer-term refinancing operation of EUR 75 billion. In November 2007, the Governing Council decided upon the renewal of these two LTROs in order to further consolidate the normalization of the euro money market. Both supplementary LTROs would be carried through a standard tender procedure of allotment which would take place two days and one day before the settlement. In December 2007, in collaboration with the Bank of Canada, the Bank of England, the Federal Reserve, and the Swiss National Bank, European Central Bank announced measures to address the pressure in short-term funding markets. These measures included joint actions with Federal Reserve in order to provide US dollar liquidity operations to the counterparties within the Euro-system. As an additional measure, the maturities of the supplementary longer-term refinancing operations and the main refinancing operations were extended. Indeed, these measures cannot be considered "unconventional" as the procedure and the allotment was totally standard.

At the beginning of 2008, Governing Council decided to renew the supplementary longer-term refinancing operations that were allotted in November and December 2007, with a standard tender procedure. In March 2008, the Governing Council decided to conduct supplementary longer-term refinancing operations (LTROs) with a maturity of six months and further LTROs with a maturity of three months without affecting the regular LTROs which were conducted monthly. In view of the persistent liquidity pressures, the European Central Bank, the Federal Reserve and the Swiss National Bank, agreed on reciprocal currency arrangements (swap lines) to expand their liquidity measures. The size of these measure was agreed to increase if necessary, in order to accommodate whatever quantity of US dollar funding was demanded. In October 2008, it was announced the expansion of the list of eligible assets used as collateral for the credit operations. The list of new instruments included: market debt instruments denominated in foreign currency and issued in euro, Euro-denominated credit claims governed by UK law, all debt instruments which were issued by credit institutions and traded on the accepted non-regulated markets including certificates of deposits (CDs) and subordinated debt instruments that were protected by an acceptable guarantee. Further, the Euro-system lowered the credit threshold for marketable and non-marketable assets from A- to BBB-, with the exception of asset-backed securities (ABS). Consistent with the extension of the collateral, the Euro-system decided to enhance the provision of longer-term refinancing operations and also accept fixed term deposits with a one-week maturity. The financial crisis and the inflationary pressures partly decrease the prices and central banks engaged in unprecedented joint actions such as the provision of liquidity to reduce constrains in financial markets. Hence, the Governing Council of the ECB, decreased the main refinancing rate, the marginal lending facility and deposit rate by 50 basis points

to ensure the price stability in the medium term which supported sustainable growth and employment and contributed to financial stability.

In 2009, the Governing Council of the European Central Bank (ECB) decided that the European Investment Bank (EIB) would become an eligible counterparty in the Euro system's monetary policy which gave EIB full access, if and when is required for the treasury management, complying with all eligibility requirements and it will hold minimum reserves with the Euro system. Moreover, it was announced for the conduct of three liquidity-providing longer-term refinancing operations (LTROs) with a maturity of one year as part of the Enhanced Credit Support programme (ECS). The operations were defined with a fixed rate tender procedure with full allotment. The operations were conducted in addition to the regular and supplementary longer-term refinancing operations, which were unaffected. Covered Bond Purchase Programme was announced which was carried by direct purchase for an amount of EUR 60 billion in the primary and secondary market. Credit operations within the Euro-system in order to be considered eligible for purchase of the covered bonds as collateral, should have had a minimum rating AA or equivalent by at least one of the major rating agencies (Fitch, Moody's, S&P) and, in any case, not lower than BBB-/Baa3; an issue volume of about EUR 500 million or not lower than EUR 100 million and have underlying assets that include exposure to private and/or public entities. The main aim of this programme was to support the financial markets for the funding of banks that were affected by the financial crisis. In the same time, the main refinancing operation, the marginal lending facility and the deposit facility rates decreased further reaching 1, 1.75 and 0.25 percent by December 2009.

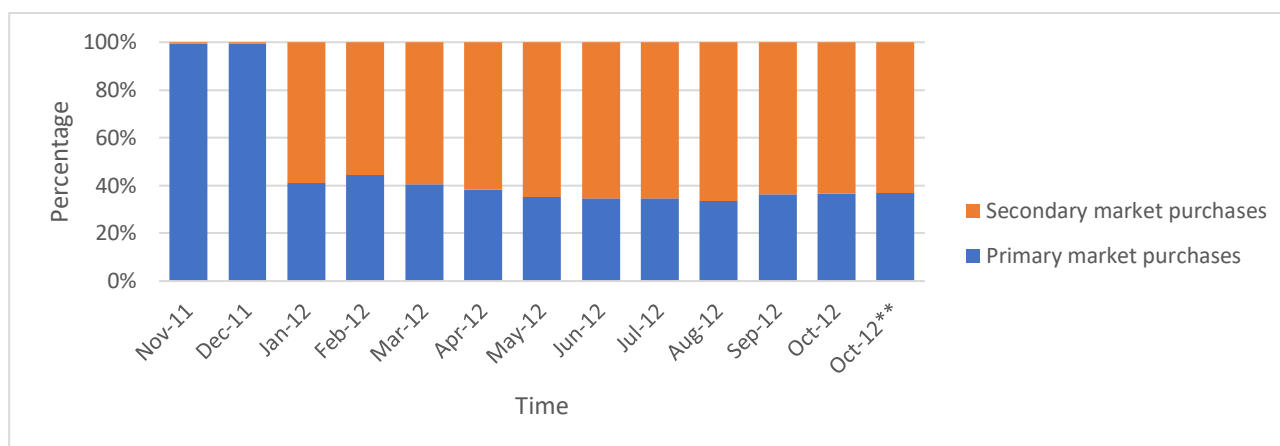
In May 2010, the Governing Council of the ECB announced Security Markets Programme, which meant interventions in the euro area public and private debt security markets to address the malfunctioning of the security markets and ensure the transmission mechanism of the monetary policy. The aim of the Governing Council together with the governments of the euro area was to take all the measures needed to meet their fiscal targets and the commitments to ensure the sustainability of the public finances for the present and the years ahead. The liquidity injected through Securities Market Programme did not affect the monetary policy stance. Further, the temporary swap lines with Federal Reserve were reactivated to provide US dollar liquidity operations. The operations were decided to be carried as fixed rate tenders with full allotment and took the form of repurchase operations against ECB-eligible collateral on 7-days operations on a weekly basis and an 84-days operation. In December 2010, within the framework of central bank cooperation, the European Central Bank together with Bank of England came to an agreement for a temporary liquidity swap facility, under which if necessary, the Bank of England could provide liquidity up to GBP 10 billion. Moreover, both banks together with Bank of Canada, Japan and Swiss National Bank decided upon the extension of liquidity swap with the Federal Reserve. The US dollar liquidity operations took the form of repurchase operations against eligible collateral and were carried out as fixed rate tenders with full allotment with a maturity of seven days.

In 2011, a second round of Security Market Programme was implemented. Further, to address the tensions in some financial markets in the euro area, the Governing Council of the European Central Bank decided to conduct liquidity-providing supplementary longer-term refinancing operation (LTRO) with different maturities at a fixed rate tender procedure with full allotment. In October 2011, it was announced Covered Bond Purchase Programme 2 (CBPP2) which was set to be implemented in November and to be completed in October 2012. The covered bonds had to be eligible as collateral in the credit operations; had to comply to an issue volume of EUR 300 million or more; having at least a rating of BBB- or equivalent from one of the rating agencies; a residual maturity of 10.5 years and have underlying assets that include exposure to private and/or public entities. The portfolio of CBPP2 was available for lending, which was voluntary, and it was conducted via security lending facilities offered by central securities depositories, or matched repo transactions with eligible

counterparties. Governing Council announced two LTROs with fixed rate full allotment one with a maturity of 12 months (conducted in October 2011) and the second one 13 months maturity to be implemented in December 2012. Main refinancing operations (MROs) and the monthly 3-month LTROs continued to be conducted with fixed rate tender procedures and full allotment as long as it was needed.

reveals the purchase of euro-denominated covered bonds that had an intended value of EUR 40 billion and had to be distributed in the euro area through direct purchases in the primary and the secondary markets. The covered bonds had to be eligible as collateral in the credit operations; had to comply to an issue volume of EUR 300 million or more; having at least a rating of BBB- or equivalent from one of the rating agencies; a residual maturity of 10.5 years and have underlying assets that include exposure to private and/or public entities. The portfolio of CBPP2 was available for lending, which was voluntary, and it was conducted via security lending facilities offered by central securities depositories, or matched repo transactions with eligible counterparties. Governing Council announced two LTROs with fixed rate full allotment one with a maturity of 12 months (conducted in October 2011) and the second one 13 months maturity to be implemented in December 2012. Main refinancing operations (MROs) and the monthly 3-month LTROs continued to be conducted with fixed rate tender procedures and full allotment as long as it was needed.

Figure 1. 8 Cumulative purchase under CBPP2



Source: European Central Bank

Note: **book values in EUR mil, including the last transactions that settled in November

At the end of 2011, ECB announced two longer term refinancing operations with a maturity of 36 months with the possibility for repayment after one year. The loans were not offered directly to the governments, but banks could use securities as a collateral. ECB decided to decrease the reserve ratio from 2 to 1 percent and increase the collateral availability through reducing the rating for certain asset-backed securities and allowing national central banks to accept temporary solutions that fulfil the eligibility criteria.

In 2012, the Governing Council of ECB decided to continue to conduct its main refinancing operations (MROs) as fixed rate tender procedures with full allotment for as long as necessary. The same procedure remained in use for special-term refinancing operations with a maturity of one maintenance period, which continued to be conducted for as long as needed. The fixed rate in these special-term refinancing operations was the same as the MRO rate prevailing at the time.

In August 2012, the Governing Council of ECB decided for the technical features of outright transactions in secondary sovereign bond markets to safeguard the appropriate monetary policy transmission and the singleness of the monetary policy. These would be known as Outright Monetary Transactions and the Governing Council was the legitimate authority deciding for the start, continuation and suspension of transactions in full discretion and acting in accordance with its monetary policy mandate. Transactions were focused on the shorter part of the yield curve, and in particular on sovereign bonds with a maturity of between one and three years and no ex-ante size of it was defined. Thus, the liquidity created was sterilized.⁴ The Governing Council decided on additional measures to increase collateral availability for counterparties in order to maintain their access on the liquidity operations of Euro-system. The council decided to suspend all the application of the minimum credit rating threshold in the collateral eligibility requirements for the purposes of the Euro system's credit operations in the case of marketable debt instruments issued or guaranteed by the central government, and credit claims granted to or guaranteed by the central government, of countries that are eligible for Outright Monetary Transactions or are under an EU-IMF programme and comply with the attached conditionality as assessed by the Governing Council. The suspension applied to all outstanding and new assets. The list of the assets eligible used as collateral was also extended and included marketable debt instruments denominated in currencies other than the euro, issued and held in the euro area.

In 2013, the Governing Council of the European Central Bank (ECB) changed the collateral rule in order to prevent the use of uncovered bank bonds as collateral when the issue is done by the counterparty itself or entities close to the counterparty. Moreover, it decided to conduct its main financing operations as fixed rate tender procedures with full allotment for as long as necessary, and at least until the end of the 6th maintenance period of 2014 on 8 July 2014. The Governing Council has decided to implement the three-month longer-term refinancing operations as fixed rate tender procedures with full allotment. The rates in these three-month operations were fixed at the average rate of the MROs over the life of the respective LTRO. In July 2013, in the speech of Draghi's⁵ it was declared a form of forward guidance, that the key interest rate on the main refinancing operations, the interest rates on the marginal lending facility and the deposit facility will remain unchanged or at lower levels for an extended period of time. Further, it was decided to continue conducting main refinancing operations as fixed rate tender procedures with full allotment for as long as necessary, and at least until the end of the 6th maintenance period of 2015 on 7 July 2015.

In the beginning of 2014, the main refinancing operation rate, the marginal lending facility and the deposit facility rate were 0.25, 0.75 and 0 percent. The Governing Council of the ECB decided to reduce the main refinancing operation rate by 0.05 percent and the marginal lending facility by 0.30 percent while deposit facility rate was decreased to negative bound, reaching to -0.2 percent. Negative rates applied also to average in reserve holdings in excess to the minimum reserve requirements and other deposits within Euro system. To pursue the price stability mandate, the ECB announced measures which aim to enhance the functioning of the monetary policy transmission by supporting the lending to the economy. These measures include a series of targeted longer-term refinancing operations (TLTROs) aimed at improving bank lending to the euro area non-financial private sector, excluding loans to households for house purchase, over a window of two years and intensify the work related to outright purchases of asset-backed securities. Counterparties were entitled to an initial

⁴ Sterilization happens when weaker securities are purchased in the exchange of high value assets.

⁵ Speech by Mario Draghi, President of the European Central Bank at the Global Investment Conference in London 26 July 2012, <https://www.ecb.europa.eu/press/key/date/2012/html/sp120726.en.html>

TLTRO borrowing allowance (initial allowance) equal to 7 percent of the total amount of their loans to the euro area non-financial private sector, excluding loans to households for house purchase, outstanding until 30 April 2014. In two successive TLTROs that were conducted in September and December 2014, the counterparties were able to borrow an amount that cumulatively did not exceed the initial allowance. During 2015 and 2016, all counterparties were to borrow additional amount in a series of TLTROs conducted quarterly. These additional amounts were able to cumulatively reach up to three times each counterparty's net lending to the euro area non-financial private sector, excluding loans to households for house purchase, provided between 30 April 2014 and the respective allotment reference date in excess of a specified benchmark. The interest rate on the TLTROs was fixed over the life of each operation at the rate on the Euro system's main refinancing operations (MROs) prevailing at the time of take-up, plus a fixed spread of 10 basis points. Interest was paid in arrears when the borrowing is repaid. Starting 24 months after each TLTRO, counterparties had the option to repay any part of the amounts they were allotted in that TLTRO at a six-monthly frequency. The Governing Council intensified the work related to outright purchases in the ABS market under which the Euro-system considered the purchase of simple and transparent ABS fixing the key requirements for the ABS to be eligible.

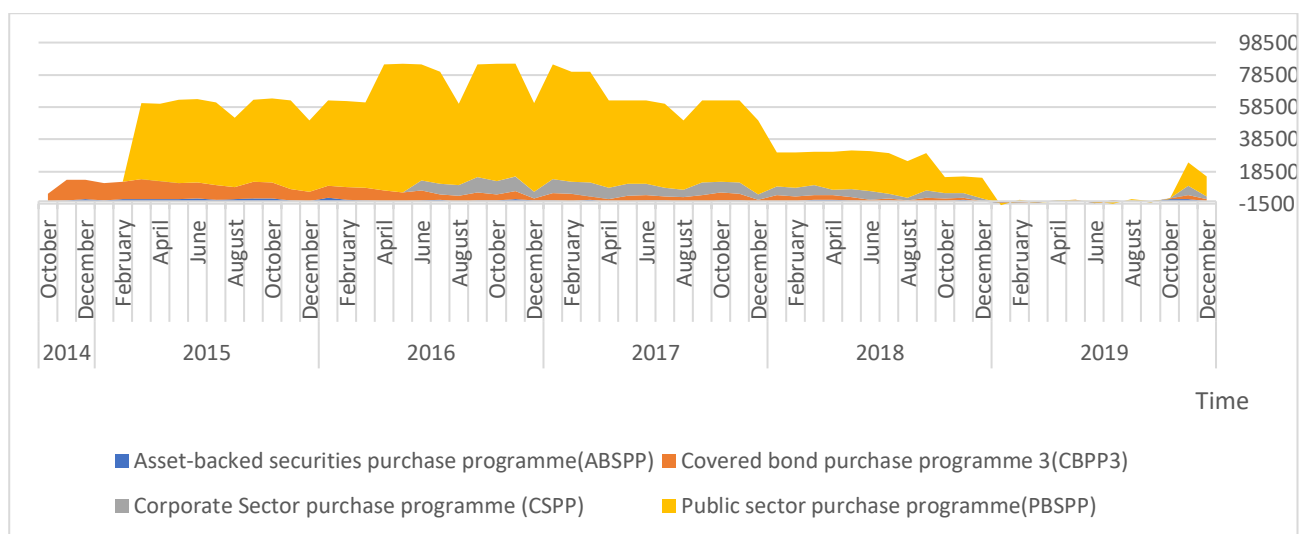
In 22 January 2015 was announced an expanded asset purchase programme that adds to the existing programs ABS and CBPP, a purchase programme for the securities of public sector to fulfil price stability objective and address the prolonged period of inflation with a combined monthly purchase of EUR 60 billion. The ECB purchased bonds issued by euro area central governments, agencies and other institutions. This was intended to stimulate the economy when the rates were at lower level, to ease the financial and monetary conditions, to make borrowing less expensive, support investment and consumption and return the inflation at 2 percent. The purchase of additional euro-denominated securities had to meet the following eligibility criteria: They fulfilled the eligible criteria of marketable assets as collateral to be used in the monetary policy operations, they were issued by an entity which is established in the euro area and they had a first-best credit assessment from an external credit assessment institution for the issuer or the guarantor. All securities inflation-linked and floating rates issued by central governments, agencies established in the euro area and international or supranational institutions located in the euro area were eligible for purchase under the expanded asset purchase programme. All the securities under expanded asset purchase programme that were not covered by ABSPP and CBPP3 had at least 2 years maturity remaining and a maximum of 30 years remaining maturity when they are purchased; these securities were subject to an issue limit, an aggregate holding limit and other operational modalities specified, in particular, with the aim of preserving market functioning and allowing the formation of a market price on a given security. Moreover, the limits ensured that the application of collective action clauses for a bondholder decision was not obstructed and their allocation at the issuers in European countries was based on ECB's capital key. The transactions done under the programme were decided to be published weekly and the securities of the institutions purchased under the programme were eligible for securities lending.

At the beginning of 2016 the main refinancing operations, marginal lending facility rates and deposit facility rate were 0.05, 0.3 and -0.3 percent and in March 2016, the Governing Council decided to reduce the rates to 0, 0.25 and -0.4 percent. The monthly purchases of asset purchase programme were defined to be expanded at EUR 80 billion by April 2016. The investment grade euro-denominated bonds issued by non-bank corporations established in the euro area were included in the list of assets that were regular for purchases and a new series of four targeted longer-term refinancing operations (TLTRO II), each with a maturity of four years was defined to be conducted. The operations were intended to provide liquidity for banks to ease the private sector conditions and stimulate credit creation. In conjunction with other terms, the TLTRO II contributed to inflation rate to turn to its levels, below but close to 2 percent over the medium term. Counterparties could borrow total amount of up to 30 percent of a specific eligible part of their loans on an interest rate which was fixed for

each operation at the rate applied in the main refinancing operations (MROs) prevailing at the time of allotment. In April 2016, the ECB announced the purchases of corporate sector purchase programme (CSPP), a new programme added to the existing elements of the asset purchase programme that will strengthen the pass-through of asset purchases to the real economy. In the meantime, the outright purchases of investment-grade euro-denominated bonds issued by non-bank corporations established in the euro area was carried out by six Euro system national central banks (NCBs): Banque Nationale de Belgique, Deutsche Bundesbank, Banco de España, Banque de France, Banca d'Italia, and Suomen Pankki/Finlands Bank. Each NCB was responsible for purchases from issuers in a particular part of the euro area and all purchases took place in primary and secondary markets.

In 2017, the ECB published further details on the PSPP purchases of assets which yield was below deposit facility rate (DFR). Purchase was made at yields which are below the DFR and it can change over time, reflecting the changes in the interest rates of the market relative to DFR. **Error! Reference source not found.** shows additional data on redemptions, reinvestments and role of private sector purchase programme were published on asset-backed securities purchase programme (ABSPP), the third covered bond purchase programme (CBPP3), the public sector purchase programme (PSPP) and the corporate sector purchase programme (CSPP), for a rolling 12-month period. By the end of 2017, the European Central Bank (ECB) has decided on changes to the collateral eligibility criteria applicable to unsecured debt instruments issued by credit institutions or investment firms or their closely linked entities. These instruments were known as unsecured bank bonds (UBBs). The changes on eligibility criteria on senior unsecured bank bonds were decided, and all senior unsecured bank bonds which did not fulfil the new eligibility criteria were eligible until 31 December 2018. The interest rates on the main refinancing operations and the interest rates on the marginal lending facility and the deposit facility remained unchanged at 0.00, 0.25 and -0.40 percent and these rates remained at their present levels for an extended period of time, and well past the horizon of the net asset purchases. For its non-standard measures the ECB stated that it will continue to make net asset purchases under the asset purchase programme (APP) until September 2018, or beyond if necessary until it is consistent with the inflation aim.

Figure 1. 9 Monthly net purchase at book value



Source: European Central Bank

Note*: For ECB in EUR million, for FED in US million, for BOJ in YEN trillion and for BOE in GBP million. For Bank of England the series from 2008 to 2013 the data is available monthly, from

2014 the data is taken for the last quarter, for 2018 the data available is for third quarter 2018 (All not seasonally adjusted)

In 2018, the Governing Council decided that the interest rate on the main refinancing operations and the interest rates on the marginal lending facility and the deposit facility will remain unchanged at 0.00, 0.25 and -0.40 percent at least until summer 2019 and in case, for as long as necessary to ensure that inflation is below but close to, 2 percent over the medium term. The net purchases under the asset purchase programme (APP) were defined to end in December 2018. In the same time, the Governing Council increased the forward guidance reinvestment. According to this, the Governing Council continued to reinvest, in full, the principal payments for the securities matured which were purchased under APP for an extended period of time, when the key interest rates of ECB increased or when in necessary to maintain an accommodative monetary policy. The purchase remained the same size of the net purchases under each programme of the APP, the public sector purchase programme (PSPP), the asset-backed securities purchase programme (ABSPP), the third covered bond purchase programme (CBPP3) and the corporate sector purchase programme (CSPP) and temporary deviations were allowed in the size and composition of APP for operational reasons.

In September 2019, the Governing Council of the ECB decided that the main refinancing rate and the marginal lending facility will remain unchanged at their current level while the deposit facility decreased by 10 basis points to -0.50 percent. In December 2019, the Governing Council decided that the rates would remain unchanged. The European Central Bank and People's Bank of China extended their currency swap agreement until 2022 in order to serve to any possible sudden liquidity shortage. ECB activated a swap facility with the Bank of England in order to offer euro banks pound sterling while BOE will offer euro to its banks to support the markets that serve to households and businesses. Further, the Governing Council changed the parameters of the third series of targeted longer-term refinancing operations to ensure the smooth function of the transmission mechanism and the accommodative stance of the monetary policy. The interest rate reduced while the maturity was extended to 3 years with the repayment option after two years. At the beginning of November, the Governing Council restarted the asset purchase programme (APP) on a monthly pace of EUR 20 billion.

1.3. Literature review

Aftermath the financial crisis, the main central banks began to implement non-standard measures. Since then, various studies have contributed to a better comprehension of unconventional policies such as (Borio & Disyatat 2009; Meier 2009; Adrian & Shin 2010; Cúrdia & Woodford 2010; Gertler & Karadi 2011). This section contains a review of existing literature of non-conventional monetary policies throughout the years implemented by Federal Reserve Bank (FED), Central Bank of England (BOE), Central Bank of Japan (BOJ) and European Central Bank (ECB). After that, in Section 1.4 I present the literature on the impact of unconventional monetary policies using an event study approach while Section **Error! Reference source not found.** reports the literature that uses autoregressive general heteroskedastic (ARCH) models.

A large literature strand focuses on FED, including spillovers of its non-standard measures in emerging and advanced economies, such as (Neely 2010; Gagnon et al. 2011; Krishnamurthy-Vissing-Jorgensen 2011; Chen, Curdia & Ferrero 2012; Glick & Leduc 2012; Fratzcher, Straub & Lo Duca 2013; Berge & Cao 2014). Neely (2010) shows that FED policies led to depreciation of the currency, reduction of government bond yields and global short-term interest rates. Gagnon et al. (2011) indicate that Large Scale Asset Purchase (LSAP) reduced the long-term interest of a range of securities by involving those that were not involved in the purchase. Krishnamurthy-Vissing-Jorgensen (2011) confirm that QE affected assets through various channels; (Chen, Curdia & Ferrero

2012) reveal a mild impact of LSAP on GDP growth and inflation while (Glick & Leduc 2012) state that LSAP by FED and BOE reduced the long-term interest rates and commodity prices and depreciated their currencies. Fratzcher, Straub & Lo Duca (2013) define that QE had a significant impact in decreasing the sovereign yield and increasing equity markets but QE2 effect was modest. Ahmed & Zlate (2014) find significant impact in emerging economies especially in portfolio inflows. They observe that emerging markets are more influenced by non-standard measures because they are more exposed to external news announcements. Berge & Cao (2014) find that changing the monetary policy at the zero-lower bound can change the asset price in the US and abroad. Rogers, Scotti & Wright (2014) observe cross-country spillovers in the advanced economies while (Moessner 2014) similarly to (Berge & Cao 2014) confirms the change of asset prices and reduction of credit spreads. Bhattarai, Chatterjee & Park (2015) state that US QE appreciated the exchange rates of emerging countries against US dollar, it increased the stock market and capital inflows and it decreased the long-term bond yields of emerging economies, whilst (Passari & Rey 2015) find that US non-standard measures had an impact on mortgage spreads in the UK.

For UK, (Joyce et al. 2011) investigate the impact of QE on asset prices and they confirm a portfolio balance effect which reduced the medium to long-term yields. Christensen & Rudebusch (2012) show a reduction of the yields which comes from the reduction of term premium. Joyce, McLaren & Young (2012) state that bond yields reduced not because of lower returns but because the agents anticipated the new rounds of QE. McLaren, Banerjee & Latto (2014) study the impact of QE on gilt yields and the results reveal that QE purchases reduced the yields. Filardo & Hofmann (2014) conclude that forward guidance did not reduce expected future rates and government bond yields. Joyce & Spaltro (2014) find that the first round of QE had a modest effect in the lending growth of banks. Similar to the work of (Joyce & Spaltro 2014), the work of (Butt et al. 2014) show that QE increased aggregate demand and inflation through portfolio rebalancing channel. Weale & Wieladek (2016) confirm a significant impact on GDP and CPI due to asset purchase. De Los Rios & Shamloo (2017) state that the first round of QE had diminishing effects and the impact was high especially for the 10-year bond yield while (Chortareas, Karanos & Noikokyris 2018) indicate that non-standard measures in the UK had significant effect in domestic equity returns.

For Japan, Kimura et al. (2003) state that when the monetary base is increased it impacts prices positively but does not have any impact at the zero bound in the short horizons. Okina & Shiratsuka (2004) reveal that the monetary policy at the lower bound is effective to stabilize the expectations and to flatten the yield curve. Oda & Ueda (2005) show that the QE and the lower bound decreased the medium-to long-term interest rates. Similar to the work of (Okina & Shiratsuka 2004) and (Baba et al. 2005) find that the zero-interest rate had significant effect for a longer period than expected, it affected the future short-term interest rates and thus the entire yield curve. Hosono (2006) confirms that during the crisis the monetary policy was efficient in bank loan supply. Kobayashi, Mark & Nobuyoshi (2006) find that returns of Japanese banks were higher when Bank of Japan applied unconventional monetary policy. Ugai (2007) indicates that QE helped to induce an accommodative environment for corporate financing while (Bowman et al. 2011) state that bank liquidity had an important effect in lending and the increase of the reserves increased the flow of the credit. Han & Seneviratne (2018) indicate scarcity effects of Bank of Japan purchase government on market liquidity. Ryou, Baak & Kim (2019) estimate the impact of qualitative and quantitative easing in Japanese and Korean economies and the authors find that announcements help increase the inflation in the long run, it depreciates Japanese yen while Korea's GDP becomes stronger.

There is a wide existing literature that documents the spillovers of ECB unconventional monetary policies in the European countries while research on other small advanced and open economies remains scant so far. Lenza, Pill & Reichlin (2009) describe that non-standard measures of ECB, FED and BOJ had a stabilizing impact in the financial sector and the economy. Peersman (2011) states that

Euro system can stimulate the economy through the monetary base or expansion of balance sheet while (Beirne et al. 2011) show that CBPP was effective in the primary and secondary bond markets. Abassi & Linzert (2012) find that before the crisis the market rates still respond to revisions in the expected path of future rates even though in modest effects than before the crisis. Gambacorta, Hofmann & Peersman (2014) state that the expansion of balance sheet at the zero-interest rate increase economic activity and the inflation temporary. Daaracq-Paries & De Santis (2015) document significant impact in real GDP and loan provisions to non-financial corporations. Levis & Roth (2015) estimate the impact of balance sheet policies in the markets, banking sector and lending to non-financial firms and the results indicate that the policies reduced the risks. Boeckx, Dossche & Peersman (2014) indicate that the increase of balance sheet increased bank lending, stabilized the markets and had a positive impact on prices. Georgiadis & Grab (2015) investigate the impact in global equity prices, bond yields and exchange rates. Their findings show that announcements boosted the equity prices and depreciate the euro vis-à-vis the emerging and advanced market economy currencies.

1.4. Empirical literature on event study methodology

Event-study methodology was firstly introduced in the work of (Dolley 1993) who estimates the nominal price effects of stock splits. Ball & Philip (1968) considered the information content of earnings while (MacKinlay 1997) highlights the methodology focusing on corporate finance issues. The work of (Fama et al. 1969) is of great significance who defined the methodology and is similar to the one that is being used today on event-study papers. Existing literature on investigating the spillover effects of ECB's non-standard monetary measures using event-study methodology are receiving great attention nowadays.

(Bernake, Reinhart & Sack 2004) evaluate the effectiveness of unconventional monetary policies at zero lower bound and focus particularly in modern industrial economies such as United States and Japan. They use event-study to estimate the response of financial markets to central bank statements and announcements. Three different market-based measures of policy expectations at various horizons are built. The first factor equals the current policy surprise as inferred from the federal funds futures market, which also affects the year-ahead futures rate and the five-year yield. The second factor equals the portion of the change in year-ahead policy expectations (as measured by the change in the Eurodollar futures contract) while the third factor is the change in the five-year Treasury yield. The dummy variables are constructed to capture the day of the statements and, in order to capture if the sign of the expectations matches to the predicted direction, statements are divided into "hawkish" and "dovish". In the second part, no-arbitrage vector autoregression model of the term structure of the interest rates is used both for United States and Japan. These models allow to project the expected level and shape of the term structure for any given macroeconomic conditions and stance of monetary policy. This predicted term structure can be used as benchmark in order to assess if factors which are not involved in the model, such as changes in the relative supplies of Treasury securities during the recent debt buyback episode in the United States or quantitative easing in Japan, can have a significant effect on interest rates. Results show that Federal Reserve communications were successful to impact market expectations and long-term yields. On the other hand, nonstandard policies of Bank of Japan reduced the long-term yields but had rather limited effect on the expectations.

The already cited paper by (Gagnon et al. 2011) adopted an event study methodology to estimate the effects of Large-Scale Asset Programme on interest rates, through the cumulative change as a measure of the overall effect. The response of interest rates was considered through a one-day window around the announcements which is calculated as the difference between the spread on the day of the announcement with the spread one day prior to the announcement. Time-series analysis is used to estimate the impact of asset purchases (or sales) on the ten-year term premium and in order to explain

the variation in the term premium other factors related to the business cycle, uncertainty about economic fundamentals, and the net public-sector supply of longer-term dollar-denominated debt securities are included in the model. Using a variety of model specifications, the authors estimate the effects of changes in the stock of longer-term debt held by private investors on the term premium. Then these results are used to estimate the (out- of-sample) impact of the Federal Reserve's asset purchases, which represent a reduction in the supply of longer-term debt securities to private investors. Results show that LSAP had the power to lower the yields of the assets which were included in the purchase programme and on assets which were not included in the programme such as corporate bond yields. Moreover, the decline in the term premium reduced the yield of 10-year Treasury.

Swanson (2011) tried to forecast the impact of QE taken by Federal Reserve in November 2010, by studying the Operation Twist, a similar program which was undertaken by the Federal Reserve in 1961. The programme of 2010 was LSAP-2, which is known as Quantitative Easing 2 Programme and the main aim was stronger economic recovery and maintaining the inflation stable. With this operation by selling short-term bonds and purchasing long-term bonds, Federal Reserve was seeking to influence the term structure, increasing the yields on short-term securities and reducing the yields on long-term securities. In September 2011, FED announced Maturity Extension Programme, which was as "Operation Twist 2" similar to Operation Twist One. FED bought long-term Treasury securities with a maturity from 6 to 20 years and sold the short-term securities with a maturity less than 3 years. The author considers an event-study approach with high-frequency data, focusing on the major announcements of Operation Twist and on the changes of Treasury yields in two days window in order to ensure that the changes in prices and returns are only due to policy announcement. The econometric test is based on a two-sided t-test and the null hypothesis is the ineffectiveness of the announcements on the term structure at any maturity. The alternative hypothesis is that the short-term yields should increase or stay same while the long-term yields should decrease. The study reveals that the announcements might have affected yields via two possible transmission channels: a direct channel through the reduction of the expected supply of long-term treasuries which leads to a fall in yields and the indirect channel, which these announcements can be interpreted by investors as a signal for the future stance of the monetary policy. The aim of the econometric test was to test if the announcements had significant impact on the spreads and the results revealed that four of them had important effect on the yield curve. Contrary to (Modigliani & Stuch 1966), (Swanson 2011) found a significant impact on long-term Treasury yields. However, similar to (Modigliani & Stuch 1966), the findings show that the effect is more likely to be between 10 and 20 basis points.

Falagiarda & Reitz (2013) study the impact of ECB communications on the perceived sovereign risk of Italy. They perform an event-study analysis focusing on the Italian spread of sovereign bonds around ECB announcements and they define cumulative and average effect of each event on the spread. For the event-analysis, one-day window, and two two-days different windows are used to check for the delay and anticipation effects. Moreover, according to the event-days pseudo p-values are calculated as the spreads which are higher in absolute value than the spread on the announcement day. As the monetary policy decisions are already priced in the market, in order to capture the surprise component which is the only one which drives changes to the yield, the authors construct the surprise indicator. This monetary policy surprise shock is computed as yield changes of Italian long-term bond futures (EUREX-Euro BTP futures index) from 15 minutes before each ECB announcement to 1 hour and 45 minutes afterwards. The yield changes are constructed as returns on the futures contract divided by the duration of the cheapest- to-deliver asset in the deliverable basket. Since futures on Italian government bonds are introduced in September 2009, for the period of study before September 2009 Bund futures are used as an approximation due to the high correlation of the prices between Italian and German long-term bond futures.

Rivolta (2014) through an event-study focuses on government bond yields of 10 European countries and 6 extra -Euro countries to investigate the transmission mechanism. The difference in yield variation is scaled on the standard deviation of 1- or 2-day changes of bond i in the event j . The standard deviation is calculated 30 days prior to the announcement day so is not influenced by variation of announcement itself. The study is similar to event-study approach by (Swanson 2011), and the econometric methodology consists of a two-sided t-test, the null hypothesis is that bond yields are unaffected by the announcements of non-standard measures while the alternative hypothesis is that the announcements have some effect on bond yields. The procedure starts by shrinking the dimensionality of data; it starts from the yields of different bonds for different countries in different events (j) and the author aggregates the yields by time dimension to obtain the Q t-statistics for each event. Then, the t-statistics are aggregated by bonds in order to obtain Wald statistics for the country and for each event. As a second empirical analysis, a panel is built for both Euro-area and extra Euro-area country yields to investigate the impact of the six longer-term refinancing operations by ECB. The findings for the first analysis show that Covered Bond Purchase Programme, Security Market Programme and extension of the maturity of LTRO were the announcements which had significant impact. Results for the panel indicate that the transmission for the liquidity injections was different, especially the last three LTROs increased the market spreads for lower-rated Euro countries due to safety.

Falagiarda & Reitz (2015) study the impact of ECB's non-standard policy measures on non-euro area EU countries in Central and Eastern Europe. They use event study to estimate the impact of ECB announcements on financial assets in CEE countries. A simple OLS is used to express the relation between exchange rate, stock market index, sovereign bond yields, CDS spreads and the policy rate of ECB and the rate of non-euro area EU countries (Czech Republic, Hungary, Poland and Romania). Three event dummies are built to capture the decisions of non-standard measures by the domestic monetary policy authority, ECB and FED. To check for the expectations of market participants, an additional variable is introduced to test how the news impacts the variables mentioned above. The results indicate that SMP announcements had stronger effect than OMT and PSPP which effect was rather modest. Turning to the transmission channels of these spillovers, the authors show that SMP worked through portfolio rebalancing and signaling channel. The OMT influenced the CEE countries via confidence channel leading to the reduction of redenomination risk within the euro area but it did not result in spillovers across the border.

Urbschat & Watzka (2017) investigate the impact of Asset Purchase Programme (APP) implemented by European Central Bank on the short-term reaction of financial markets, bond yields and spreads in several Euro countries on a total of 10 event dates. Running event regressions, the study tries to estimate different asset price channels through quantifying the cumulative decrease of spreads. Focusing on the signaling channel, which is measured by the Overnight Index Swap (OIS) rate and portfolio rebalancing channel, measured by the conditional bond-OIS spread, results suggest that the initial announcement of Public Sector Purchase Programme (PSPP) produced significant yield and spread reduction. Possible explanations for this are the declining degree to which the ECB surprised markets and the increasingly burdensome institutional set-up of the APP. Yield reduction seems to be larger for periphery countries rather than for core countries that shows that the stronger reduction is due to a decreasing risk component of southern bonds. Moreover, while controlling for credit risk reduction, the results are slightly significant for all countries.

Neugebauer (2018) employs event study technique to estimate the impact of ECB's unconventional monetary policy on the 10-year government bond yields in euro area. The empirical estimation is carried out on a baseline specification, an extended case of program-specific effects and a panel analysis. For every specification, is investigated the immediate effect and then the specifications are analyzed with a delay of one day. The reason for the delay effect is transactional frictions and due to

the time that investors need to digest and react to the new information. In the baseline specification, for every government yield an identical regression is estimated in order to check for different reactions between countries. Program-specific effects check for the differences between the programs and six program-specific dummy variables are defined for each specific asset purchase program j , each taking the value of 1 in case of an event belonging to the specific program, and 0 otherwise. The panel distinguishes the country based on the solvency and it is limited only to long-term yields in order to avoid the issue of possible negative short-term yields or rather zero lower bound. Therefore, three panel regressions are defined, one for the 11 euro area countries, and then one for Core countries and Periphery countries as group-wise panels, respectively. The former searches for a Europe-wide effect, while the latter analyzes group-specific effects of the asset purchase announcements. The results show that the extent of yield reduction is highly related to the solvency rating of the country. The panel analysis confirms the division between country groups while program-specific announcements seem to have an ambiguous conclusion; the latter supports the reduction of the yields, but the results are not consistent for each program-specific effect. The study confirms that impact of asset purchase announcements depends on the number of chosen events and employing different data as control variables, the results are robust for a given event set.

Korus (2019) investigates the impact of ECB's announcements on a range of financial assets (benchmark bond yields, CDS spreads, 3-month interbank rate, exchange rate vis-à-vis the euro, equity price index and S&P corporate bond index) of Denmark, Norway and Sweden and the monetary policy surprise is based on the 10-year German Bund futures. If the price of the Bund future increases, it indicates an expansionary monetary policy of ECB more than expected by the financial markets. In spite of the exchange rate regime, ECB's announcements had spillover effects on asset prices of Denmark, Norway and Sweden. The announcements reduced government bond yields and increased corporate bond indices. Thus, the results show that the sovereign bond yields and corporate bond yield were affected via portfolio rebalancing channel. This shows for a close substitution rate of medium and long-term government bonds of respective countries with those of euro area government bonds. Unconventional monetary policies influenced CDS spread in Denmark and interbank rate in Norway, but bilateral exchange rates and benchmark stock market indices were not affected by the ECB's announcements. SMP announcements, CSPP announcements and forward guidance had significant impact on financial assets of Denmark, Norway and Sweden. SMP announcements affected government bond yields and corporate bond indices via portfolio rebalancing channel and exchange rate channel. CSPP announcements operated via confidence channel and exchange rate channel to impact government bonds, corporate bond indices and bilateral exchange rates vis-à-vis the euro. Forward guidance affected long- and medium-term government bond yields, stock prices and bilateral exchange rates vis-à-vis the euro via the signaling channel. OMT and PSPP announcements were the only one which had modest effect on the financial assets of Denmark, Norway and Sweden.

1.5. Transmission channels

In this section, I discuss possible transmission channels through which ECB unconventional monetary policies could affect the financial assets in my countries of interest.

The first transmission channel that monetary policy can use to influence the financial assets is the exchange rate channel. The reduction of the policy rate in a country and the increase of its money supply under flexible exchange rate regime, can depreciate the nominal spot exchange rate of its national currency. When a foreign monetary shock occurs, countries which have open capital account will adjust their exchange rates if the monetary authorities do not respond to the shock. Unconventional monetary policies aim to influence long-term interest rates, which make the country more attractive if the foreign long-term rates are lower, so it is more favorable for the investors to

invest. Therefore, it is necessary to adjust the capital flows which can lead to the appreciation of the domestic currency. However, this adjustment process could be complex as the reduction of foreign long-term rates may reduce the domestic rates too if the central authority does not react (Bernhard & Ebner 2016).

Portfolio rebalancing channel is another possible channel through which the non-standard monetary policies could have significant impact. There are two possible explanations how this channel could affect foreign assets. When the ECB purchases euro area government bonds it reduces the amount of securities available to private investors. The private investors will be crowded out from the market and they would look for assets that have a similar risk-return profile and they would move to close substitute assets which could be domestic or foreign assets. Thus, ECB purchases induce investors to rebalance their portfolio leading to changes of prices of other financial assets. Second, when ECB purchases euro area government bonds reduce the yields in comparison to non-euro area bonds. Hence, foreign assets would be more attractive, and investors would turn to non-euro area assets for higher returns. Higher demand would cause the increase of prices for non-euro bonds lowering their yields. This channel could be particularly related to announcements of SMP, PSPP and CSPP because these programs consist on the direct purchase of assets.

Signaling channel is similar to portfolio rebalancing channel as operates through prices and yields of domestic assets. Indeed, it operates via future expectations of short-term policy rates. This might happen if the central authorities commit to reduce/increase long-term interest rates, which is often referred as forward guidance. Different interest rates across countries may result in differences in all maturities of bonds. The Outright Monetary Transaction (OMT) is the best example of the signaling channel. Even though it has never been applied it reduced the risk in the financial markets.

Another potential channel of transmission can be the confidence channel. Non-standard monetary policy measures can increase the confidence in advanced economies and beyond the borders. It might influence the financial assets in different directions. If the confidence in the euro is increased, it meant that there will be capital outflows and reprising of risks from small advanced economies. Capital outflows might reduce asset prices and increase yields. On the other hand, monetary policy decisions may induce capital flows as result of trade strategies and linkages between them.

International bank lending channel operates through the dominance of banks as financial intermediaries. Except of asset purchases, unconventional monetary policies consist in special loans and lending which is mainly financed via the increase of reserves of commercial banks at the central banks. This can help to increase the lending and banks can provide more money, which fosters the consumption and investments (Falagiarda & Reitz 2015).

Hence, when the liquidity is increased in euro area, the credit in Nordic countries is influenced as there is a high presence of banks, which their parent banks are located within euro zone. When a parent bank reduces its interbank rate, it can decrease the cost of funding within the banking group. However, there is no perfect correlation among the cost of funding for the parent bank and the subsidiaries.

1.6. An event-study analysis

In this section, I perform an event study analysis of ECB unconventional monetary policy operations. I adopt an approach similar to those of (Neely 2010; Gagnon et al. 2011; Krishnamurthy & Vissing-Jorgensen 2011; Glick & Leduc 2012 and Wang 2019) who investigate the impact of non-standard

measures implemented by the Federal Reserve. In particular, I focus on the changes on Nordic spreads around ECB macroprudential policies.⁶

The source of the data is Thomson-Reuters Datastream spanning from 2008 to 2018. I estimate how long-term government bond yields change in relation to ECB non-standard monetary policy operations. There are 229 announcements which I have identified for the whole-time framework which include press conferences, press releases and public speech. Each year is made up from 259 to 262 observations which corresponds to the number of working days in one year.⁷ When a national holiday happens to be in a working day, the value of the next working day is taken in account. This smooths the variability of the data set, but on the other hand, it allows to have the data in the same time framework, and it happens in few days which does not influence my data to a great extent.

Using event-study analysis prevents to control for the other factors that might happen in the same time with the news and might influence the yields and the prices themselves. This inability to properly identify agent's behavior and the other factors affecting the variables of study, might generate biases which can influence the results. Moreover, defining the proper window to estimate the spread change presents a tradeoff between a narrow and a wider window. Choosing a narrow window allows to capture the impact of the news and avoids the noise but, on the other hand, it does not capture the anticipation/delay effects. Hence, I will adopt a one-day window, a 3-days window and a 5-days window.⁸

Following the work of (Craine & Martin 2008) I report the standard deviations of daily spread changes for event and non-event days over the entire period 2008-2018 and each individual year in **Error! Reference source not found.** The findings show that the standard deviation of spread changes on event days is slightly higher than on non-event days indicating the importance of ECB announcements on the Nordic spread movements. Moreover, the volatility of the spreads has been increased in 2010, 2011 and 2012 in comparison to non-event days. There is a modest impact on event days in 2010 while in 2011 the impact seems to increase. Lastly, the difference in volatility between event and non-event days after 2014 is not pronounced.

Table 1. 2 Standard deviations of daily basis point changes in the spread

	Denmark	Finland	Iceland	Norway	Sweden
2008					
Event days	0,34	0,31	1,77	0,33	0,51
Non-event days	0,36	0,34	1	0,32	0,49
2009					
Event days	0,17	0,2	0,57	0,23	0,31
Non-event days	0,13	0,18	0,55	0,16	0,26
2010					
Event days	0,43	0,34	0,89	0,32	0,36
Non-event days	0,42	0,32	0,78	0,28	0,32
2011					
Event days	0,55	0,46	0,58	0,51	0,67

⁶ The list of macroprudential policies taken by ECB from 2008-2018 is available in Appendix section

⁷ In total there are 2874 observations from 2008-2018, for which 229 are event days and 2645 are non-event days.

⁸ Event windows larger than five days are not considered as (Wang 2019) to avoid the effects of other news.

Non-event days	0,54	0,44	0,55	0,48	0,67
2012					
Event days	0,34	0,35	0,32	0,26	0,32
Non-event days	0,27	0,3	0,26	0,18	0,2
2013					
Event days	0,32	0,43	0,33	0,39	0,45
Non-event days	0,21	0,21	0,17	0,33	0,3
2014					
Event days	0,32	0,43	0,43	0,33	0,39
Non-event days	0,27	0,42	0,3	0,38	0,42
2015					
Event days	0,3	0,33	0,57	0,14	0,22
Non-event days	0,27	0,24	0,56	0,14	0,2
2016					
Event days	0,23	0,23	0,42	0,19	0,28
Non-event days	0,22	0,21	0,41	0,2	0,3
2017					
Event days	0,08	0,09	0,31	0,08	0,14
Non-event days	0,11	0,09	0,18	0,07	0,12
2018					
Event days	0,14	0,11	0,31	0,08	0,14
Non-event days	0,15	0,09	0,28	0,1	0,14
Total Event Days	1,4	1,4	1,62	1,07	1,19
Total Non-event days	1,32	1,33	1,43	1,04	1,16
All sample	1,33	1,34	1,45	1,04	1,41

Source: Author's calculations

In Table 1. 3 I present the cumulative and the average spread changes of the pseudo p-values over all announcements for 1-day window, 3-days window and 5 days-window. Pseudo p-values are estimated as the proportion of daily changes during 2008-2018 period which are larger in absolute value than the actual change on the announcement day. The cumulative spread changes are calculated as the cumulative sum of all pseudo p-values and are a measure of the overall effect. Average spread changes are calculated as the average sum of all pseudo p-values from 2008 to 2018. First, I calculate the basis points spread changes for 1-day window as the difference between the closing spread on the event day and the closing spread value on the day before (Neely 2010) and (Glick & Leduc 2012). There seems to be an insignificant increase for the spreads of Nordic countries which amount to limited average effects. The only effect that is negative for the 1-day window effect is Iceland which has a reduction of 5,1 basis points whilst the average impact is not significant. I follow the work of (Wang 2019) and I calculate 3-days window and 5-days window which are indicated in the second and third row of

Table 1. 3 Results for an event window without considering the sign of the event

	Denmark		Finland		Iceland		Norway		Sweden	
	Sum	Avg	Sum	Avg	Sum	Avg	Sum	Avg	Sum	Avg

1-day window	0,431	0,001	0,234	0,001	-	-	0,104	0,0004	0,058	0,0002
3-days window	-0,518	-0,002	-1,789	-	-	-	-0,599	-0,002	-0,767	-0,003
5-days window	-1,348	-0,011	-2,888	-	-4,28	-	-0,791	-0,003	-2,327	-0,010
				0,007	1,871	0,008				
				0,012	0,018					

Source: Author's calculations

To allow for the delayed reactions to news of the agents, 3-days window is calculated as the closing level of the spread before the announcement and the closing spread on the second day after the announcement. 5-days window is calculated as the closing level of the spread on the second day before the announcement, the spread on the day of the announcement and the closing spread of the second day after the announcement. The findings for the 3-days and 5-days window are negative which show that ECB probably reduced the spread of the Nordic countries, however, this decrease is limited. I proceed with the significance of the effects; if the proportion calculated is higher than 0.05 it means that the change observed in the announcement is not exceptionally large hence, I conclude that the announcement effect is not statistically significant. Table 1. 4 defines that the vast majority of the events are not significant. Finland is the only country that has the highest number of significant events when the 5-days window is used.

Table 1. 4 Significance of the events without the sign effect

	Denmark		Finland		Iceland		Norway		Sweden	
	<0,05	>0,05	<0,05	>0,05	<0,05	>0,05	<0,05	>0,05	<0,05	>0,05
1-day window	13	216	20	209	15	214	15	214	10	219
3-days window	16	213	31	198	14	215	15	214	11	218
5-days window	3	226	12	217	11	218	14	215	16	213

Source: Author's calculations

1.7. Robustness check

In order to check for the robustness of our results, we allow for the sign effect to influence the magnitude of the event. We assume that an increase in the government bond yields has a different from the decrease of the yields. In Table 1. 5 *Error! Reference source not found.* I calculate the pseudo p-values, and then I proceed with cumulative and average effects but in comparison to the previous estimations, I allow for the sign effect to influence the magnitude of the event. As a matter of fact, I find that the sign of the event has a great influence in the estimation of event windows. I show that ECB announcements increased the Nordic spreads. The highest impact is found for the 1-day window for Finland which highlights an increase of 186 basis points.

Table 1. 5 Results for the event window with sign effect

	Denmark		Finland		Iceland		Norway		Sweden	
	Sum	Avg	Sum	Avg	Sum	Avg	Sum	Avg	Sum	Avg
1-day window	114,3	0,49	186,6	1,62	113,2	0,98	110,7	0,96	57,02	0,49
	4		9		7		8			

3-days window	113,6 5	0,49	112,6 7	0,51	183,6 2	1,58	72,74	1	111,70	0,48
5-days window	110,5 1	0,96	111,1 4	0,96	116,7 2	1	112,6 4	0,97	29,28	0,51

Source: Author's calculations

The results reveal that Iceland has had an increase of 183 basis points for the 3-days window. Sweden is the country which shows the lowest cumulative effect respectively 57 basis points. In Table 1. 6,I investigate the significance of the events by considering their sign but the findings are not different from those of

. Again, Finland has the highest number of important events when 1-day window is used. As expected, as Finland is part of the EU it follows the policies of ECB. Overall, **Error! Reference source not found.** and **Error! Reference source not found.** indicate opposing results, however, the findings of **Error! Reference source not found.** seem to be more reliable.

Table 1. 6 Significance with sign effect

	Denmark		Finland		Iceland		Norway		Sweden	
	<0,05	>0,05	<0,05	>0,05	<0,05	>0,05	<0,05	>0,05	<0,05	>0,05
1-day window	14	215	18	211	14	215	17	212	16	213
3-days window	13	216	15	214	14	215	15	214	15	214
5-days window	17	212	14	215	12	217	14	215	14	215

Source: Author's calculations

The even study shows opposite results between the findings without sign effect and with the sign effect. Moreover, event study is not accurate as the choice of the event window is subjective to the researcher and involves a tradeoff between choosing an interval that is narrow to avoid the noise produced by other information or keeping a wider window to identify anticipated or delayed effects. Hence, the decision of the event windows can generate biases in the estimation. Moreover, I did not check on particular ECB announcements which could indicate which type of operation has had the highest impact. However, the identification of the operations would complicate the work. Therefore, an econometric analysis would be far better than an event study approach.

1.8. Concluding remarks

As the perceived risk in the euro area increased, the European Central Bank implemented a series of non-standard operations in order to inject liquidity and restore the function of financial markets. This chapter performs a review of European Central Bank unconventional monetary policies from 2008 to

2018. We have done a review on the possible transmission channels of unconventional monetary policy and on the current literature using event study approach. Further, we have explored the impact of ECB announcements in the Nordic spreads from 2008-2018. The findings show that there is a slightly increase in the volatility in 2010, 2011 and 2012 in event days in comparison to non-event days. In the lenses of event study, the results indicate opposite findings when we consider, and we exclude the impact of the sign in the event window. The results without the sign effect show limited effect of ECB communications in the Nordic spreads whereas counting on the sign effect the cumulative effect is really significant. When considering the significance of the events, there seem to be similar results. As a matter of fact, event study reveals opposing results hence, a formal analysis would be more preferable.

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CHAPTER 2

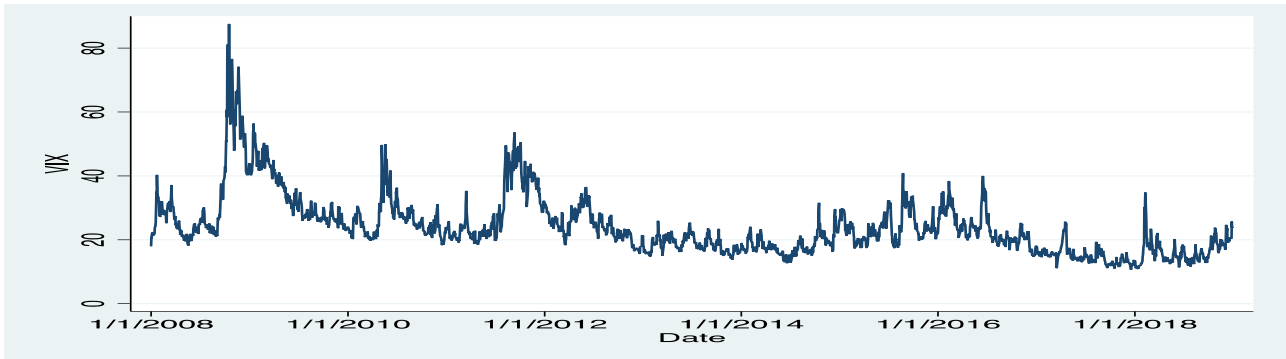
ECB'S SPILLOVERS OF UNCONVENTIONAL MONETARY POLICIES IN FINANCIAL MARKETS

2.1 Introduction

The global financial crisis of 2007-2008, the collapse of Lehman brothers and the sovereign debt crisis brought lack of confidence, stressed markets, discrepancy and insolvency in the financial markets. Financial turmoil indicated by the volatility index (see Figure 2. 1) and TED spread as a tool of the perceived global risk (see Figure 2. 2) increased while the EUDS which controls for the economic outlook (see Figure 2. 3) decreased sharply.

Figure 2. 1 Volatility index

(price index, euro)

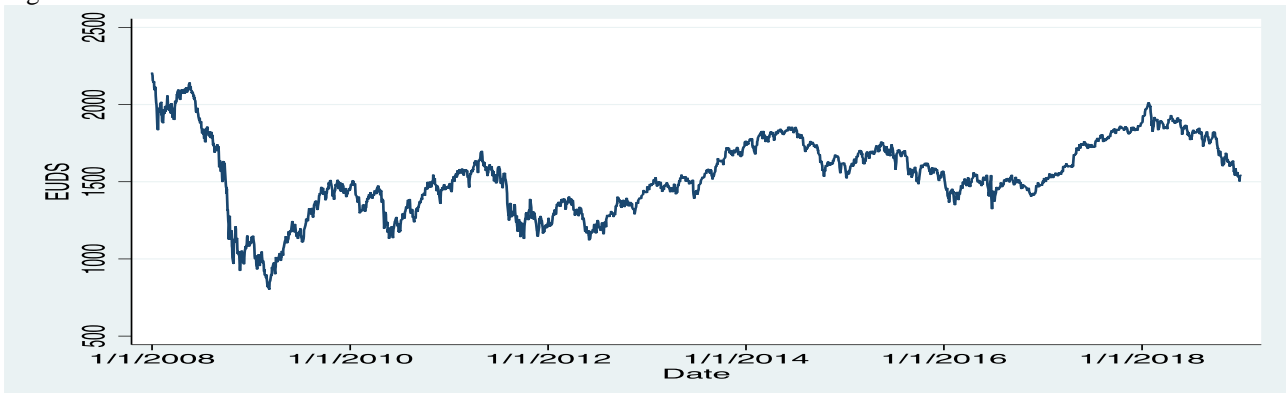


Source: Thomson Reuters-Datstream
Figure 2. 2 TED spread



Source: Thomson Reuters-Datstream

Figure 2. 3 EUDS index



Source: Thomson Reuters-Datstrea

Central banks all over the world took extensive actions in order to address the systemic risk that was built in the financial system. Hence, macroprudential policies began to be implemented which focused on the system as a whole instead of the single institutions. The global crisis brought the set-up of several institutions and frameworks to conduct the macroprudential measures. In 2010 the European Systemic Risk Board (ESRB) was established which is responsible for the macroprudential framework of the financial system in the European Union and is part of the European System of Financial Supervision. In 2011 the Board recommended that Member States should implement

macroprudential authorities⁹ in order to pursue macroprudential objectives.¹⁰ The new prudential regulations for banks were established in 2014, which include Capital Requirement Directive IV¹¹(CRD IV) and Capital Requirements Regulation¹²(CRR). The initiative for the new regulations consisted in a set of tools which were packed in Basel III developed by the Basel Committee on Banking Supervision with the aim to address the risks of the financial sector, provide financial stability and mitigate systemic risk. Different from Basel II, Basel III defines two additional buffers, the capital conservation buffer and the countercyclical buffer¹³ (see **Error! Reference source not found.**). Common Equity Tier 1 capital (CET1) is the core capital of a bank which includes sum of common shares (equivalent for non-joint stock companies), stock surplus, retained earnings, other comprehensive income, qualifying minority interest and regulatory adjustments.

Table 2. 1 Capital buffers in Basel II and Basel III

	Tier 2 2.0
	Additional Tier 1 1.5
Tier 2 4.0	Countercyclical Buffer 2.5
Additional Tier 1 2.0	Conservation Buffer 2.5
Common Equity 2.0	Common Equity 4.5
BASEL II	BASEL III
Total Buffer =8 percent	Total Buffer =13 percent

Source: Bank for International Settlement

⁹ Recommendation of the European Systemic Risk Board of 22 December 2011 on the macroprudential mandate of national authorities (ESRB/2011/3) (OJ C 41, 14.0.2012, p. 1).

¹⁰ Recommendation of the European Systemic Risk Board of 4 April 2013 on intermediate objectives and instruments of macroprudential policy (ESRB/2013/1) (OJ C 170, 15.6.2013, p. 1).

¹¹ Directive 2013/36/EU of the European Parliament and of the Council of 26 June 2013 on access to the activity of credit institutions and the prudential supervision of credit institutions and investment firms (OJ L 176, 27.6.2013, p. 338)

¹² Regulation (EU) No 575/2013 of the European Parliament and of the Council of 26 June 2013 on prudential requirements for credit institutions and investment firms and amending Regulation (EU) No 648/2012 (OJ L 176, 27.6.2013, p.1)

¹³ The capital buffers in Basel III – Executive Summary, Financial Stability Institute Papers 28 November 2009, Bank for International Settlements, (Accessed in 16 January 2020)

Additional Tier 1 (AT1) includes sum of capital instruments, related surplus, qualifying minority interest and regulatory adjustments. That means that CET1 should absorb losses immediately while AT1 instruments provide absorption on going-concern basis. Not all the instruments AT1 instruments fulfil the criteria of CET1 such as certain debt instruments, perpetual contingent convertible capital instruments that can be included in AT1 but not CET1. Additional Tier 2 involves sum of capital instruments that fit in Tier2, related surplus, qualifying loan loss provisions and regulatory adjustments. By contrast Tier 2 is gone-concern capital bases, which means that when the bank fails, its instruments should absorb the losses before the depositors and creditors. In Tier 2 the instruments with a maturity date are eligible while for AT1 only perpetual instruments are involved.¹⁴ Additional requirement such as Total Loss-Absorbing Capacity (TLAC) standards are set for Globally Systemic Important Banks which losses might have consequences for the financial system, the government and the taxpayers of a country.¹⁵ Following the recommendations of the ESRB, all countries settled authorities which have the responsibility of macroprudential policies. These national authorities have to inform the ESRB for the implementation of the tools by using the notification templates using the European Banking Authority notification (currently nine notification templates).¹⁶

There is vast literature on the impact of ECB macroprudential policies in advanced economies but there is lack of literature that focus in small, advanced economies such Nordic countries. The financial crisis period and the wave that hit the economies afterwards have raised a number of certain questions in the impact of unconventional monetary policies. Namely, (i) whether and the extent to which ECB non-standard monetary policies have affected Nordic countries?; which are the assets that are impacted by the unconventional monetary policies? I address these questions by analyzing ECB spillovers of unconventional monetary policies in Nordic economies during the period which spans from 2008 to 2018.

To investigate the relevance of the macroprudential policies, I follow the econometric methodology proposed by (Falagiarda and Reitz 2015), who investigate the extent that ECB communications influence the spread between Italian and German long-term bonds. Haitsma, Unalmis, & De Haan (2016) and Chebbi (2019) follow a similar approach but they estimate the impact of ECB communications in stock markets. Following the studies mentioned above, I estimate the spillovers of ECB unconventional monetary policies in a set of financial variables for Nordic countries. In practice, I measure the impact by following a four-step approach. First, I estimate the models through a simple OLS and test for the presence of ARCH effects. Second, I estimate an AR(1)-ARCH (9) model. However, as the autoregressive models are

¹⁴ Definition of capital in Basel III – Executive Summary, Financial Stability Institute Papers 29 June 2019, Bank for International Settlements, (Accessed in 16 January 2020)

¹⁵ TLAC – Executive Summary, Financial Stability Institute Papers 24 June 2017, Bank for International Settlements, (Accessed in 16 January 2020).

¹⁶ The templates could be found here https://www.esrb.europa.eu/national_policy/html/index.en.html (Accessed in 2 January 2020).

sensitive to the number of lags and in order to have a parsimonious model, I proceed in the third step with a GARCH (1,1) model. Finally, I test for the presence of leverage effects and if I find presence of asymmetric effects, I proceed with a threshold GARCH model.

I contribute to the existing literature in several ways. First, I give a deep insight of ECB unconventional policies and respective macroprudential policies of Nordic countries. Second, by analyzing a time period which spans from 2008 to 2018, this paper provides up-to-date estimates. In addition, I explore whether the ECB and domestic communications have had a significant impact in the Nordic countries. Furthermore, I include in my estimation three different surprise components which are calculated as the spread between Italian, Spanish, Greek bond yield to German government bond yields. My findings confirm those of (Trebesch & Zettelmeyer 2018; Rogers, Scotti, & Wright 2014; Haitsma, Unalmis, & De Haan 2016) which show that monetary actions taken by ECB were effective in reducing sovereign risks and bond yields.

Nordic countries belong to the same region and as Andersen (2007) states that Nordic countries belong to the same model and they create a cluster of their own. However, they exhibit high heterogeneity between them. Denmark and Finland indicate significant ECB spillovers as Denmark has given up its monetary autonomy while Finland belongs to the Euro System. Domestic policy rates and domestic announcements mirror those of ECB. Iceland is not a member of EU but is part of Economic Area I find highly significant impact of ECB policy rate and its announcements in Iceland. Norway seem to have a low influence from the financial crisis as it was highly influenced from the crisis of early 90s. Further, Sweden has grabbed the attention of researchers worldwide on the fascinating way how Ministry of Finance and Central Bank have swiped out the crisis. Iceland is not a member of EU but is part of Economic Area I find highly significant impact of ECB policy rate and its announcements in Iceland and limited effect for the other countries. Results for surprise components are similar to those of Rogers, Scotti & Wright 2014; Haitsma, Unalmis, & De Haan 2016; Chebbi 2019) that show that ECB actions were effective in reducing bond yields. Specifically, I show that the vast majority of the coefficients have the expected negative sign in all specifications. Even though the magnitude of the impact is low, the rationale behind is that announcements have caused a reduction in the yield spread between a vulnerable and a core country. Announcements that make investors feel that are better conditions in the financial markets increase the confidence globally which could cause a reversal of the “flight to quality” in safe assets such as government bonds which can be in higher demand and increase their prices.

The remainder of the paper is organized as follows. Section 2.2 illustrates a simple theory of macroprudential policies in Nordic countries. Section 2.3 describes the methodology and the dataset, and Section 2.4 presents the estimation results. Section 2.5 is the robustness check while section 2.6 concludes. The appendix provides details on the additional materials used in this study.

2.2. Macroprudential policies in Nordic countries

In the wake of the financial crisis, the central banks directed to the European Central Bank (ECB) as the main responsible authority to increase their reserves for onward lending and reduce their exposure to liquidity shortage. The Nordic region (Denmark, Finland, Iceland, Norway and Sweden) followed the same strategy. Nordic countries were able to survive with low losses to the crisis except Iceland which experienced a breakdown of its financial system. The neighbor countries and the international financial institutions provided assistance, guidance and rescue packages which saved the Icelandic economy, unless the crash would have had major consequences for the global banking system. Nordic countries belong to the Nordic model sharing similar features which make up the essence of the model. There are differences among countries which are defined in Table 2. 2 and nevertheless, a recent study focused on the Nordic model defines that Nordic countries tend to create a cluster of their own along many dimensions. The Nordic model is a combination of openness to globalization and collective risk sharing.¹⁷

Table 2. 2 Country comparison

Country comparison	Denmark	Finland	Iceland	Norway	Sweden
Main Stock Index	.OMXC20	.OMXH25	.OMXIPI	.OBX	.OMXS30
	1.015,52	4.006,50	1.436,33	822,97	1.640,28
Central Bank Rate	0,05	0	5,5	1,25	-0,25
3 Month IBOR / Fixings	-0,3825	-0,36	3,85	1,55	-0,034
6 Month IBOR / Fixings	-0,255	-0,344	4,025	1,72	0,05
2Y Benchmark Bond	-0,676	-0,661	--	1,29	-0,577
5Y Benchmark Bond	-0,626	-0,551	--	1,308	-0,499
10Y Benchmark Bond	-0,282	-0,098	3,889	1,469	-0,006
2Y Sovereign CDS	3,4	4,26	44,75	4,08	4,69
5Y Sovereign CDS	11,09	12,08	75,08	10,46	11,08
10Y Sovereign CDS	20,16	24,77	94,07	22,3	21,76
2Y Swap	-0,3165	-0,402	4,1	--	-0,05
5Y Swap	-0,1826	-0,285	4,1	1,75	0,101
10Y Swap	0,1808	0,0923	--	--	0,502
2Y Swap Spread	-37	-26	--	-48,8	-52
5Y Swap Spread	-46,3	-25,5	--	-43,6	-55,3
10Y Swap Spread	-48,4	-19,4	--	-35,7	-53,4
FX Rate	Bid	Bid	Bid	Bid	Bid
Against USD	USD/DKK	EUR/USD	USD/ISK	USD/NOK	USD/SEK
Spot rate	6,647	1,1227	126,07	8,6154	9,4316

¹⁷ Andersen (2007)

1 Month Fwd	-195,8	30,38	11,42	-101,8	-237,09
3 Month Fwd	-525,19	82,01	40,07	-226,43	-625,1
1 Month Vol	3,75	4,97	--	6,8	6,36
3 Month Vol	3,875	4,9	--	7,095	6,525
Against EUR	EUR/DKK	--	EUR/ISK	EUR/NOK	EUR/SEK
Spot rate	7,4627	--	141,54	9,6716	10,5882
1 Month Fwd	-18,4	--	51,7	151,78	20,26
3 Month Fwd	-47,2	--	148,81	463,04	72,76
1 Month Vol	--	--	--	4,738	4,35
3 Month Vol	--	--	--	5,113	4,597

Source: Thomson and Reuters (Accessed in 8 July 2019)

In his speech, the Governor of Central Bank of Finland states that the Nordic model has received high attention as it combines a high level of social protection and equal income distribution with high economic dynamism. However, the foundation for this kind of progressive development is the traditional institutional system of the Nordic countries which consists in coordinated negotiations among government and common policies implemented.¹⁸ The Nordic banking system is integrated and is dominated by a number of large banks which are located in the region. The integration of the region began in early 90's when the Swedish bank Nordbanken was merged with Merita, a Finnish bank, which currently represents the largest banking group Nordea.¹⁹ Financial integration of the countries within the region gives the households and the companies the opportunity to benefit from a variety of financial products, lower prices and interest rates. Despite this, the integration gives rise to the contagion risk, which can easily spread from one country to the other. Nordic countries such as, Finland, Norway and Sweden have experienced crisis from 1980 to early 1990 and were ranked among "the big five" advanced economy crisis.²⁰ Although there are high financial interlinkages among countries, there are huge differences among them. Denmark, Finland and Sweden are part of the European Union whereas Finland is part of Single Supervisory Mechanism. Norway and Iceland belong to European Economic Area which gives them access to the European single market. Norway, Iceland and Sweden follow an inflation-target monetary policy with floating exchange rate, while Denmark has a fixed exchange rate regime against euro. The banks within the Nordic region operate as subsidiaries or branches which tend to increase the financial integration across countries. When a bank has subsidiaries in another country, in case of any financial crisis the responsibility of dealing with it has to be shared among countries. Further, when a branch operates abroad, in a country with a currency different from its home currency, it can restrict its ability to require liquidity assistance in another currency. Hence, these differences can impose challenges for the Nordic countries. When the wave of the crisis hit Europe in October 2008, the interbank rate of the countries rose

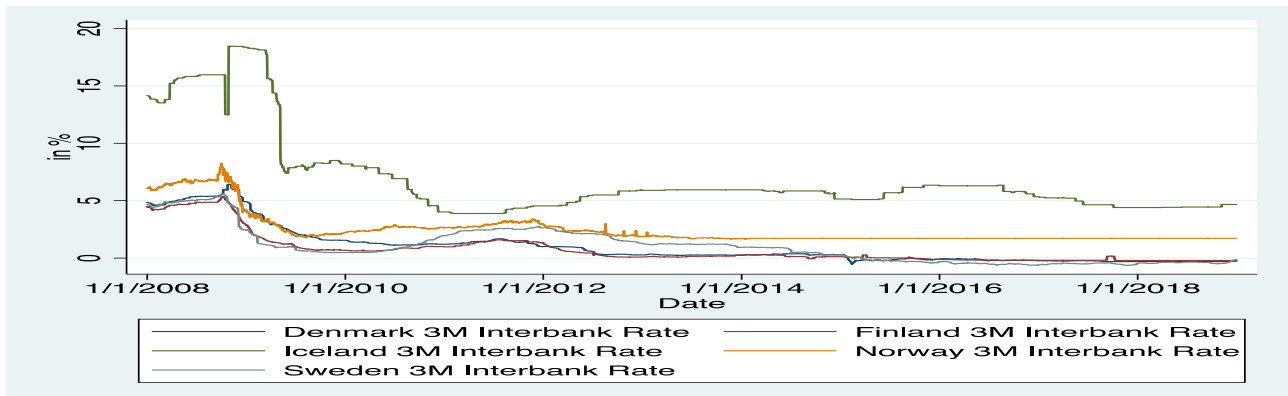
¹⁸ Liikanen (2008)

¹⁹ Nordea (2015)

²⁰ Reinhart and Rogoff (2008)

especially in Iceland. It is evident in **Error! Reference source not found.** that during the whole-time framework Iceland interbank rate was relatively high compare to other countries. This reflects the overall financial condition of the Icelandic system and the rate is increased as the agents lost the confidence among each other.

Figure 2. 4 Interbank rates



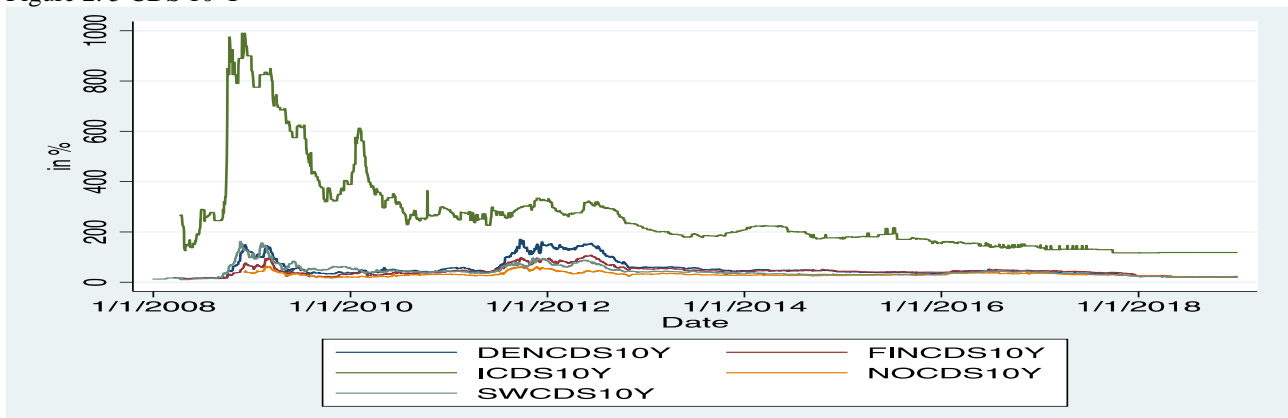
(daily percentage point change)

Source: Thomson Reuters-Datstream

In

Figure 2. 5 I show the credit default swap for 10 years, again the CDS spread of Iceland is higher reflecting the risk of Icelandic banking system.

Figure 2. 5 CDS 10-Y

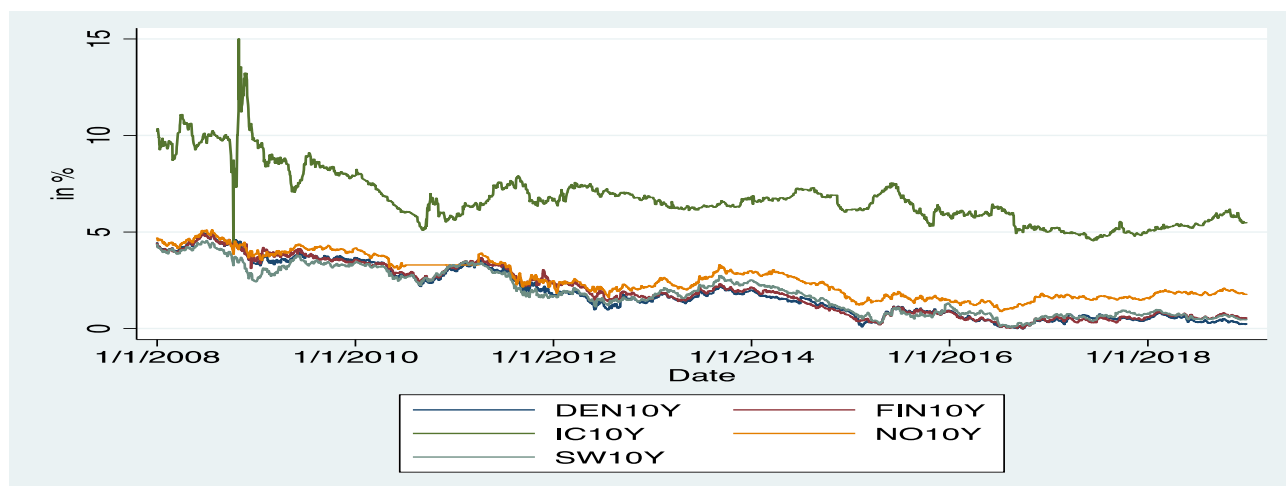


(daily percentage change)

Source: Thomson Reuters-Datstream

The yield of long-term bonds for Denmark, Finland, Norway and Sweden in Figure 2. 6 prove that Iceland's bond yields are higher in comparison to other countries.

Figure 2. 6 Long-term government bond

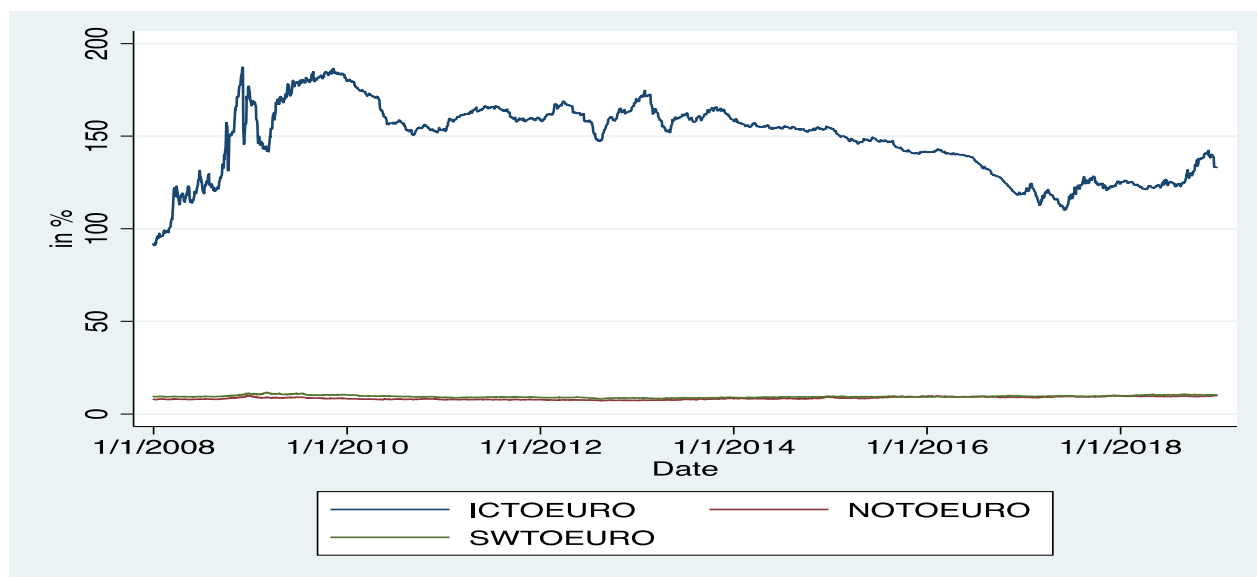


(daily percentage point change)

Source: Thomson Reuters-Datastream

In Figure 2. 7 I show the domestic currencies vis-à-vis to euro and I show that Iceland experienced a depreciation of its currency while the two other currencies followed a similar path.

Figure 2. 7 Exchange rate of Nordic currencies to euro



(daily percentage point change)

Source: Thomson Reuters-Datastream

All states in the Nordic region have established authorities which are responsible for the implementation of macroprudential policy and shown in Table 2. 3. In Denmark the Systemic Risk Council is the macroprudential authority while the Ministry for Industry, Business and Financial Affairs is the designated authority. Finland and Sweden have a Financial Supervisory Authority which is the responsible

macroprudential authority²¹ and the designated authority²² and is the same authority that takes decisions on macroprudential policies. In Iceland, the Central Bank and the Financial Supervisory Authority are responsible for the macroprudential policies²³. Recently, in 8 January 2020 it was announced the merge of Central Bank of Iceland with the Financial Supervisory Authority. In Norway, the Ministry of Finance is the responsible authority for macroprudential policies.

Table 2. 3 Authorities responsible for macroprudential policies

	Denmark	Finland	Iceland	Norway	Sweden
Central Bank			X		
Supervisory Authority		X	X		X
Government				X	
Council	X				

Source: European System of Financial Supervision

After the authorities settled, the Nordic countries began to impose buffers and implement various tools which aim was to address the fluctuations in their banking system. Each tool carried out by the Nordic countries is available in **Error! Reference source not found.**

Table 2. 4 Macroprudential tools in Nordic countries

Country	Denmark	Finland	Iceland	Norway	Sweden
CCoB	The capital conservation buffer is applied to all Danish institutions from January 1, 2015. In 2019 is currently 2.5 per cent in 2019. Exemption of small and medium-sized investment firms from the capital conservation buffer. Currently applicable	Early introduction at 2.5% level. The measure become active 1 January 2015 and is currently applicable	Early introduction at 2.5% level. The measure become active 1 January 2017 and is currently applicable	Early introduction at 2.5% level. The measure become active 1 July 2013 and is currently applicable	Early introduction at 2.5% level. The measure become active 2 August 2014 and is currently applicable
CCyB	Currently 1 % implemented in 30 September 2019, in 30 June 2020 will be increased at 1.5 % while in December 2020 will reach 2 %	Currently 0 % implemented in 16 March 2015.	Currently 1.75 % implemented in 15 May 2019 and will increase to 2 % in 1 February 2020.	Currently 2.5 % implemented on 31 December 2019.	Currently 2.5 % implemented on 19 September 2019. Exemptions are provided for certain small and medium-sized investment firms

²¹ Macroprudential authority established in accordance with Recommendation ESRB/2011/3

²² Designated authority established in accordance with Article 136 of Directive 2013/36/EU (CRD IV)

²³ Source: List of national macroprudential authorities and national designated authorities in EEA Member States, European System of Financial Supervision http://195.128.1.96/national_policy/shared/pdf/esrb.191125_list_national%20macroprudential_authorities_and_national_designated_authorities_in_EEA_Member_States.en.pdf (Accessed in 3 January 2020)

G-SII		The initiative began in 2018 for setting of a fully phased in G-SII buffer for Nordea Group. Active since 1 January 2020			Identification of Nordea as G-SII (bucket 1, 1% when fully phased-in buffer). The buffer is phased-in with yearly increments of 0.25% until reaching 1% on 1 January 2019. There were two initiatives, one in 2015 and the other in 2017.
O-SII	Identification of seven individual O-SIIs	Identification of three O-SIIs and the buffer is 0.5 to 2 %	Identification of three O-SIIs and the buffer is 2 %	Identification of two national corporations	Identification of four O-SIIs, three O-SIIs have a 2% buffer rate and one have a 0% buffer
SRB	7 institutions and a buffer from 0 to 3 % (All exposures) Faroe Iceland (Domestic exposure 2-3 %)	All banks (All exposure) and a buffer rate from 1 to 3 %	All banks (All exposure) and a buffer rate from 2.5 to 3 %	All banks (All exposure) a buffer rate of 3 %; 1 bank and 1 mortgage company should have a buffer rate at 5 %	The 3 largest banking groups are subject to an SRB of 3%. Applied to all exposures on a consolidated basis.
Reciprocation	Reciprocation of the Swedish article 458 measure (a credit institution-specific floor of 25 per cent for the exposure-weighted average of the risk weights applied to the portfolio of retail exposures to obligors residing in Sweden secured by immovable property, to credit institutions authorized in Sweden and using the IRB Approach for calculating regulatory capital requirements.)	Reciprocation of the average institution-specific risk weight floor of 25 per cent for Swedish mortgage exposures measure, applicable to credit institutions that have adopted the Internal Ratings-Based Approach for credit risk and reciprocation of Estonian systemic risk buffer.		Reciprocation of the Finnish minimum risk weight floor on housing loans provided by IRB credit institutions.	Reciprocation of tighter model requirements by Finanstilsynet (Norwegian FSA) for mortgage lending by IRB banks.
	Reciprocation of tighter model requirements by Finanstilsynet (Norwegian FSA) for mortgage lending by IRB banks.			Reciprocation of Estonian systemic risk buffer.	
	Reciprocation of the Finnish minimum risk weight floor on housing loans provided by IRB credit institutions.			Reciprocation of the Finnish minimum risk weight floor on housing loans provided by IRB credit institutions.	
	Reciprocation of 1-percent SRB rate applied to the domestic exposures of all credit institutions authorized in Estonia.			Reciprocation of the French measure consisting of a tightening of large exposure limits applicable to highly indebted large non-financial corporations that are resident in France taken under Article 458 CRR.	
	Reciprocation of the French measure consisting of a tightening of large exposure limits applicable to highly indebted large non-financial corporations that are resident in France taken under Article 458 CRR.			Reciprocation of the French measure consisting of a tightening of large exposure limits applicable to highly indebted large non-financial corporations	
	Reciprocation of the Belgian measure of 5 percentage point add-on to the risk weights of IRB credit institutions.			Reciprocation of the French measure consisting of a tightening of large exposure limits applicable to highly indebted large non-financial corporations	

Note*: All rates are based on the update of combined requirements as of 1 October 2019

Source: European System of Financial Supervision

The capital conservation buffer (CCoB) is the buffer that a bank should have for the total exposure that needs to be met with the additional of Common Equity Tier 1 capital

minimum requirement. Norway was the first to establish the capital conservation buffer in 1 July 2013 followed by Sweden (with the exemption of small and medium-sized investment firms) in 2 August 2014.²⁴ Denmark and Finland activated the CCoB in 1 January 2015 with Denmark that set the same exemptions as Sweden. Iceland activated the capital conservation buffer in 1 January 2017. Except of conservation buffer, responsible authorities have established the countercyclical capital buffer which is part of the macroprudential instruments to address the pro-cyclicality of the financial system. The capital is aimed to be accumulated when the cyclical systemic risk is increasing, and the buffers enhance the resilience of the banking sector. It helps to preserve the supply of the credit and reduce the downswing of the financial sector.

The countercyclical capital buffer (CCyB) aims to ensure that the capital requirements of the banking sector take in consideration the macro-financial environment that banks operate. The main aim is to use the buffer of the capital to achieve the broader macroprudential goal in order to protect the banking sector from periods in which the aggregate credit growth is excess and related to the build-up of system wide risk. The buffer regime could help to lean against the build-up of the credit cycle in the first place. In downturns, the regime could help to decrease the risk that the supply of credit will be constrained by regulatory capital requirements that could undermine the performance of the real economy and result in additional credit losses in the banking system. The countercyclical capital buffer is calculated as an average of the buffers which are in effect in the jurisdictions that banks have a credit exposure and is implemented as extension of the capital conservation buffer. Banks should make sure that the buffers requirements are calculated and publically disclosed. The banks are obligated to disclose the break down the exposure of the credit of their private sector that are being used in the calculation of the buffer requirement. The regime of the counter cyclical capital buffer was phased in together with the conservation buffer from 2016 to 2018 and it has become fully effective in 2019. The reciprocity of the jurisdictions could be applied in case of international banks and jurisdictions could choose to implement higher countercyclical buffer requirements.²⁵

Globally (G-SIIs) and other (O-SIIs) systemically important institutions should comply to additional requirements for the amount of Common Equity Tier 1 capital they should have as buffer in order to avoid the negative impact that these authorities could have in the domestic or international financial system. For every country, systemically important institutions are ranked based on an overall score which is defined based on the size, importance (substitutability), complexity (cross-border activity) and interconnectedness. The systemic risk buffer aim is to address the long-term systemic risks which are not covered by the Capital Requirements Regulation. The level of the buffer can vary across institutions and there is no restriction for the buffer, but the level

²⁴ There is a difference of the date in which the initiative has started, the date which ESRB was notified and when the measure became active. However, for brevity purpose I define only the date in which the measure became active.

²⁵ Bank for International Settlements, Countercyclical capital buffer (CCyB), <https://www.bis.org/bcbs/ccyb/>, (Accessed in 18 November 2020)

depends on the respective country and it should be approved from the European Commission. Other macroprudential measures include measures that target the systemic risks in the real estate sector. It includes caps to loan-to-value ratios (LTV), debt-to-income ratios (DTI) and debt-service-to-income ratios (DSTI). Further, reciprocation measures are widely used across the region. Reciprocation occurs when an authority in one Member State applies the same macroprudential measure in another Member State to address a specific risk related to an exposure which makes both institutions to be affected similar. Reciprocation aim is to increase the efficiency and the effectiveness of the macroprudential measures within the European Union.²⁶

2.2.1 Macroprudential policies in Denmark

The global financial crisis led to reduction of house prices and household income, which forced the households to reduce their consumption while deleveraging. Nevertheless, the household's debt in Denmark remains one of the highest one among OECD countries which increase the concern that households are forced to borrow more than they could afford.²⁷ Hence, if the lending rate is increased, they will be more sensitive to tighten their financial conditions. Central Bank of Denmark started to get prepared for the wave of the crisis in May 2008, when the bank stated that due to the financial turmoil, they found it appropriate to extend the list of collateral in order to support the exchange of liquidity in the money market. Denmark's National Bank together with Central Banks of Norway and Sweden have entered a bilateral facility agreement with the Central Bank of Iceland, based on which Seðlabanki Íslands (Central Bank of Iceland) could acquire euro against Icelandic krona for an amount of EUR 500 million. As a result of discussions between the Denmark's National Bank, the Danish Bankers Association, Ministry of Economy and the Danish Financial Supervisory Authority decided to provide necessary liquidity for Roskilde Bank A/S. Later, Denmark's National Bank took over of Roskilde Bank A/S, through a new bank, buying all assets and took over the debt and other liabilities, except of the core capital and subordinated loan capital. On 24 September, Denmark's National Bank together with the Federal Reserve, the Reserve Bank of Australia, Central Bank of Norway and Sveriges Riksbank (Central Bank of Sweden) announced common swap facilities to address the pressures in U.S dollar short-term funding markets. Denmark's National Bank announced a swap facility with the European Central Bank to improve the liquidity in euro in short-term markets. However, different from other central banks, the Denmark's Central Bank continued to increase the interest rate in order to support its currency and the reduction started at the end of 2008. The Central Bank of Denmark prolonged the swap facility with Seðlabanki Íslands and together with the Central Bank of Sweden entered a bilateral swap agreement with the Central Bank of Latvia. On 17 December Banque Centrale du Luxembourg (Central Bank of Luxemburg) and Denmark's National Bank signed a Memorandum of Understanding (MOU) that

²⁶ European Systemic Risk Board, European System of Financial Supervision, National Policy, www.esrb.europa.eu, (Accessed on 4 January 2020)

²⁷IMF (2019), (Accessed on 27 December 2019)

concerned the oversight of the system in order to fulfill the oversight activities for security settlements. In 2009, swap facility with the Federal Reserve was extended and the interest rates were brought close to zero. By the end of 2009, the rate on certificates of deposit, lending rate, current-account rate reduced at 0.95, 1.20 and 0.85 per cent while the discount rate was maintained 1 per cent. In August 2010, the Nordic and Baltic authorities signed a Memorandum of Understanding to enhance cooperation and reduce the risk of the financial crisis to spread across borders.²⁸ Various demand-side macroprudential measures have been put in place to ensure the resilience of the borrowers. Loan and amortization measures include four sets of measures: in 2010, the Financial Supervisory Authority implemented the Supervisory Diamond for Commercial Banks which became active in June of 2010. The limit values which are defined address the excessive risk-taking and make the banks more resilient. The liquidity requirement ratio should be higher than 100 percent, the commercial property exposure should be less than 25 percent of total bank exposures, the funding ratio lower than 100 percent; the lending growth less than 20 percent and the sum of large exposures less than 175 percent of Common Equity Tier 1 (CET1). The measure was implemented as micro prudential policy but had also macroprudential implications and is currently active.²⁹ Supervisory Diamond for Mortgage-Credit Institutions³⁰ (it is proposed on December 2014, and became effective in January 2018) consists of regulatory framework of institutions to adjust their business models to five benchmarks for mortgage credit institutions. It ensures the robustness of the institutions and the stability of the Danish mortgage credit system. It has been adjusted to several areas and the adjustments are done to accommodate the consultation responses so the impact on the supervisory diamond and the individuals bearing the marks is unchanged. The five-diamond marking are: Lending growth to each segment should not exceed 15 per cent per year³¹. The proportion of loans where Loan-to-value (LTV) exceeds 75 percent of the loan limit, and where the interest rate is only locked up for up to two years, should be less than 25 percent. It applies only to private and home rental loans. Loans with hedging in the form of interest rate swaps are disregarded. The proportion of loans to private individuals on installment with an LTV band which exceeds 75 percent of the loan limit may not exceed 10 percent of the total loan amount. This measure has become effective since 1 January 2020. Further, the proportion of loans refinanced per quarters should be less than 12.5 percent of the total loan portfolio and annually less than 25 percent of the loan portfolio. The sum of the 20 largest exposures must be less

²⁸ Central Bank of Denmark, Press Releases <http://www.nationalbanken.dk/en>, (Accessed on 20 October 2019)

²⁹ Danish Financial Supervisory Authority, The Supervisory Diamond for banks, <https://www.dfsa.dk/Supervision/Supervisory-Diamond-for-banks> (Accessed in 10 January 2020)

³⁰ The Danish FSA characterizes the regulatory purpose of the supervisory diamond for MCIs as prudential due to its implementation, but in a broader context it functions as a macroprudential tool by applying to all systemic credit institutions, <https://www.finanstilsynet.dk/Nyheder-og-Presse/Pressemeddelelser/Arkiv/Presse-2014/Pressemeddelelse-tilsynsdiamant-realkreditinsitutter-021214>, (Accessed in 4 January 2020)

³¹ Lending segment includes private homeowners, rental property, agriculture and other corporates

than the institute's core capital, the Common Equity Tier 1 (CET1).³² In 2011, the Denmark's National bank announced the expansion of the collateral basis in order to improve the bank's liquidity. Further, it introduced 6-month loans, beside the 7-day existing loans to ensure banks to raise various types of loans to enhance the banks and mortgage-credit institutions access to longer-term financing. In 2012, Denmark's National Bank signed a bilateral agreement with International Monetary Fund (IMF) to support its capacity in promoting the global and economic financial stability. Mandatory down payment is proposed in December 2014 and became effective in November 2015 and mandates at least 5 percent down payment for residential real estate purchases which is translated in an effective 95 percent maximum loan-to-value (LTV) limit. However, the tighter single-loan restrictions apply with 80 percent LTV per loan. The measure is currently applicable. During 2014 and 2015, the Central Bank went ahead of interest rates reduction and in few cases, the policy rate was increased to support the exchange rate. By July 2014 the granted loans matured while the company shares, and banks' credit claims were omitted from the collateral basis. In January 2015 the suspension of issuance of government bonds contributed to reduce the interest-rate spreads in the longer maturity to limit the inflow of foreign exchange. Supply-side measures were introduced in relation to European directives. Since 2015, under CRD IV a liquidity coverage ratio and net stable funding ratio (NSFR) replaced liquidity buffer and funding ratio. In March 2016, the Central Bank of Denmark decided to keep the lending rate, the interest rate on certificates of deposit, the current account rate and the discount rate unchanged based on the sale of exchange market. Moreover, they had to sign for a bilateral agreement with IMF which supported its purpose to ensure financial stability. Secondary homes and properties have lower LTV limits which was raised for vacation houses from 60 percent to 65 percent in order to promote the housing recovery from the housing bust. On the recommendation by the Systemic Risk Council, Danish Financial Stability Authority defined guidelines on good mortgage lending and good business practice for mortgage lending. The latter was proposed in March 2017 and is effective since January 2018. It included lending restrictions for households with Loan-to-Income (LTI) greater than 4 times and LTV greater than 60 percent: the interest-rate fixation of floating rate mortgages needs to be at least 5 years and deferred amortization is only applicable on 30-year fixed-rate loans.³³ These measures were aimed to fit the risk of the households instead of outright restrictions of lending. During 2018, the Governor Rohde, came up with the recommendations that the low level of interest and rising the asset prices may increase the risk appetite however, the imbalances in the Danish economy were not significant. A capital conservation buffer, a systemic risk buffer and a countercyclical capital buffer were introduced. The capital conservation buffer which applies to Danish credit institutions reached 2.5 percent of risk-weighted assets in 2019.³⁴ The systemic risk

³²Danish Financial Supervisory Authority, The Supervisory Diamond for mortgage lenders, <https://www.finanstilsynet.dk/Nyheder-og-Presse/Pressemeddelelser/Arkiv/Presse-2014/Pressemeddelelse-tilsynsdiamant-realkreditinsitutter-021214>, (Accessed in 10 January 2020)

³³Consultation regarding draft Executive Order amending the Executive Order on Good Housing Credit <https://www.hoeringsportalen.dk/Hearing/Details/61185>, (Accessed on 5 January 2020)

³⁴ Exemption of small and medium-sized investment firms from the capital conservation buffer

buffer applied to six systematically important institutions³⁵ and in 2019 it is forecasted to range between 1 to 3 percent of risk-weighted assets based on the institution while the countercyclical capital buffer for all credit institutions took effect in 31 March 2019 and was set 0.5 percent of risk-weighted assets.

2.2.2. Macroprudential policies in Finland

Central Bank of Finland began 2008, with various speeches of the Governor stating that the financial turbulence reached Finland too, with an economic outlook which was deteriorated. The reference rate³⁶ for 2008 was 4.5 percent while the penalty interest rate³⁷ was 11.5 percent, but the rates lowered to 2.5 and 9.5 percent during the first half of 2009.³⁸ Penalty rates are rates that the bank imposes on overdue payment or on commercial contracts and is applicable if not otherwise specified in loan agreement. Governor Liikanen often stated that the banking sector in Finland remained profitable and the capital adequacy was high even though at a difficult operating environment. Narrowing the net interest income and increasing loan losses were expected to low the profits while the buffers were forecasted to withstand even lower developments.³⁹ In 2010, the reference rate was brought at 1 percent while the penalty rate reduced at 8 percent. During 2010, the Governor claimed for more liquidity and higher capital buffers for the Finnish banks. The growth of housing loans was lower than before the financial crisis. On the other hand, household's debt began to increase making them more vulnerable. Therefore, the Single Euro Payments Area was put in place in 2011 and in Finland it replaced the traditional credit transfer at rapid pace. For 2011, the rates were increased by 0.5 percent, the reference rate at 1.5 percent and penalty interest rate at 8.5 percent. In 2012, the rates were similar to 2010. At the speech of 12 December 2013, Governor Liikanen⁴⁰ stated that with monetary union there is a national need for macroprudential tools in order to address the country-specific housing market risks and the system risks with: countercyclical capital buffer (excessive lending growth), loan-to-value limit (housing market risks), capital buffer for systemically important banks and systemic risk buffer (concentrated banking sector). For 2013 and 2014, the reference and the penalty rate were 0.5 and 7.5 percent respectively. The capital conservation buffer began as initiative in 2014 and became active on 1 January 2015. The buffer is currently 2.5 percent and is still active. The

³⁵ The systematically important institutions are Danske Bank, Nykredit, Jyske Bank, Sydbank, Nordea Kredit, and DLR Kredit, Notifications by Danish Financial Supervisory Authority on six other systematically important institutions, 31 July 2018, (Retrieved on 10 January 2020)

³⁶ Under the Interest Rate Act (633/1982), the reference rate used in defining the penalty rate is the interest rate applied in the last main refinancing operation of the European Central Bank prior to the first calendar day of the half-year in question, rounded up to the nearest one-half percentage point. Such reference rate is effective for the following six-month period. (Retrieved from Central Bank of Finland Website on 15 January 2020)

³⁷ The penalty interest rate is the reference rate plus 7 percentage points as stipulated in the Act. (Retrieved from Central Bank of Finland Website on 5 April 2020)

³⁸ Central Bank of Finland, Releases, <https://www.suomenpankki.fi/en/media-and-publications/> (Accessed on 18 December 2019).

³⁹ Governor Liikanen, Speech 10 December 2009, (Accessed 1 January 2020).

⁴⁰ Speech of Governor Liikanen, General government sustainability requires comprehensive implementation of structural reform programmed 12 December 2013, (Accessed in 9 January 2020)

countercyclical capital buffer is actually at 0 percent.⁴¹ In 2016, the reference rate reached the zero bound while the penalty interest rate was increased to 8.5 percent in comparison with 7.5 in 2015 (the reference rate in 2015 was 0.5 percent). The caps for the loan-to-value ratio for residential mortgages were announced and these caps to new loans are set at 95 percent for first-time borrowers and 90 percent for other loans. Only the Finnish Financial Supervisory Authority can reduce the ratios up to 10 percent and define the type of collateral which can be involved in the calculation. Except this, in order to address the risks which could have a potential negative impact for the Finnish financial system and the real economy, the Financial Supervisory Authority introduced a credit institution-specific minimum level of 15 percent for the average risk weight on housing loans to all credit institutions that have applied the Internal Ratings-Based Approach.⁴² In 2017, the size of banking sector was increased, however the macroprudential tools used lacked the tools for borrower's income.⁴³ The rates both for 2017 and 2018, remain same at 0 percent for the reference rate while the penalty rate at 7 percent. Further, the Financial Supervisory Authority in March 2018 announced the reduction of the binding maximum loan-to-collateral ratio to 85 percentage for residential mortgage loans different from those that take for the first-time house purchase. The effects aim was to limit the mortgages and housing markets in order to reduce the debt accumulation. For Global Systemically Important Institutions Buffer, the rate was set at 1 percent and became active on 1 January 2020. For other systematically important institutions the capital requirements are set between 0.5 to 2 percent starting from 1 January 2019. The rate for Systemic Risk Buffer without phase-in period is at 1 percent for all institutions in Finland and specific rates are applied to other systemically important institutions.

2.2.3 Macroprudential policies in Iceland

Iceland was one of the Nordic countries which was heavily affected by the financial crisis and received attention in the international markets which granted to the government assistance to save it from the breakdown. Iceland's boom-bust cycle, management problems and the expansion of cross-border operations were the main reasons for the Icelandic financial crisis. Iceland is a small, open economy and as its integration with the rest of the world increases, the more dependent and complicated became its economy. In the boom-bust story of Iceland, capital inflows were present, asset price boom which turned soon into a bubble lead to a double current account deficit. Meanwhile, there were lack of macroprudential policies. A pivotal reason which gave rise to the Icelandic crisis was the European "passport". This meant the rise and fall of three cross-border banks operating on the basis of EU legislation. The

⁴¹ National Policy, ESRB, https://www.esrb.europa.eu/national_policy/capital/html/index.en.html (Accessed on 8 January 2020).

⁴² Finish Financial Supervisory Authority, https://www.esrb.europa.eu/pub/pdf/other/esrb.notification_other170627_Finland.en.pdf?663d5f7dd2e2c29c5b61dcd7d9d4f92b (Accessed on 11 January 2020).

⁴³ Speech of Marja Nykanen, Member of the Board of Central Bank of Finland 5 December 2017 (Accessed on 1 January 2020).

banking system grew too much, to an aggregate size 10 times Iceland's GDP and an oversize of foreign assets and liabilities. The Central Bank failed to act as the lender of last resort in foreign currency as its FX reserves could not match the needs of the banks

(Baudino, Sturluson , & Svoronos , 2020). Most of the expansion was cross-border and two thirds of the balance sheet of the three cross-border banks was denominated in foreign currency.⁴⁴ After the crisis, Iceland began to compensate its savers, but Icelandic bank, Landsbanki that offered higher interest saving accounts under the UK and Dutch branches failed to compensate the savers which experienced the magnitude of the Iceland crisis. Therefore, this brought clashes among authorities, which went back and forth to the court. In 2008, the Central Bank of Iceland expanded the list of eligible collateral and included foreign currency denominated bonds. The Board of Governors of the Central Bank decided to make some amendments which are expected to facilitate the transactions in the financial market and especially the interbank market for Icelandic kronor. The amendments include reserve requirements which omit the reserve requirements for Icelandic banks' foreign branches; the list of collateral includes covered bonds that have a specific rating while for the issuer the credit rating is removed, and the bank issued certificates of deposits which were offered at financial companies for sale on the same day that regular collateral is granted. In 2009, Monetary Policy Committee has lowered the interest rates and the rates have reached: deposit rate 8.5 percent, the maximum bid rate for 28-day certificates of deposit 9.75 percent, seven-day collateral 10 percent and overnight lending rate 11.5 percent. By the end of 2009, the first tranche of Nordic loan was disbursed to Iceland in connection to the programme of Icelandic government with the International Monetary Fund (IMF). In 2010, the Central Bank begin to purchase bonds and the bank anticipated to buy more based on its liquidity and the market conditions. The Central Bank reached an agreement with the Central Bank of Luxembourg and the liquidator of Landsbanki Luxembourg S.A concerning the purchase of 98 percent of outstanding Avens B.V bonds. The bonds were owned by Landsbanki Luxembourg and pledged to Central Bank of Luxembourg as collateral of a liquidity facility. The agreement gave the Central Bank of Iceland full access over the assets which is the largest single owner of krona-denominated assets outside Iceland. This agreement was crucial following the collapse of the Icelandic banks reducing the external debt and the reduction of holdings by non-residents. Central Bank of Iceland signed a bilateral currency swap agreement with the People's Bank of China with a maturity of 3 years. In 2011, the Central Bank on behalf of Treasury, purchased bonds in order to ensure liquidity, debt management of Treasury and reserve management strategy of the central bank. The last tranche of Nordic loans to Iceland was done on 3 January 2012, which was helpful to maintain a sizeable foreign exchange reserve. In 2013, the Central Bank of Iceland and the People's Bank of China concluded the extension of bilateral swap facility agreement.

⁴⁴ Már Guðmundsson, Governor of the Central Bank of Iceland Remarks at a conference on Nordic-Baltic financial linkages and challenges, Managing capital flows in a financially integrated area: Lessons from the Icelandic financial crisis, Tallinn 13 December 2013, <https://www.cb.is/library/Skraarsafn---EN/Speeches/MG%20Tallinn%20LOKA.pdf> (Accessed in 9 January 2020).

In 2014, the Central Bank of Iceland adopted new rules on the foreign currency funding ratio of commercial banks which aim was to ensure a minimum level of stable one-year funding in foreign currency, reduce the maturity mismatches when banks depend on short-term funding to finance long-term operations. Except this, the central bank has granted exemption to Landsbankinn-bonds for further partial payments to priority creditors. At the end of 2015, the Monetary Policy Committee of the Central Bank of Iceland, has decided that its interest rates will remain unchanged. The rate on seven-day term deposits remained 5.75 percent, the current account rate 5.5 percent, the seven-day collateralized lending rate 6.5 percent and the overnight lending rate 7.5 percent while the reserve requirements was lowered by 1.5 percentage points. In 2016, the swap agreement with the People's Bank of China was renewed while the committee decided for the interest rates to be lowered by 0.25 percentage points. The seven-day term deposit rate to 5 percent, deposit rates (current account rates) to 4.75 percent, the seven-day collateralized lending rate to 5.75 percent, and the overnight rate to 6.75 percent.⁴⁵ The initiative for capital conservation buffer began in 2016 and became active in January 2017. The conservation buffer is currently 2.5 percent of a bank's total exposure. Systemic Risk Buffer (SRB) initiative started in 2016 and the measure became active in the same year. In Iceland the application of SRB consists to eight institutions at a rate of 3 percent and it applies to all domestic exposures. A new regulation on requirements for new residential mortgage loans was introduced which covers all institutions such as banks, the housing financing funds, pension funds and registered creditors. The measure aim was to strengthen borrowers and mortgage lenders resilience to a negative shock in the housing market. The regulation defines a loan-to-value cap on new residential mortgage loans to consumers at 85 percent LTV limit and 90 percent limit for the first-time buyers. By the end of 2017, the rates were lowered at: the seven-day term deposit rate 4.25 percent, the current account rate 4 percent, the seven-day collateralized lending rate 5 percent, and the overnight lending rate 6 percent. In 2018, the Central Banks of Nordic and Baltic countries signed a Memorandum of Understanding (MOU) in order to have cooperation and coordination on cross-border financial stability. Except this, after the financial crisis the Financial Supervisory Authority and the Central Bank of Iceland merged in order to ensure the inflation targeting as the principal objective of monetary policy. In 15 May 2019 the countercyclical capital buffer is defined at 1.75 percent while in February 2020 the buffer reached 2 percent. Further, the Financial Supervisory Authority published the list of three other systematically important institution buffer which was announced and implemented in May 2018 (currently applicable).

2.2.4 Macprudential policies in Norway

In 2008, the Executive Board decision left the key policy rate of Norway unchanged at 5.25 percent. Norges Bank entered a swap agreement together with other central banks of the region in order to support Icelandic authorities for the stability of economic

⁴⁵ Central Bank of Iceland, <https://www.cb.is>. (Accessed in 19 November 2019)

conditions in Iceland. Further, a reciprocal currency agreement was signed with the Federal Reserve, to provide U.S dollar liquidity in Norway if necessary. The Ministry of Finance together with Norges Bank decided to provide two-year F-loan⁴⁶ on fixed rate to secure funding for small banks and the banks eased the collateral requirements temporary in order to increase the access to loans. By the end of 2008, the policy rate was lowered at 3 percent. In 2009, the swap facility with the Federal Reserve was extended and the loan agreement for Iceland was signed on 1 July 2009. The key policy rate reached at 1.75 per cent in December 2009. In order to reduce the exposure to risks and to ensure the adequate borrowing facility for banks, Norges Bank made few amendments for collateral for loans by omitting securities issued by banks. By the end of 2010, the Executive Board of Norges Bank decided to increase the rate from 1.75 percent to 2 percent. The first policy to address the credit growth and leverage took place in 2010 with a notification to ESRB in 2011. The guidelines for residential mortgage lending specify that LTV ratio for mortgage loans is capped at 90 percent and 75 percent for home equity lines of credit. In 2011, the LTV-caps were reduced to 85 and 70 percent.⁴⁷ By the end of 2011, Norges Bank policy rate was lowered at 1.75 percent while it introduced haircut to the market value of securities pledged as collateral.⁴⁸ During 2012 and 2013, the policy rate remained unchanged at 1.5 percent. The capital buffer initiative was implemented in July 2013 at 2.5 percent. In 2014, the policy rate was lowered at 1.25 percent while in 2015 it reached 0.75 percent. In 2014, the Ministry of Finance approved a rule related to the calculation of risk-weighted assets in order to ensure financial stability and promote banks internal models. The minimum requirement of Loss Given Default (LGD) is increased from 10 to 20 percent for mortgage loan exposures.⁴⁹ This rule is applied to all foreign branches operating in Norway. There was a high discussion on the calculation of risk weights under the IRB approach (for the internal models) and risk weights of residential mortgage loans and corporate loans. Ministry of Finance issued a public consultation on four possible alternatives to the current backstop on the level of risk-weighted assets, the so-called Basel I floor. Under the Basel I rules, the risk-weighted assets cannot decrease lower than 80 pct. of banks' risk-weighted assets and the EU's CRR/CRD IV framework implies, as a main rule, an obligation to continue the Basel I floor rule until 31 December 2017, with a possibility of further extension. In Norway, this was decided to be fulfilled by a continuance of the current Norwegian Basel I floor rule. Hence, under the new EU rules, banks can choose to increase the minimum requirement on LGD estimates for exposures secured by property in their territory. This measure applied for domestic banks and branches of foreign banks. Further, in order to

⁴⁶ F-loans are the instrument primarily used to supply liquidity to the banking system, Market operations, Norges Bank, <https://www.norges-bank.no/en/topics/liquidity-and-markets/Market-operations/>. (Accessed in 5 April 2020)

⁴⁷ The supervisory guidelines from 2010/2011 was replaced by a regulation in 2015, hence the guidelines are no longer active. Revocation date 1 July 2015. (Accessed in 10 January 2020)

⁴⁸ Central Bank of Norway, News, <https://www.norges-bank.no/en/>. (Accessed in 29 October 2019)

⁴⁹ Norway Ministry of Finance, Risk weights under the IRB approach, <https://www.regjeringen.no/en/historical-archive/Stoltenbergs-2nd-Government/Ministry-of-Finance/Nyheter-og-pressemeldinger/nyheter/2013/risk-weights-under-the-irb-approach/id742309/>. (Accessed 11 January 2020)

strengthen banks internal models, the LGD minimum is increased by 10 pct. to 20 pct. for mortgage loan exposures and the Financial Supervisory Authority considered the increase of Probability Default (PD) estimates. The measure was introduced in 2014 and became active in 2015. Another measure was introduced for higher risk weights at 100 percent and stricter criteria than in CRR for commercial real estate exposures of banks. This measure became active in 2014 and is currently applicable. In December 2015, The Ministry of Finance established the rules for new liquidity reserve requirements (Liquidity Coverage Ratio, LCR) for banks, mortgage companies and holding companies in non-insurance financial groups. The rules are included in the CRR/CRD IV regulations. The new regulations meant that an entity should have all times a liquidity reserve of 100 percent at least, which is the holding of liquid assets and corresponds to the net liquidity output in a stressed period of 30 calendar days. Enterprises phased the liquidity reserve requirement of 70 percent in December 2015, 80 percent in 31 December 2016 and 100 percent in 31 December 2017. The countercyclical capital buffer by the end of 2017 was defined at 2 percent. LCR requirement applies to the total level, but the entities should have significant LCR for other significant currencies if the liabilities in that currency reach more than 5 percent of the debt. The phase in of LCR within the Euro area is a binding quantitative rule which follows a specific schedule. The EU commission defined January 2015 as the implementation date however, the date was postponed. The settled date was which the measure was effective for EU was 1 January 2018 while in Norway the phase-in began since 2015. The number of days defined signals for how many days liquid means must be available in times of stress and assumes an equal distribution of daily net cash outflow over all 30 days (Eckhardt & Roosebeke , 2015). In 2016 and 2017 the policy rate was lowered at 0.50 percent. In 2018, the policy rate increased at 0.75 percent. Norges Bank announced the renewal of the regulations for new residential mortgages which contain a stress test when assessing the ability of borrower's debt-servicing, meaning that the lender has to make allowance for an interest rate increase of 5 percentage points. For the first house the LTV ratio limit should be 85 percent of the value of the dwelling and the total debt that a borrower could have it cannot exceed five times gross annual income⁵⁰ while the limit for the loans for the secondary dwellings is 60 percent. Up to 10 percent of the value of gross loan volume granted per quarter can be loans that do not satisfy the requirements mentioned above and is called speed limit. The new regulations for the new residential loans include a loan-to-value (LTV) capped at 60 percent for the new residential mortgage loans for secondary homes in Oslo and otherwise at 85 percent additional collateral is accepted. An amortization requirement is introduced for residential mortgage loans with an LTV higher than 60 percent that can be amortized at a rate of 2,5 percent per annum or equivalent to an annuity loan with a 30-year repayment period. A speed limit of 10 percent of the mortgage volume per quarter is allowed not to meet the requirements

⁵⁰Template for notifying national macroprudential measures not covered by CRR/CRD, Notification by Norges Bank (Central Bank of Norway) on requirements for new residential mortgage loans, ESRB, https://www.esrb.europa.eu/pub/pdf/other/esrb.notification180702_NO_rml.pdf?1adb117f8a4f79c4202c358fcdcab253. (Accessed on 11 January 2020)

while the limits for mortgages in Oslo is 8 percent. In 31 December 2018, the countercyclical buffer was set at 2.5 percent. Authorities in Norway have had various initiatives to identify and implement the measures to systematically important institutions. However, only the most recent one which took place in 2018 is currently applicable while the others are not active. The last initiative defines only two O-IIS and the systemic risk buffer for identified O-IISs is set at 2 percent. In addition, a systemic risk buffer of 3 percent applies to all banks in Norway.⁵¹

2.2.5 Macroprudential policies in Sweden

At the beginning of 2008, the Executive Board of Riksbank has decided to raise the repo rate to 4.25 per cent in order to reduce inflation and bring it at the target of 2 per cent as the inflation was expected to be high. The bank entered a swap facility agreement with the Central Bank of Iceland to provide euro against Icelandic krona in order to support the macroeconomic and financial stability. The Swedish National Debt decided to issue short-term treasury bills in additional auctions to ease the shortage of the Swedish market. The rules for collateral changed by including covered bonds and the maturity of loans is extended. The Riksbank entered a swap facility with Federal Reserve Bank to increase the access of the dollars in the financial markets. The policy rate started to decrease only by end of 2008 and in the meantime, it was declared the issuance of certificates of deposits to ease the bank financing. In the last decision of 2008, the central bank decided to cut the repo rate by 1.75 percentage points to 2 percent in order to attain the inflation target. The Riksbank granted loan to Latvia Central Bank to assist the preservation of macroeconomic and financial stability and liquidity assistance to Kaupthing Bank Sverige AB and Carnegie Investment Bank AB.⁵² In 2009, loans at variable and fixed interest rates were introduced and the swap line with FED was extended. In the decision of July 2-nd, the central bank decided to reduce to repo rate by 0.25 percentage point to 0.25 per cent and it was held unchanged for all year. The list of eligible counterparties extended while a precautionary agreement was signed with Eesti bank (the Central Bank of Estonia) to promote the confidence of financial stability. In 2010, the repo rate was increased to 1.25 percent to slow the growth in household borrowing and reduce the risk of imbalances in the Swedish economy. In October 2010, a Loan-to-Value (LTV) limit with a cap of 85 percent of the value of the house is imposed.⁵³ Liquidity Coverage Ratio (LCR) was introduced in 2013 and is the minimum standard for short-term liquidity. It aims that Swedish banks have sufficient liquid assets to counteract the liquidity stress in the short time framework.⁵⁴ LCR is set at 100 percent for USD, EUR currencies which

⁵¹ Ministry of Finance of Norway, Decision on systematically important financial institutions, <https://www.regjeringen.no/en/aktuelt/decision-on-systemically-important-financial-institutions/id2424671/>. (Accessed on 11 January 2020)

⁵² Notice and Press release of Riksbank, (Accessed on 2 January 2020).

⁵³ Swedish Financial Supervisory Authority, <https://www.fi.se/sv/vara-register/sok-fffs/2016/201633/>, (Accessed on 4 January 2020).

⁵⁴ Swedish Financial Supervisory Authority, <https://www.fi.se/en/our-registers/search-fffs/2012/20126/>, (Accessed on 8 January 2020)

corresponds to the capacity to withstand the stress within 30 days. In 2011, the capital requirements for Swedish banks were announced stating that the capital adequacy requirements for four major banks in Sweden should be at least 10 per cent of their risk weighted assets as common equity Tier 1 capital from 1 January 2013, and 12 per cent from 1 January 2015. During 2012 and 2013, the policy rate was close to zero, and the rate was at the zero bound in 2014 to address the inflation to pick up. The Capital Requirements Directive IV (CRD IV) and the Capital Requirements Regulation (CRR) begin to be implemented in Sweden in summer 2014 in order to improve the resilience of the banking sector and to increase quality of the capital. The requirements include: a higher capital base and higher minimum capital requirements, additional capital requirements for calculating the risk-weighted assets, leverage ratio and liquidity standards. The capital conservation buffer was introduced in 2014 and became active in the same year with a level of 2.5 percent. Further, since May 2013 to August 2014 the capital requirements have been strengthened several times by including an increased systematic risk buffer for the four largest banks. In January 2014 the Financial Supervisory Authority (Finansinspektionen) got the main responsibility for the macroprudential policy and by the end of the year they decided to amend the regulations for the countercyclical capital buffer rate at 1 percent. The aim of the countercyclical capital buffer was to strengthen the resilience of the firms and the banks when a shock can cause financial imbalances to the banking system. In 2015, the Executive Board kept the repo rate at -0.35 per cent and extend the purchase of governments for further SEK 65 billion. The rate of the counter cyclical buffer is increased at 2.5 percent and the same rate has applied until the last quarter of 2019.⁵⁵ In March 2015, the Financial Supervisory Authority published a proposal for the amortization of new mortgages, and it applies to all new loans that are collateralized by a home. In 2016, the repo rate was reduced and prior to the meeting of December, the Executive Board announced that bond purchases will be extended. In June 2016, an amortization requirement came into force for new mortgagors with mortgages in excess of 4.5 times of their gross income (LTI) which means that they should amortize at least 1 percent of the debt additionally to the existing amortization requirement.⁵⁶ Further, the households should amortize 2 percent of the total size of their mortgage if the LTV is above 70 percent and 1 percent if the LTV is between 70 and 50 percent.⁵⁷ The four largest banking groups are subject to a Pillar II capital add-on of 2 percent and the risk weight floor is increased from 15 to 25 percent for Swedish mortgage loans.⁵⁸ For all the mortgages before June 2016, additional loans may be paid in accordance with the basic rule or over a period of ten years. The option of amortizing

⁵⁵Swedish Financial Supervisory Authority, Countercyclical Capital Buffer, <https://www.fi.se/en/financial-stability/countercyclical-capital-buffer/?catid=61&catid=80&catid=84&page=3>, (Accessed in 2 January 2020)

⁵⁶ Swedish Financial Supervisory Authority, <https://www.fi.se/en/published/news/2017/proposal-for-a-strictier-amortisation-requirement-for-households-with-high-loan-to-income-ratios/>, (Accessed in 7 January 2020)

⁵⁷ Swedish Financial Supervisory Authority, <https://www.fi.se/sv/vara-register/sok-fffs/2016/201616/201616/>, Accessed in 10 January 2020)

⁵⁸Swedish Financial Supervisory Authority, <https://www.fi.se/en/published/important-pms-and-decisions/2018/changed-method-for-the-application-of-the-risk-weight-floor-for-swedish-mortgages/>, (Accessed in 12 January 2020)

an additional loan over a 10 year was introduced in order to avoid the threshold effects for those households with existing mortgages that are not subject to amortization requirement. Exemptions from the amortization requirement are allowed in certain situations such as unemployment or sickness.⁵⁹ A deduction is applied on mortgage interest for loans, 30 percent tax for the loans below SEK 100000 and 21 percent for the loans above SEK 100000. Mortgage firms may waive the amortization requirement for a loan collateralized by a newly produced residential property for a maximum of five years, and this is available only for first buyers. A risk weight of 100 percent applies to all exposures secured on commercial immovable property. The weight for corporate exposures is increased too through the methods for banks internal models that are being used for corporate exposure: the estimations of the probability of default should anticipate a larger proportion of economic downturns with higher default rates. More specifically, every fifth year should be considered a “downturn year”. Further, a maturity floor of 2.5 years is implemented under Pillar 2 for banks that use the advanced Internal Ratings Based approach.⁶⁰ A credit institution-specific minimum level of 25 percent average risk weight applies to housing loans of credit institutions that have implemented the IRB approach. In 2017, the Ministry of Finance send a proposal to Riksbank for the extension of macroprudential tools and in 2018, a Memorandum of Understanding (MOU) was signed between the Nordic and Baltic countries to ensure the cross-border financial stability of the region.

2.3 Methodology and Dataset

In this section, I present a simple autoregressive conditional heteroskedastic (ARCH) model as argued by (Engle 1982) and (Engle, Lilien & Robins 1985) and then I proceed with a general autoregressive conditional heteroskedastic model (GARCH) as (Bollerslev 1985). Further, I give an insight of threshold autoregressive conditional heteroskedastic models (T-GARCH). Time-varying volatility models have been used for a long time for price series and heteroskedasticity has been specified as a function of exogenous variables. However, this formulation proved to be restrictive and lead to an endogenous dynamic of the variables (Zakoian 1982) I define the ARCH model based on the distribution of the errors of a dynamic linear regression model. Let the dependent variable y_t defined in the equation below:

$$y_t = x_t' \delta + \epsilon_t \quad t=1,2,3,\dots,T \quad (1)$$

X represents a $p \times 1$ vector of exogenous variables, which can include lagged values of the dependent variable, and δ a $p \times 1$ vector of the parameter estimates. The distribution

⁵⁹ Swedish Financial Supervisory Authority, Amortisation requirements for new mortgages, <https://www.fi.se/en/published/press-releases/2016/amortisation-requirement-for-new-mortgages/>, (Accessed on 5 April 2020)

⁶⁰ Swedish Financial Supervisory Authority, <https://www.fi.se/en/published/news/2016/new-methods-for-banks-risk-weights-and-capital-requirements-decided/>, (Accessed on 9 January 2020)

of the stochastic error term ϵ_t is defined as conditional on the realized values of the set of variables $\Psi_{t-1} = \{y_{t-1}, x_{t-1}, y_{t-2}, x_{t-2}, \dots\}$. Engle (1982) in the ARCH (q) model assumes that

$$\epsilon_t | \Psi_{t-1} \sim N(0, h_t), \text{ where } h_t = \alpha_0 + \alpha_1 \epsilon_{t-1}^2 + \alpha_2 \epsilon_{t-2}^2 + \dots + \alpha_q \epsilon_{t-q}^2 \quad (2)$$

with constraints $\alpha_0 > 0$ and $\alpha_i \geq 0$, for $i=1, 2, \dots$ to ensure that the conditional variance is positive and h_t is a function of the elements of Ψ_{t-1} since $\epsilon_t = y_t - x_t' \delta$. Volatility episodes are characterized of large shocks to the dependent variable y_t and a large shock means a large deviation of the dependent variable y_t from its mean $x_t' \delta$. It is important to note that a large shock is represented by a large positive or negative value of the error term ϵ_t . The order of q lag determines how long the shock remains in the conditional variance of the subsequent errors and the higher the lags the longer the episode of volatility (Bera & Higgins 1993). The ARCH model was first empirically applied to the volatility of inflation by (Engle 1982) and (Bera & Higgins 1993). Engle (1982) states that a large q is required in the function of the conditional variance and this requires estimation of a large number of parameters due to the restrictions. Hence, the conditional variance is defined:

$$h_t = \alpha_0 + \alpha_1 \sum_{i=1}^q w_i \epsilon_{t-i}^2, \quad (3)$$

where the weights $w_i = \frac{(q+1)-i}{\frac{1}{2}q(q+1)}$ that tend to decline over time and $\sum_{i=1}^q w_i = 1$. Bollerslev (1986) extended the variance function by defining it as:

$$h_t = \alpha_0 + \alpha_1 \epsilon_{t-1}^2 + \alpha_2 \epsilon_{t-2}^2 + \dots + \alpha_q \epsilon_{t-q}^2 + \beta_1 h_{t-1} + \beta_2 h_{t-2} + \dots + \beta_p h_{t-p} \quad (4)$$

with the following inequality constraints to ensure that the conditional variance h_t is positive:

$$\alpha_0 > 0, \alpha_i \geq 0 \text{ for } i=1, \dots, q \text{ and } \beta_j \geq 0 \text{ for } j=1, \dots, p$$

There is vast existing literature which defines the advantages of using GARCH models instead of other autoregressive models. Akgiray (1989) states that GARCH model is superior to ARCH, moving average and historical mean models which are used to forecast the US monthly stock index volatility. West & Cho (1995) report the superiority of GARCH model when using to forecast dollar exchange rate volatility. Pagan & Schwert (1990) use GARCH, EGARCH, Markov switching and three non-parametric models in forecasting US stock returns. The results define that GARCH and EGARCH perform far better than other models. Franses & Van Dijk (1996) use three version of GARCH family model (GARCH, QGARCH and the GJR model) in forecasting European stock market volatility and the findings confirm the superiority of standard GARCH model. Brailsford & Faff (1996) confirm the superiority of

GARCH and GJR to other models in predicting Australian stock markets. The GARCH (p, q) model consists of three components:

- 1) α_0 is the weighted long run variance
- 2) $\sum_{i=1}^q \alpha_i \epsilon_{t-1}^2$ is a moving average term (MA), which is the sum of m previous lags squared-innovations multiplied by the assigned weight α_i for each lagged square innovation
- 3) $\sum_{j=1}^p \beta_j h_{t-j}$ is an autoregressive term (AR), defined as the sum s of the previous lagged variances multiplied by the assigned β_j for each lagged variance.

Therefore, the conditional variance h_t can be expressed as a GARCH process:

$$h_t = \alpha_0 + \alpha(B)\epsilon_t^2 + \beta(B)h_t, \quad (5)$$

$$\text{where } \alpha(B) = \alpha_1 B + \alpha_2 B^2 + \dots + \alpha_q B^q \text{ and } \beta(B) = \beta_1 B + \beta_2 B^2 + \dots + \beta_p B^p \quad (6)$$

are polynomials in the back-shift operator B (Bera & Higgins 1993). So if the roots of $1 - \beta(B)$ lie outside the unit circle, I can rewrite the conditional variance function

$$h_t = \frac{\alpha_0}{1 - \beta(1)} + \frac{\alpha(B)}{1 - \beta(B)} \epsilon_t^2 = \alpha^* + \sum_{i=1}^{\infty} \zeta_i \epsilon_{t-1}^2 \quad (7)$$

where $\alpha^* = \frac{\alpha_0}{1 - \beta(1)}$ and the coefficient ζ is the coefficient B^i in $\left[\frac{\alpha(B)}{1 - \beta(B)} \right]^{-1}$. The authors above state the restrictions in (4) to ensure that the variance of GARCH (p,q) to be strictly positive. However, Nelson (1991) reveal weak conditions for the conditional variance. (Bera & Higgins, 1993) state that the conditions $\alpha_0^* > 0$ and $\zeta_i \geq 0, i=1, \dots, \infty$ (6) and they expressed α^* and ζ 's in terms of the original parameters of the GARCH model showing that based on (6) not all inequalities of (4) are required to hold. (French, Schwert, & Stambgauh 1987; Bollerslev, Engle, & Jeffrey 1988; Baillie, Bollerslev & Mikkelsen 1996) have shown negative coefficients and still satisfy the conditions for the positive conditional variance. They concluded that the restrictions should be imposed in the estimation even if they are violated because the violation does not mean the variance is misplaced (Bera & Higgins 1993). Using GARCH model has certain constraints. First, non-negativity constrains can be breached therefore the only way to avoid this issue is to place artificial constrains to the model in order to force the coefficients not to be negative. As more artificial constrains are added to the model, it makes the model less reliable and efficient and far from a good approximation to reality. Second, GARCH models even though they count for volatility clustering and leptokurtosis, they do not count for leverage effects. Third, the model does not allow the researcher to get a direct feedback between the conditional mean and variance equation (Brooks 2008). In order to take in account the asymmetry in volatility as a function of positive and negative parts of the innovation process, (Glosten, Jagannthan

& Runkle 1993) estimated an extension of GARCH model in which the variance is expressed as a linear function of the squared positive and negative parts of the noise. Davidian & Carroll (1987) used a different approach for variance function estimation indicating that non-normal distributions, yield variance estimates that are more efficient than squared residuals. In a similar approach (Zakoian 1994), specified conditional standard deviation instead of the conditional variance. As a matter of fact to the disadvantages that GARCH model has, I proceed with a threshold conditional heteroskedastic model (T-GARCH) which allows me to check for the leverage effects.

2.3.1 Threshold conditional heteroskedastic (T-GARCH) model

The previous ARCH/GARCH models formulate the time-varying conditional variance by relating the variables known to the previous periods. ARCH/GARCH models have two features which made them a good approximation to reality: time-varying volatility and leptokurtosis. The quadratic specification makes the parameter constraints easy, as it ensures the positivity of the variance. Further, the models give an ARMA representation for the ε^2 process which makes the model tractable (Zakoian 1994). However, the quadratic specification does not take in account the sign of the shock and whether a shock is positive or negative, it has the same effect on the present volatility.

One of the advantages of Threshold GARCH in comparison to other versions of GARCH models is that it allows different reactions of the volatility to the sign of the past innovations. Further, different lags can yield opposite contributions due to asymmetry. In T-GARCH negative past values of ε_{t-1} can have more impact on the volatility than positive values of the same magnitude. Thus, I will go further and use T-GARCH model in this chapter, for which I will define two equations, one for the mean and one for the variance. The threshold GARCH (p,q) lags process will be:

$$\varepsilon_t = \sigma_t Z_t \quad (8)$$

$$\sigma_t = \alpha_0 + \sum_{j=1}^p \beta_j \sigma_{t-j} + \sum_{i=1}^q \alpha_i^+ \varepsilon_{t-1}^+ - \alpha_i^- \varepsilon_{t-1}^- \quad (9)$$

(Z_t) i.i.d, $EZ_t=0$, $VZ_t=1$, Z_t independent of ε_{t-1} for all t, while $(\alpha_i^+)_{i=1,q}$, $(\alpha_i^-)_{i=1,q}$ and $(\beta_j)_{j=1,p}$ are scalar sequences. The approach of (Zakoian 1994) is similar to (Tong 1990), the conditional standard deviation in (9) has a linear combination of past and variables and the regime at date t. The model is completed with the following restrictions for positivity:

$$\alpha_0 > 0, \alpha_i^+ \geq 0, \alpha_i^- \geq 0, \beta_i \geq 0 \text{ for all } i.$$

2.3.2 Data

The analysis presented in this chapter is based on daily data over the period 2008-2018⁶¹. The source of the data is Thomson Reuters Datastream. Each year is composed of daily observations and every year is made from 259 to 262 observations which correspond to the number of working days per one year. When a national holiday happens to be in a working day, the value of the next working day is taken in account. This smooths the variability of the data set, but on the other hand it helps to have the data in the same time framework. However, it happens only few times and this does not influence the dataset to a great extent. I will investigate whether and to what extent ECB communications of unconventional monetary policies have been capable to influence the set of financial variables for Nordic countries. In the lenses of autoregressive conditional heteroskedastic models, I specify the conditional mean which is defined below:

$$S_t = \alpha + \sum_{i=0}^p \beta_i S_{t-i} + \sum_{j=0}^q \gamma_j \text{UNC}_{t-1} + \beta_1 \text{IR}^{\text{Dom}} + \beta_2 \text{IR}^{\text{ECB}} + \beta_3 \text{NSMP}^{\text{Dom}} + \beta_4 \text{NSMP}^{\text{ECB}} + \delta \Delta X_t + \varepsilon_t \quad (10)$$

where S_t represents the government bond yields 10 years, 5 years and 2/3 years, the exchange rate vis-à-vis to euro, credit default swaps 10 and 5 years, interbank market rate (3M), while UNC is the monetary policy surprise indicator for unanticipated component of the ECB's unconventional monetary policies. To determine the measure of the unanticipated component, I rely on three different approaches; all are based on the asset prices.⁶² Rogers, Scotti & Wright (2014) approach calculates the surprise as the change in the spread between Italian and German long-term yields as an alternative indicator of ECB surprises. Chebbi (2019) includes the Spanish spread too as a possible proxy for the monetary surprise and argues that monetary policies do not reduce only the Italian spread but the spread of other countries under stress too. Therefore, in the light of work of (Rogers, Scotti & Wright 2014) and (Chebbi 2019) I include the Greek spread as the third approach. If the spread is increased following the announcement of the unconventional monetary policies, it implies tightening of the monetary policy more than expected and vice versa. The surprise component is calculated:

$$\Delta r_t^u = (y_{s,t}^I - y_{s,t}^G) - (y_{s,t-1}^I - y_{s,t-1}^G) \quad (11)$$

where y^I and y^G are the Italian (Spanish/Greek) and German 10-year government bond yields at t-day and t-1 respectively. The variable IR^{Dom} reflects the domestic central bank policy rate and IR^{ECB} represents ECB policy rate. The vector NSMP^{Dom} is a country specific dummy and contains the announcements of domestic monetary policies released by the domestic monetary policy authority while NSMP^{ECB} is a dummy that

⁶¹ Due to the data availability the study was restricted in the time framework from 2008-2018 and we were not able to capture the recent impact of Covid-19 pandemic in Nordic countries even though this would be interesting for this research. However, I am aware that this remains one of the main limitations of the study.

⁶² The methodology used in this chapter is similar in spirit to (Glick & Leduc 2012; Rogers, Scotti, & Wright 2014; Haitsma, Unalmis, & De Haan 2016; Chebbi 2019). Indeed, through the ECB communications I define the “news” and the unanticipated term of the macroprudential policies.

captures the announcements of ECB. X_t is a vector of control variables which includes a set of variables. As (Arghyrou & Ktonikas 2012) and (Glick & Leduc 2012), I include the variable VIX_t which is the volatility index to control for the financial turmoil in the euro area financial markets. Based on (Gerlach, Schulz, & Wolf 2010) I include the variable TED_t , which represents the ted spread that is calculated as the three-month LIBOR rate less the Treasury bill rate and tests for the perceived credit risk in the global economy. I include the variable $EUDS_t$ based on (De Bruyckere et al. 2012) that represents the total stock market index for the EU, and it controls for market-wide business climate changes in the EU. The bilateral exchange rate vis-à-vis the euro, the CDS spreads, the VIX volatility index are expressed as daily percentage changes. The monetary policy rate, the interbank interest rate, government bond yields are expressed as daily percentage point changes. The S&P corporate bond indices are defined as daily basis point changes. I will begin my analysis with a simple OLS and then run an AR (1)-ARCH (9) model. Brooks (2008) states that defining the number of lags of the squared residuals in the model is a crucial problem. When involving a large number of lags to capture all the dependence in the conditional variance model it can result in a model which is not parsimonious (Engle 1982). In an ARCH model, non-negativity constrains can be violated, the more parameters are involved in the conditional variance equation, the more likely is that one or more parameters will have negative values. Thus, I will proceed with the benchmark GARCH (1,1) model. GARCH model is far better and widely used in comparison to ARCH because is more parsimonious and avoids overfitting. Therefore, it is less likely that the model will breach non-negativity constrains (Brooks 2008). Further, I will test for the presence of the leverage effects and if I find asymmetric effects, I proceed with a threshold autoregressive conditional heteroskedastic model (T-GARCH).

2.4 Results

This section investigates, through the lenses of time-series econometrics the extent ECB announcements of unconventional monetary policies influence a set of financial variables in Nordic countries. More specifically, I estimate the impact of the communications on long, medium and short-term government bond yield, credit default swaps for 10 years and 5 years, interbank rate, domestic policy rate, S&P corporate bond index in domestic and foreign currency and exchange rate vis-à-vis euro using a threshold GARCH framework. I begin with a descriptive statistic of the variables per each country and then I test for the stationarity. I proceed with an Ordinary Least Squares estimation and I test for the ARCH effects. However, checking for heteroskedasticity in a model which assumes constant variance is statistically wrong. Hence, I define an AR(1)-ARCH (9) model to be able to capture the heteroskedasticity in the residuals. After the diagnostic tests, I still find presence of ARCH effects and autocorrelation in the residuals and squared residuals. Hence, I

estimate the benchmark GARCH model⁶³ and then I test for the leverage effects and in case I find asymmetric effects I define a threshold GARCH model. I have included all the passages only for the first country, Denmark whilst for the other countries, for brevity purposes I determine only the final models. Moreover, in the robustness check I substitute the Italian-German surprise component with the Spanish and Greek-German spread.

In Table 2. 5 Table 2. 5 Summary statistics below I do a summary statistics of the independent variables used in the estimation for all countries. ECB main refinancing rate (MRO) shows a mean 0.57 and a standard deviation of 0.66. The rate is skewed to the right and presents an excess kurtosis of 7.47. TED spread has a mean of 38.28 and a deviation of 26.27. It is skewed to the right and has a kurtosis of approximately 21.15. Volatility Index (VIX) has a mean of 23.73 and a deviation of 9.35. The index is skewed to the right and it clearly indicates a non-normal distribution with a kurtosis of 8.14. EUDS, which controls for the market-wide business climate in the EU, is skewed to the left and does not show excess kurtosis.

In the last column, I report the summary statistics for the surprise component which is calculated as the Italian-German spread. The surprise component has the lowest mean, a standard deviation 39.99 and it exhibits high variability, is skewed to the left and it has excess kurtosis.

Table 2. 5 Summary statistics

	ECB	TED	VIX	EUDS	UITGE
Mean	0.57	38.28	23.73	1513.64	-0.08
Median	0.25	31	21.72	1515.43	0.001
Max.	3.75	249	87.51	2012.90	942.05
Min.	0.00	10.00	10.68	803.17	-990.01
Std.Dev.	0.66	26.27	9.35	227.79	39.99
Skew.	1.67	3.70	1.85	-0.36	-6.08
Kurt.	7.47	21.15	8.14	2.76	383.78

Source: Author's calculations

I begin my analysis with descriptive statistics of Denmark's variables which are shown in Table 2. 6⁶⁴. The average mean for the variables available for Denmark falls in a great range from 0.31 (policy rate) to 141.07 (S&P corporate bond index in foreign currency). The variability is dispersed, with both credit default swaps having the highest standard deviation. Apart from indices that are skewed to the left, all variables are skewed to the right. The variables that exhibit excess kurtosis⁶⁵ are government

⁶³ By default, GARCH models in EViews are estimated by maximum likelihood using the Broyden, Fletcher, Goldfarb and Shanno (BFGS) numerical algorithm with the assumption that errors are conditionally normally distributed.

⁶⁴ All the summary statistics for the variables are performed at levels.

⁶⁵ Skewness and kurtosis are the third and the fourth central moments of a series which indicate the asymmetry and the tail thickness. All symmetric distributions, including normal distribution have skewness equal to zero and kurtosis equal to 3. All the other distributions which show a negative/positive skewness have a left/right tail and if they display excess kurtosis it means that the distribution is leptokurtic. In comparison to the normal distribution, it implies that the distribution has fat or thick tails and it puts more support on the mass tail than the normal distribution (Rummel 2012).

bond yield 3-year, credit default swaps 10 years and 5 years, interbank rate and policy rate. Following (Jarque & Bera 1987; Lütkepohl 1993; Hamilton 1994), Jarque-Bera Test strongly rejects the null hypothesis of a normal distribution.

Table 2. 6 Summary statistics for Denmark

	DEN10 Y	DEN5Y	DEN3Y	DENCD S10Y	DENCD S5Y	DENIN TER	DENRA TE	SPDEN	SPDEN F
Mean	1.76	1.07	0.72	53.77	37.47	0.83	0.31	119.28	141.07
Median	1.52	0.62	0.24	43.65	24.00	0.29	-0.10	121.04	143.73
Max.	4.98	5.10	5.15	170.79	157.46	6.43	5.50	131.45	159.38
Min.	-0.02	-0.49	-0.79	15.25	8.76	-0.54	-0.75	103.31	114.25
Std. Dev.	1.27	1.35	1.29	33.08	33.81	1.46	1.32	6.02	11.46
Skew.	0.60	0.96	1.31	1.71	1.77	2.07	2.08	-0.76	-0.48
Kurt.	2.19	2.87	4.12	5.07	4.99	7.01	7.20	2.93	2.07
J-B Test	240.24	430.32	939.88	1857.88	1906.80	3841.84	4050.85	271.21	208.20
Prob.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Source: Author's calculation

Based on the work of (Granger & Newfold 1974) and (Phillips 1986), the estimation of non-stationary variables can lead to spurious regression. I perform the unit root test following (Dickey & Fuller 1981) and (Phillips & Perron 1989) to check for unit root in my financial time series. Therefore, I perform the augmented Dickey-Fuller test which can be estimated based on the equation below:

$$\Delta y_t = \psi y_{t-1} + \sum_{i=1}^p \alpha_i \Delta y_{t-i} + u_t \quad (12)$$

The test is known as augmented Dickey-Fuller (ADF) test which is conducted on ψ and the lags of Δy_t “soak up” any possible structure that is present in the dependent variable to ensure that the error term is not autocorrelated. Further, for robustness check I perform the Phillips-Perron test. Both tests in

Table 2. 7 are performed for levels and first difference of the variables, the first row is the ADF test while the second row is the PP test. The second column defines the model with an intercept and without trend; the third represents the model with an intercept and trend; and the fourth without an intercept and trend. The same procedure is repeated for first difference too. The overall estimation is performed by using the first difference of the variables except Iceland for which I use the variables at their levels.

Table 2. 7 Unit root test

Levels	T_u	T_t	T	First difference	T_u	T_t	T	Test
DEN10Y	1.55	2.72	2.25**	DDEN10Y	39.15***	39.15***	39.10***	ADF
	1.54	2.62	2.31**		54.20***	54.20***	54.14***	PP
DEN5Y	1.58	1.87	2.21**	DDEN5Y	18.50***	18.53***	18.42***	ADF
	1.92	2.10	2.58***		55.94***	55.97***	55.88***	PP

DEN3Y	2.14	1.91	2.82**	DDEN3Y	17.70***	17.75***	17.60***	ADF
	2.32	2.17	2.97***		59.23***	59.28***	59.14***	PP
LDENCDS10Y	2.12	3.24*	0.13	DLDENCDS10Y	16.36***	16.47***	16.37***	ADF
	2.10	3.14*	0.13		42.25***	42.10***	42.26***	PP
LDENCDS5Y	1.28	3.32*	0.33	DLDENCDS5Y	43.50***	43.55***	43.50***	ADF
	1.51	3.41**	0.35		44.67***	44.50***	44.68***	PP
DENINTER	2.68*	1.42	3.6***	DDENINTER	17.52***	17.68***	17.31***	ADF
	2.61*	1.48	3.49***		53.38***	53.19***	53.90***	PP
LSPDEN	1.79	1.76	1.37	DLSPDEN	19.20***	19.22***	19.14***	ADF
	1.92	1.77	1.5		54.92***	54.92***	54.89***	PP
LSPDENF	1.97	2.31	2.97	DLSPDENF	53.92***	53.91***	53.92***	ADF
	2.03	2.38	0.28		53.92***	53.91***	53.93***	PP
DENRATE	2.95**	1.64	3.57***	DDENRATE	53.65***	53.76***	53.54***	ADF
	2.94**	1.64	3.55***		53.66***	53.76***	53.56***	PP

Note: *, **, *** denotes 10% , 5% and 1% level of significance

Source: Author's calculation

Before I estimate an ARCH model, I estimate my equations using Ordinary Least Squares (OLS) and then I test for the ARCH effects. Testing for ARCH effects will indicate whether I will perform an ARCH model or a simple OLS. Engle (1982) states that the test is a Lagrange multiplier test in order to test for the presence of the heteroskedasticity in the residuals. If the variance equation is correctly specified, there should be no ARCH effects left in the residuals (Rummel 2012). I include only one lag but when dealing with high-frequency data, choosing the appropriate lag-length sometimes becomes an issue. On one hand, very long lags mean a large number of parameters which becomes difficult for the estimation and reduces the precision. On the other hand, including a small number of lags reduces the power of the test and I may not be able to detect the presence of the conditional volatility. Moreover, using OLS and testing for ARCH effects in a model which assumes constant variance of the errors is statistically wrong. Table 2. 8 displays the values for the ARCH effects for the eight dependent variables after estimating an OLS with the surprise component (Italian-German spread). It is evident that the majority of the variables have presence of the ARCH effects except the government bond yields for 5 and 3-years and the S&P bond index in domestic currency.

Table 2. 8 ARCH effects in OLS

Variable	Test for ARCH effects	
	UITGE	
	Obs*R-squared	Prob.
DDEN10Y	29.06	0.00
DDEN5Y	0.51	0.47
DDEN3Y	0.44	0.5
DDENINTER	14.68	0.00
DLDENCDS10Y	72.73	0.00

DLDENCD5Y	64	0.00
DLSPDEN	1.40	0.23
DLSPDENF	62.47	0.00

Source: Author's calculations

I switch to Autoregressive Models (AR) in order to be able to capture the ARCH structure following the passages specified by (Rummel 2012). Further, to test the joint hypothesis that all the autocorrelation coefficients are zero, I use the Q-statistic introduced by (Box & Pierce 1970) and extended by (Ljung & Box 1978). The Q-statistic is a test at lag k under the null hypothesis that there is no autocorrelation up to order k. All the probabilities for the residuals and squared residuals are reported for 10 lags.

Harvey (1989) suggests that after the test for the ARCH effects, I can use the Box-Ljung test on the squared fitted residuals to check if they are uncorrelated. Both these tests are helpful to capture the ARCH effects and GARCH effects as well. Following (Engle 1982), in the light of tremendous number of possible ARCH specifications I begin with a simple model and determine if it is adequate or not. As my starting point, as stated by (Rummel 2012) I begin with an AR(1) model for the mean equation and an ARCH(9) model for the conditional variance equation.⁶⁶ I estimate the models for each of the dependent variables and the results are defined in Table 2. 9. Each of the models gives evidence that the variables are highly significant in the mean equation.

Table 2. 9 AR(1)-ARCH(9) model with the surprise component

	DDEN10 Y	DDEN5 Y	DDEN3 Y	DLDENCD510 Y	DLDENCD5 Y	DDENINTE R	DSLPE N	DLSPDEN F
DLVIX	-0.01*	0.01	0.02**	-0.01***	-0.01**	0.004***	0.002***	0.04***
DECB	0.01	-0.02	0.03	0.009	0.01	-0.02***	0.003***	0.002
DLEUDS	1.18***	1.26***	0.90***	-0.36***	-0.62***	0.05***	-0.01***	0.4***
DLTED	0.03***	0.02**	-0.008	-0.004	-0.002	0.001**	-0.001***	-0.003***
ECBDUM	0.003	0.003	0.002	-0.003***	-0.005***	-0.001***	-0.0001**	-0.0002
DDENRAT E	0.04**	0.08***	0.06***	0.02**	0.009	0.45***	-0.002***	-0.007***
DEDUM	0.003	-0.002	-0.0003	-0.002**	-0.003**	-0.0007***	- 0.0001** *	-0.001***
UITGE	-2.67E- 05**	-9.95E- 06	-1.96E- 05	2.39E-06	-1.44E-06	-5.31E-06**	1.07E- 06**	3.22E-06

Note: *, **, *** denotes 10%, 5% and 1% level of significance

Source: Author's calculations

After I estimate the respective equations AR(1)-ARCH(9) I test for the presence of ARCH effects, the autocorrelation for the residuals at levels and for the squared residuals. None of the variables in Table 2. 10 shows evidence of ARCH effects or autocorrelation in residuals/squared residuals after the estimation (except of the interbank market rate which shows presence of autocorrelation at 5 % significance level).

⁶⁶ Note that E-views cannot estimate an ARCH model higher than of order 9.

Table 2. 10 Diagnostic tests

Variable	Test for ARCH effects		Autocorrelation of residuals in levels		Autocorrelation of squared residuals	
	Obs*R-squared	Prob.ChiSquare	Q-Stat	Prob.	Q-Stat	Prob.
DDEN10Y	0.14	0.70	4.05	0.94	4.10	0.94
DDEN5Y	0.07	0.78	10.13	0.42	0.44	1
DDEN3Y	0.24	0.62	6.70	0.75	2.17	0.99
DDENINTER	0.47	0.48	139.05	0.00	19.25	0.03
DLDENCDS10Y	0.08	0.76	3.01	0.98	5.01	0.89
DLDENCDS5Y	0.09	0.75	9.61	0.47	3.80	0.95
DLSPDEN	1.84E-05	0.99	13.70	0.18	1.97	0.99
DLSPDENF	0.19	0.65	8.09	0.61	8.48	0.58

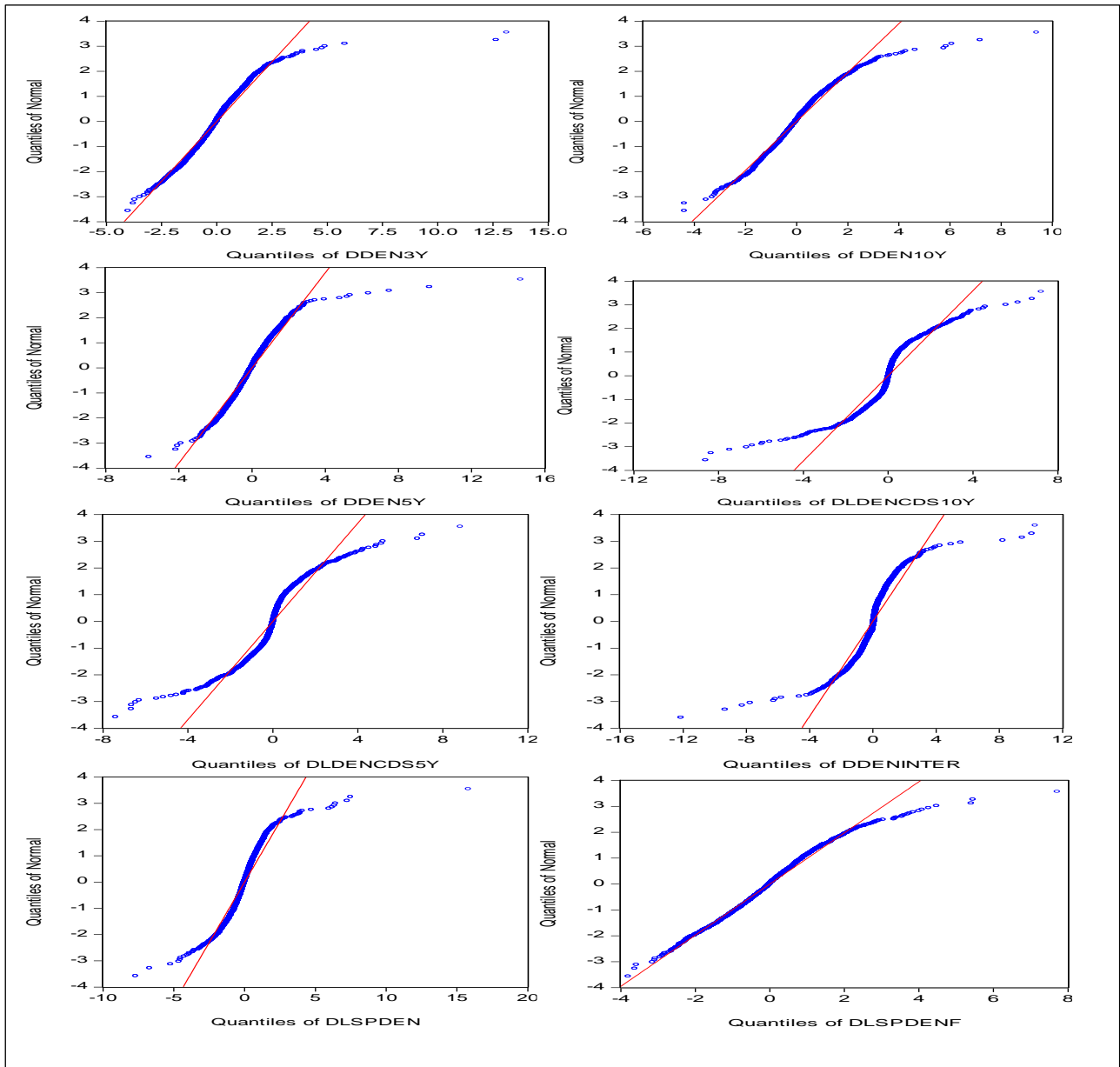
Source: Author's calculations

However, estimating a model which contains 9 residuals is not parsimonious, therefore I should consider alternative models. Hence, I will proceed with a benchmark GARCH (1,1) model and then I will test for the leverage effects. If there is presence of asymmetric effects, I can apply a T-GARCH model (Zakoian 1994). I worry about the non-normally distributed residuals and I suspect that the assumption of conditional normality does not hold. GARCH parameter estimates will be still consistent, meaning that the mean and the variance will still be correctly specified but the estimates of the conditional variance matrix will not be consistent, and will result in incorrect standard errors.

For this reason, in

Figure 2. 8 I plot the quantiles of each dependent variable in order to examine the distribution of the residuals. If the standardized residuals are normally distributed, they should lie alongside a straight line in the QQ-plots.

Figure 2. 8 QQ plots for Denmark



Source: Author's calculations

Figure 2.8 shows that the residuals of government bond yields and S&P corporate bond index in foreign currency follow more closely a straight line, in the sense that fewer of the large and positive shocks deviate from the normal distribution while other

remaining variables clearly show that there is no departure from normality distribution. There are two options which I could choose if I suspect that the standardized residuals are not conditionally normally distributed. The first option is to assume explicitly another conditional distribution for the residuals such as t-distribution or general error distribution (GED) for which both of them have fatter tails than the normal distribution. The second option is to estimate the GARCH model using quasi-maximum likelihood (QML) rather than maximum likelihood estimation methods. Quasi-maximum estimates use the normal distribution even though the actual distribution of the residuals is fat-tailed. Following the work of (Bollerslev & Wooldridge 1992), I proceed with the second alternative by using the Broyden, Fletcher, Gold-farb and Shanno (BFGS) optimization method with Bollerslev-Wooldridge covariance which can ascertain the efficiency of my estimation. Bollerslev & Wooldridge (1992) is a different variance-covariance estimator which is robust to non-normality and this procedure is called maximum likelihood with Bollerslev-Wooldridge standard errors, known as quasi-maximum likelihood, or QML (Brooks 2008).

Denmark conducts a fixed exchange rate policy since early 1980s and the aim of its policy is to keep the krone stable against the euro.⁶⁷ Based on the results reported in Table 2. 11, I conclude that there is a negative impact of volatility index in the long and medium-term government bond yields but a positive impact in the yield of short-term bond. More specifically, a one percent increase on the European risk measure (VIX_t) decreases the government bond yield of 10 years and 5 years by 0.02 and 0.003 points. The increase of volatility (VIX_t) by one percent increase 3-years government bond yield by 0.02 points. The decrease of the yields might indicate that Danish bonds are more adequate in comparison to euro area bonds; these bonds are more attractive hence, there is less capital outflow from Denmark. My results are similar to (Korus 2019) who states that Security Market Programme (SMP) has led to the reduction of long and medium term government bond yields, increase of corporate bond indices and reduction of credit default swaps. Ghysels et al. (2013) and Andrade et al. (2016) find the same results too, stating that the asset purchase of ECB lead to decrease of long-term government bond yields. Andrade et al. (2016) show that the findings are consistent with the portfolio rebalancing channel, reduction of duration risk and relaxation of leverage constrains for financial intermediaries. The same negative impact is found on the spreads of credit default swaps. A reduction of sovereign bond yields due to ECB's announcements of non-standard monetary policy measures has led to lower CDS spreads because the decrease of the yields might imply an improvement of debt liability of Denmark. The decrease of sovereign bond yields in Denmark

⁶⁷ After the collapse of the Bretton Woods, the European countries created the European Exchange Rate Mechanism (ERM) which was a fixed exchange rate system based on bilateral central parities for all the participating countries. In the late 1970s ,Germany was the main exporter in Denmark and its currency was devaluated several times due to alignments within the ERM. Hence, since then it was declared the announcement on fixed-exchange rate and Denmark pursued a "hard"fixed-exchange rate policy against Germany (Abildgren 2004)

suggests a decrease of the confidence in euro area therefore, investors switch to Danish bonds by considering them as “safe havens”. ECB announcements could boost the confidence and the economic sentiment in the Nordic countries in comparison to euro area hence, leading to capital outflow from euro area countries. The opposite happens for the short-term bonds meaning that Danish short-term bonds are related with capital outflows. There is a positive impact of the risk in bond indices which does not support the theory of the existing literature which might come from a signal of an anticipated future monetary easing by the central bank.⁶⁸ A one percent increase in the risk has a positive impact in S&P bond indices by increasing them by 1 and 2.1 percent. Hence, the reduction of long and medium-term government bond yields is transmitted to corporate bond yields. Forward guidance (FWG) was one of the main tools that was mainly used during the time of the upheaval to provide information about the future monetary policy, and I expect that it would be working through the signaling channel. Korus (2019) found that FWG for Denmark was not associated with asset purchase but with the increase of interbank money rate through the signaling channel. Further, the author states that the impact in corporate bond indices could be ambiguous. Corporate bonds could have a higher yield due to confidence channel if ECB is committed to main lower interest in the future. The appreciation of domestic currency against euro through exchange rate channel can imply an increase of corporate bond yields. The local Danish corporate bond market remains small, representing approximately 2 percent of the Nordic corporate bond market (NordicTrustee 2019). Not surprisingly, there seems to be a significant effect of ECB’s policy rates in Denmark. By keeping its exchange rate fixed, Denmark has given up its monetary autonomy, hence I expect a high influence of ECB policy rate in Denmark (Ellen, Edvard & Midthjell 2008). Drejer et al. (2011) focus on the possible channels of monetary policy in Denmark and they state that in a cyclical position in Denmark which resembles that of euro area, higher interest-rate sensitivity could be an advantage. But if the interest-rate sensitivity is higher in Denmark compared to euro area as a whole, than it becomes a disadvantage. The interest rate changes of European Central Bank could be too strong for Danish conditions, even though tax deductibility of interest payments in Denmark will mitigate this effect to some extent. Moreover, the higher interest-rate sensitivity could present a challenge if the cyclical development in Denmark deviates from that of the euro area, or if interest rates are changed to defend the krone. As the economic outlook improves, it increases that yields of sovereign bonds which is related to increase of confidence in the euro area and there is “flight to quality “from Denmark. Further, it increases the bond index in foreign currency by 35 percent but it reduces the index in domestic currency by 2 percent. The improvement of economic outlook is reflected in the reduction of default spreads and surprisingly, there is higher interbank rate. This increment is indeed evidence of international banking channel, indicating that ECB announcements have led to the increase of 3 months interbank rates (Korus 2019) while (Adolfson & Spange 2020) state that the

⁶⁸Different from other central banks, Denmark in the awake of the crisis increased its rate in order to support the currency.

channel in Denmark has been working qualitatively as normal times, but has come with some delay. I would expect a lower interbank market rate in such conditions, but it indicates that the economy is in the conditions of monetary tightening and the policy rate is already high. This is shown in the positive relation between the policy rate and the interbank rate. The increase of the TED spread influences only the long-term government, reduces the interbank rate to provide flow in the economy and reduces the bond indices. The increase of the global risk makes long-term government bonds less attractive while investors switch to corporate bond indices. ECB announcements affect significantly Denmark's variables. As the number of announcements increase, it makes government bond yields less attractive while investors turn to corporate bond indices. Further, it reduces the interbank rate and decreases the spread of credit default swaps (Abbassi & Linzert 2012). Korus (2019) found similar results when tested for the CSPP announcements which lead to increase of government bond yields and decrease of corporate bond indices. As a matter a fact, when the domestic policy rate falls, the government bond yields will fall, the economy will be in expansionary state and the risk reflected in the swaps will be lower. The opposite happens when the policy rate is high. Policy rate has a significant impact in the short and medium-term bond yields, interbank rate and bond indices. An increase of the policy rate increases the yields by 0.13 and 0.09 points but it affects bond indices negatively. The increase of policy rate increases the interbank market rate by 0.42 points. The increment of the policy rate makes bond yields less attractive, the corporate bonds become more adequate while borrowing becomes more expensive. Abildgren et al. (2015) compare the interbank market before and after the financial crisis and show that there has been downward trend in trading activity in terms of volumes and number of transactions, the number of counterparties is reduced while the number of significant important institutions and the volume of transactions done by them is high. Hence, this might be a reason for the interbank rate to be high. Domestic announcements seem to be highly significant and obviously, mirror those of ECB. As the announcements increase, it increases the long-term yield by 0.004 points and the interbank rate by 0.0002 points. It seems that domestic announcements switch investors from government bonds to corporate bonds. The spread component negatively affects the regressors, but it has a positive impact on the bond indices. It has a negative and significant effect on government bond yield 3 years and interbank rate. However, the impact is modest.

As for the variance equation, all the coefficients are “correct” in sign and magnitude meaning that $\alpha_1 + \beta < 1$. For a GARCH model which is stationary, as the horizon predicted increase, the conditional variance forecasts converge upon the long-term average value of the variance.

Table 2. 11 GARCH model

	DDEN10Y	DDEN5Y	DDEN3Y	DLDENC DS10Y	DLDENCDS5 Y	DDENINT ER	DLSPDE N	DLSPDE NF
Mean Equation								
DLVIX	- 0.02*	-0.003*	0.02**	-0.002	-0.01**	0.003	0.021***	0.01***
DECB	-0.01***	0.02***	0.04***	0.04***	0.06***	-0.001***	0.005***	0.001**

DLEUDS	1.13***	0.98***	0.97***	-0.30***	-0.65***	0.02***	-0.02**	0.35***
DLTED	0.03*	0.001	-0.008	0.0001	0.009	-0.002***	-0.004***	-0.002**
ECBDUM	0.003***	0.003***	0.001***	-0.001***	-0.001**	-0.002***	-0.0005*	-0.0006
DDENRATE	0.07	0.13**	0.09*	-0.006	-0.01	0.42***	-0.02***	-0.004*
DEDUM	0.004*	0.0002*	-0.003***	-0.0001***	-0.0006***	0.005*	-0.0004	-0.0002**
UITGE	-3.49E-05	-2.49E-05	-1.62E-05**	-1.25E-06	-3.78E-06	-5.42E-06**	5.40E-06*	2.01E-06**
Variance Equation								
Resid(-1)^2	0.02***	0.00**	0.06***	0.00***	0.01***	0.03***	0.14***	0.00***
GARCH(-1)	0.95***	0.99***	0.90***	0.98***	0.98***	0.96***	0.85***	0.97***

Note: *, **, *** denotes 10% , 5% and 1% level of significance

Source: Author's calculations

The results of the tests in Table 2. 12 show evidence of ARCH effects and autocorrelation in residuals. The findings indicate that some of the variables show presence of ARCH effects and autocorrelation in the residuals and some don't. I have included the autocorrelation of squared residuals too, as there is higher chance that even though there might not be correlation in the levels it could be in the squared residuals as the residuals are squared. Only credit default swaps show evidence of ARCH effects and together with the interbank rate the variables show presence of autocorrelation in the levels and in squared residuals. Other variables do not exhibit heteroskedasticity or autocorrelation. ⁶⁹

Table 2. 12 Diagnostic tests for GARCH model

Variable	Test for ARCH effects		Autocorrelation of residuals in levels		Autocorrelation of squared residuals	
	Obs*R-squared	Prob.ChiSquare	Q-Stat	Prob.	Q-Stat	Prob.
DDEN10Y	0.60	0.30	4	0.92	1.89	0.70
DDEN5Y	0.32	0.82	13.	0.13	0.40	1
DDEN3Y	0.57	0.80	6.60	0.50	1.12	1
DDENINTER	0.78	0.38	144.	0.00	49.01	0.03
DLDENCDS10Y	50.41	0.00	18.02	0.02	73.35	0.00
DLDENCDS5Y	80	0.00	27.32	0.00	88.78	0.00
DLSPDEN	0.23	0.57	10.52	0.35	5.43	0.65
DLSPDENF	1.20	0.28	12.03	0.26	45.63	0.30

Source: Author's calculations

In addition to the ARCH test and Box-Ljung test for autocorrelation in the residuals and squared residuals, I have performed the test for the leverage effects. When dealing with highly volatile data, they exhibit a significant feature for which the "bad news" could have a more pronounced effect on the volatility than "good news". This tendency is called leverage effect. Rummel (2012) defines two ways of testing for asymmetry effect: Ex-ante and ex post. The ex-ante approach allows to test if there are any remaining leverage effects in the residuals. The ex-post approach is estimating a T-GARCH model and then perform a t-test of the null hypothesis that $\gamma_1^- = 0$. I proceed

⁶⁹ I have solved the residual problems using the T-GARCH model. Before estimating a T-GARCH, I have estimated higher versions of GARCH (1,1) model.

with the ex-ante approach and after estimating the GARCH (1,1) model with conditional errors following a normal distribution, I save the residuals. I estimate the residuals following the regression in Equation 13 below to test for leverage effects.

$$\zeta_t^2 = a_0 + a_1 \zeta_{t-1} + a_2 \zeta_{t-2} + \dots \quad (13)$$

If there are no leverage effects, the squared standardized residuals will be uncorrelated with the levels of the standardized residuals. This is indicated by the value of the F-test and there is presence of asymmetry if the F-statistic of the sample value for the null hypothesis $a_0 = a_1 = a_2 \dots = 0$ exceeds the critical value obtained. The findings in Table 2. 13 clearly indicate that there is asymmetric effects in the credit default swaps and the interbank market rate.⁷⁰ Therefore, I proceed to the threshold GARCH to test whether leverage effects are present in my models.

Table 2. 13 Test for leverage effects

Variable	Coefficient	Prob.	Wald Test Restrictions	Coefficient
DDEN10Y			F-Stat Prob.	
RESID01(-1)	0.02	0.60	0.70	
RESID02(-2)	-0.04	0.55		
DDEN5Y				
RESID01(-1)	0.006	0.78	0.60	
RESID02(-2)	0.005	0.72		
DDEN3Y				
RESID01(-1)	0.11	0.40	0.58	
RESID02(-2)	0.08	0.32		
DLDENCDS10Y				
RESID1(-1)	-0.04	0.02	0.02	
RESID2(-2)	0.03	0.48		
DLDENCDS5Y				
RESID1(-1)	-0.07	0.01	0.02	
RESID2(-2)	0.04	0.13		
DDENINTER				
RESID01(-1)	0.14	0.00	0.00	
RESID02(-2)	0.13	0.00		
DLSPDEN				
RESID01(-1)	0.002	0.90	0.76	
RESID02(-2)	-0.01	0.54		
DLSPDENF				
RESID01(-1)	0.08	0.10	0.17	
RESID02(-2)	-0.003	0.68		

Source: Author's calculations

⁷⁰ In fact, I should check for the leverage effect of the variables which show heteroskedasticity and autocorrelation in the residuals, but instead I check for all the variables to be sure that any of them does not indicate asymmetry even though they do not exhibit heteroskedasticity or autocorrelation

Table 2. 14 gives evidence that the T-GARCH model is satisfactory for two of the variables and unsatisfactory for the swap for 10 years. In the light of this fact, there is an asymmetric impact coming from the bad news one period ago for credit default swap for 5 years and for the interbank market rate. As the leverage term is not significant for credit default swap 10 years the model reduces to a GARCH (1,1) model.

The results show that there is negative impact of the volatility index on the spread of the credit default swaps. As the volatility risk increases by 1 percent, the spreads reduce by 0.7 and 2 percent respectively. This confirms the results of the GARCH (1,1) model that the increase of the risk is not reflected in the credit default swaps. This should be related to the decrease of government bond yields, as the spreads tend to mirror the bonds. However, the impact on the swaps could be ambiguous and as (Korus 2019) states the decrease of the swaps could be associated to increase of government bonds yields too. ECB policy rate highly impacts the variables in the T-GARCH model. As the risk in the swap is increased, it means that a tightening or an increase of the policy rate has done the government bond yields less adequate (increased the yields) hence, the investors are convinced that Denmark is risky, and the debt liability is deteriorated. However, it can happen in the opposite side too, the yields could be decreased, and the spreads could be high still. Probably, it is related to a positive yield because investors normally tend to exhibit risk-aversion behavior and do not invest in an environment where there is high risk of probability default. As the economic outlook improves, it reduces the spreads of the swaps, but in contrast to the GARCH (1,1) model estimated above, it does not have a significant impact on the interbank rate. This is expected as the improvement of the economic outlook reduces the spreads of the swaps meaning that it reduces the risk in the economy and the probability of default is lower. Global risk does not affect the variables while the ECB announcements highly reduces them. ECB announcements seem effective in reducing the interbank rate and the risk reflected in the swaps (Abbassi & Linzert 2012). The reduction of the interbank rate induced by the increased liquidity could lead to lower demand in the local market if the number of foreign banks is high (Falagiarda & Reitz 2015). When the policy rate increases, it increases only the interbank rate by 0.43 points and there is a significant effect of the domestic announcements in reducing the interbank rate and the elevated pressure of the swap for 5 years. The increase of the interbank rate might be due to higher policy rate pursued to support the currency while domestic announcements seem effective in easing the market. Surprise component affects negatively only the interbank rate while coefficients in the variance come with the expected sign and magnitude.

Table 2. 14 T-GARCH model

	DDENINTER	DLDENCDS10Y	DLDENCDS5Y
Mean Equation			
DLVIX	0.003	-0.007**	-0.02***
DECB	-0.003***	0.01*	0.02**
DLEUDS	0.02	-0.30***	-0.52***
DLTED	-0.0008	-0.003	0.001
ECBDUM	-0.001***	-0.002***	-0.003***

DDENRATE	0.43***	0.001	-0.007
DEDUM	-0.0006***	-0.0004	-0.001*
UITGE	-5.16E-06***	-1.52E-06	-1.33E-06
Variance Equation			
Resid(-1)^2	0.10***	0.05***	0.01***
TGARCH(-1)	-0.08***	-0.001	0.02***
GARCH	0.88***	0.90***	0.83***

Note: *, **, *** denotes 10% , 5% and 1% level of significance

Source: Author's calculations

I perform the diagnostic tests after estimating T-GARCH model and the findings in Table 2. 15 clearly show that there is no presence of heteroskedasticity and autocorrelation left in the residuals.

Table 2. 15 Diagnostic tests for T-GARCH model

Variable	Test for ARCH effects		Autocorrelation of residuals in levels		Autocorrelation of squared residuals	
	Obs*R-squared	Prob.ChiSquare	Q-Stat	Prob.	Q-Stat	Prob.
DDENINTER	0.10	0.68	116.50	0.00	3.8	0.87
DLDENCDS10Y	1.2	0.20	5.60	0.50	2.28	0.98
DLDENCDS5Y	1	0.21	7.80	0.28	2.28	0.89

Source: Author's calculations

Overall, long and medium-term government bonds seem to be adequate in comparison to other euro area bonds meaning that there is less capital outflow from Denmark and the same sign is found for credit default swaps too. The opposite happens in the case of short-term government bonds; the bonds for 3 years are related to capital outflow from Denmark. Further, the increase of the risk does not reduce corporate bond indices indicating that probably investors anticipate a monetary easing in the near future. Denmark is highly influenced from the volatility index for euro area but the impact of ted spread which counts for the global risk is limited. This is due to the proximity and international trade policies of Denmark with Europe and with the rest of the world. Its intra-EU trade accounts 61 percent of exports while only 8 percent goes to the US and 6 percent to Norway. In terms of imports, 70 percent comes from EU member states while outside the EU, 7 percent comes from China and 6 percent from Norway⁷¹. Overall, I find significant results for ECB policy rate and its announcements as the country has given up its monetary autonomy while domestic rate and its announcements mirror those of ECB.

I proceed with the estimation for the other countries such as Finland, Iceland, Norway and Sweden and for brevity purposes I have excluded other passages, I have included

⁷¹ Denmark Overview, European Union, https://europa.eu/european-union/about-eu/countries/member-countries/denmark_en, (Accessed in 4 December 2020)

only the results for the GARCH and the T-GARCH model. In Table 2. 16 I show the descriptive statistics for the variables used for Finland. The mean of the variables for Finland ranges from 0.55 for interbank rate to 112.58 for S&P corporate bond index in local currency. Credit default swap for 10 years is the variable with the highest dispersion (17.31) and interbank rate the lowest variability (0.57). All the variables are skewed to the right except of S&P corporate bond index in domestic currency that is skewed to the left. The variables that display excess kurtosis are: Credit default swaps for 10 years and 5 years, interbank rate and policy rate. Jarque-Bera Test clearly indicates the rejection of the null hypothesis for normality distribution.

Table 2. 16 Summary statistics for Finland

	FIN10Y	FIN5Y	FIN3Y	FINCDS 10Y	FINCDS 5Y	FININT ER	FINRAT E	SPFIN	SPFINF
Mean	2.03	1.14	0.66	49.45	29.80	0.55	0.66	112.58	107.36
Median	1.93	0.90	0.34	45.12	27.98	0.27	0.75	112.66	108.77
Max.	4.38	3.67	3.03	107.95	94.00	4.72	3.27	121.84	141.35
Min.	-0.01	-0.52	-0.67	21.00	17.00	-0.20	0.00	102.95	87.67
Std. Dev.	1.16	1.07	0.88	17.31	8.76	0.73	0.57	4.94	11.48
Skew.	0.04	0.37	0.56	1.36	4.39	2.08	0.83	-0.07	0.40
Kurt.	1.83	1.94	2.21	4.43	24.96	9.63	4.27	1.89	2.76
J-B Test	121.51	148.61	168.25	841.33	49692.5 0	5452.61	390.14	110.62	63.45
Prob.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Source: Author's calculations

As in the previous section, in Table 2. 17 I have calculated the Dickey-Fuller and Phillips-Perron tests and the results show that some of the variables are stationary at levels while all variables are stationary at first difference.

Table 2. 17 Unit root test

Levels	T_u	T_t	T	First difference	T_u	T_t	T	Test
FIN10Y	1.36	2.24	2.13**	DFIN10Y	20.39***	20.40***	20.31***	ADF
	1.52	2.52	2.26**		65.12***	65.15***	64.94***	PP
FIN5Y	1.86	2.14	2.52**	DFIN5Y	33.04***	33.06***	32.99***	ADF
	2.82*	2.32	2.77***		57.52***	57.57***	57.42***	PP
FIN3Y	2.43	2.39	3.03***	DFIN3Y	40.61***	40.64***	40.55***	ADF
	2.58*	2.54	3.20***		58.47***	58.54***	58.31***	PP
LFINCDS10Y	2.23	2.31	0.07	DLFINCDS10Y	20.10***	20.16***	20.10***	ADF
	2.15	2.21	0.11		52.81***	52.82***	52.82***	PP
LFINCDS5Y	3.60***	3.70**	0.31	DLFINCDS5Y	22.63***	22.63**	22.63***	ADF
	3.48**	3.59**	0.29		45.49***	45.49***	45.50***	PP
FININTER	2.97**	2.17	3.52***	DFININTER	11.40***	11.64***	11.29***	ADF
	2.99**	2.12	3.60***		65.03***	64.17***	65.44***	PP
LSPFIN	2.11	1.96	1.09	DLSPFIN	56.91***	56.93***	56.90***	ADF

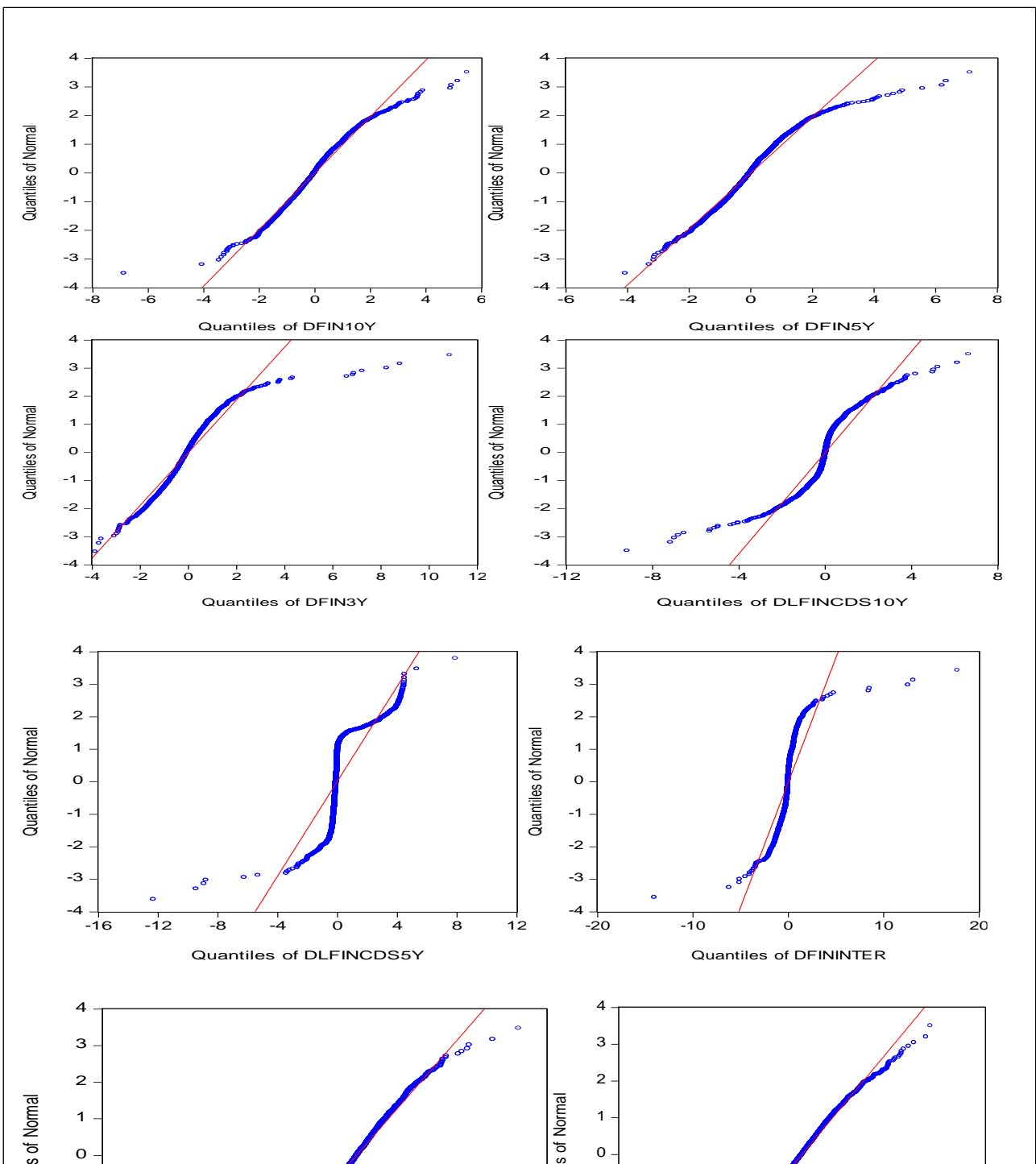
	2.14	1.96	1.13		57.02***	57.06***	56.98***	PP
LSPFINF	1.64	1.80	0.23	DLSPFINF	26.31***	26.31***	26.31***	ADF
	1.69	1.84	0.26		55.77***	55.83***	55.78***	PP
FINRATE	2.73*	2.77	2.96***	DFINRATE	5.17***	5.34***	4.99***	ADF
	3.02*	2.06	3.93***		5.44***	5.64***	5.22***	PP

Note: *, **, *** denotes 10%, 5% and 1% level of significance

Source: Author's calculations

In Figure 2. 9, the plots indicate that government bonds and bond indices follow more closely a straight line but the other variables do not match the quantiles of the normal distribution.

Figure 2. 9 QQ plots for Finland



Source: Author's calculations

Finland is part of the euro area in which is followed a single monetary policy implemented by the Eurosystem. Finland has flexible exchange rate regime and as a member of Eurosystem, the Bank of Finland participates in the decision making and implementation of the single monetary policy in the euro area. In Table 2. 18 I report the results of the benchmark model GARCH (1,1) for Finland. Overall, there is a negative impact of the volatility index on the long-term government bond yield and positive impact on the short-term framework. The negative impact of the bonds indicates that long-term Finnish bonds are good substitutes of euro area bonds and there is less capital outflow from Finland. The opposite happens in terms of short-term government bonds. The bonds for 3 years are related to “flight to quality” from Finland to euro area bonds. More specifically, a one percent increase on the European risk measure (VIX_t) decreases the government bond yield of 10 years by 0.06 points and increases 3-years government bond yield by 0.04 points. The impact on credit default reflects those of sovereign bond yields. The negative bond yields in Finland followed those of ECB when in 2015 a large scale of QE was announced which pushed the rates in negative territory. The aim of the action was to increase the incentive of the banks to lend to the customers and business in boosting inflation and growth (Nash, Wall, & Waldner 2015). During the years the reference rate has been close to zero but on the decision of 28 June 2016, the reference rate reached the zero bound. The negative sign of the bond yields confirms those of (Andrade et al. 2016) and (Ghysels et al. 2013) and who state that ECB's unconventional monetary policies reduced the yields of long-term sovereign bonds. Ghysels et al. (2013) study the impact of SMP purchases and highlight that this programme was able to reduce the volatility of the government bond yields and addressed the market malfunctioning. On the other hand, Andrade et al. (2016) indicate that the asset purchase programme had a sizable macroeconomic impact, in reducing the sovereign yields on long-term government bonds. Their evidence is constant to the portfolio rebalancing channel through the removal of duration risk and the relaxation of leverage constraints for financial intermediaries. An increase of the risk by 1 percent reduces the swaps by 1 and 3 percent while one percent increase in the risk has a positive impact in the interbank rate by 0.02 points. Credit default swaps show that the risk reduces as the capital remains within the country, hence the probability of default of the bonds is low. Korus (2019) defines the impact of non-standard measures on CDS spreads as ambiguous. In Finland's case the impact is negative which means that ECB's purchases of non- euro area bonds could reduce

the yields through the portfolio rebalancing channel or the signalling channel. The negative sign in the spreads means improvement of debt sustainability. Finland was one of the best performing economies of the world during the financial crisis and the crisis itself was not exhibited as a crisis indeed, but as a shock to the external demand. It was able to maintain a high sovereign rating during the crisis and helped the banks to secure cheap liquidity from abroad. Finland's strong bone was the the IT sector, the performance of Nokia which had a high cost competitiveness by the real exchange rate and the large surplus in the current account (Valimaki & Obstbaum 2020). The interbank rate increased making borrowing more expensive and bond indices had a similar impact too. Valimaki & Obstbaum (2020) state that one of the main objectives of the bank during the crisis was to use the interest rate tightly as an operational target. However, in the awake of the crisis the demand for the liquidity increases and irregularly as banks wanted to hoard money for precautionary purposes. This extraordinary "hoarding behavior" probably is manifested in higher interbank rate. The increase of the volatility enhances bond indices by 0.4 and 7 percent. The positive impact of bond indices indicates that probably the investors anticipate a future monetary policy easing as Finland being a member of the EU, mirrors the monetary policy pursued by ECB. Thus, I suspect that it might be related to a possible signaling channel. However, the significance of signalling channel in influencing the prices of corporate bond index depends on the reactions of ECB to maintain short-term interest rates for a longer period. ECB policy rate seem have a significant effect in the majority of the variables. The increase of ECB policy yield makes government bond yields less attractive. As the policy rate increases, it increases the interbank rate by 0.03 points. Interbank rate of Finland will follow the same direction as the ECB while it causes a negative effect in the corporate bond index in foreign currency. Many studies that confirm the reduction of long-term government bond yields and corporate bond yields which studied the impact in US (Chen et al. 2012; Glick & Leduc 2012; Berge & Cao 2014) and for EU (De Santis et al. 2018; Korus 2019). De Santis et al. (2018) state that the decrease in the corporate bond yields was due to ECB's corporate sector purchase programme which improved supply conditions and increased bank lending to non-financial corporations that did not have access to bond-financing. Economic outlook improvement increases the bond yields, making Finnish bonds less attractive and is related to credit outflows from Finland to other euro-area countries. The improvement increases the interbank rate indicating a tightening of the policy rate. A higher policy rate could be a tentative of the central bank to fight inflation because due to the crisis the central banks had to lower the rate in order to support the economy. During the recession, inflation followed the economic growth pattern in terms of consumption and production prices (BOF 2018). Finland's recession in early 90's was worse than the recession of 2010-2012. (Singala & Kumar 2012) state that the constraints in the economic recovery were high wages, high social subsidies, complex regulations and high taxes, an ageing population and limited labour force, persistent unemployment and growing globalization. A significant role played even the tension relations of EU with Russia which decreased the exports and the tourism from Finland (Jokinen 2012). An improved economic outlook ($EUDS_t$) increases the bond yields by 0.95, 0.78 and

0.30 points but it reduces credit default swaps by 20 percent and 40 percent. There is a positive significant effect on the interbank market rate by 0.04 points but it decreases bond indices by 3 percent. When the economic outlook improves, investors switch to euro area bonds and corporate bond indices are more preferable than government bonds. The Finnish corporate bond market is small and has been in decline for the past two years (NordicTrustee 2019). As the economic outlook improves, it improves the debt liability too as the spread of the swaps decline. An increase of the global risk increases the bond yields, increases the spread of the swap for 5 years and has a correct sign in bond index in domestic currency. The increase of global risk measure (TED_t) by one percent increases bond yield for medium-term by 0.05 points and 0.01 points for the short-term. It increases the swap rate for 5 years by 2 percent and reduces the bond in local currency by 0.3 percent. Obviously, in terms of high global risk, investors will turn to euro area bonds and corporate bonds and there will be “flight to quality” from Finland. Furthermore, the announcement of ECB seem to be highly effective. The announcements of ECB seem to be effective in reducing the risk and the default of governmental bonds similar to (Abbassi & Linzert 2012) and provide liquidity to the system as the interbank rate declines. The reduction of the interbank could be by a lower demand in the domestic money market if there is an increase in the liquidity (Falagiarda & Reitz 2015). As the number of announcements for tightening monetary policy by ECB increase, it tends to make corporate bond index in domestic currency attractive too while government bond yields are less attractive. Policy rate of Finland positively impacts the government bond yield for medium and short-term and it increases the interbank rate. However, there is a negative impact in the spread of the swap for 5 years and bond index in domestic currency. It reduces the credit default swap for 5 years by 20 percent and the yield for corporate bond index in the domestic currency by 2 percent, while it increases the interbank rate by 0.87 points. The increase of policy rate makes domestic bonds less attractive whilst corporate bonds are more preferable. Policy rate is related to increase of bond yields as an attempt to fight the zero bound and inflation, it increases debt liability and increases the interbank applied in the money market too. Domestic announcements seem to have a significant effect in Finland as the country mirrors the announcements of ECB. Italian-German spread has a significant impact on the credit default swaps while the impact on the other variables is not significant. However, the impact of the spread seems to be modest.

As for the variance equation, all the coefficients are correct in sign and magnitude meaning that $\alpha_1 + \beta < 1$.

Table 2. 18 GARCH model

	DFIN10 Y	DFIN5 Y	DFIN3 Y	DLFINCDS10 Y	DLFINCDS5 Y	DFININTE R	DLSPFI N	DLSPFIN F
Mean Equation								
DLVIX	-0.06*	-0.01	0.04*	-0.03***	-0.02***	0.02**	0.004**	0.07***
DECB	0.003**	0.05**	0.08**	-0.004	-0.005	0.03*	0.0005*	-0.004**

DLEUDS	0.95***	0.78***	0.30***	-0.20***	-0.40***	0.04**	-0.03***	-0.03***
DLTED	0.01	0.01**	0.05**	0.002	0.02***	-0.006	-0.003***	0.005
ECBDUM	0.002*	0.002**	0.003**	-0.001**	-0.004***	-0.002*	-0.0002**	-0.0006
DFINRATE	0.18	0.22*	0.22*	-0.002	-0.20***	0.87***	-0.02**	0.01
FIDUM	0.001*	0.002**	-0.003*	0.002	0.002	-0.002**	0.0002	-0.0009
UITGE	2.15E-06	2.42E-05	-2.50E-06	1.E-05**	-1.40E-05***	2.78E-05	5.40E-08	1.50E-06
Variance Equation								
Resid(-1)^2	0.03***	0.18***	0.00***	0.06***	0.10***	0.02***	0.15***	0.01***
GARCH(-1)	0.89***	0.70***	0.90***	0.90***	0.70***	0.78***	0.73***	0.97***

Note: *, **, *** denotes 10% , 5% and 1% level of significance

Source: Author's calculations

After estimating the benchmark model, I test is there is any presence of heteroskedasticity and autocorrelation in the residuals in Table 2. 19. The results show that there are still effects left only for the credit default swap for 10 years.

Table 2. 19 Diagnostic tests for GARCH model

Variable	Test for ARCH effects		Autocorrelation of residuals in levels		Autocorrelation of squared residuals	
	Obs*R-squared	Prob.ChiSquare	Q-Stat	Prob.	Q-Stat	Prob.
DFIN10Y	10	0.00	2.40	0.80	12.50	0.15
DFIN5Y	0.20	0.44	9.8	0.30	7.50	0.50
DFIN3Y	0.45	0.36	18.20	0.28	1.80	0.87
DFININTER	0.18	0.53	100.60	0.00	13.42	0.15
DLFINCDS10Y	12.50	0.00	35.22	0.00	33.43	0.00
DLFINCDS5Y	0.11	0.50	9.22	0.40	24.35	0.25
DLSPFIN	1.60	0.15	5.25	0.45	3.50	0.79
DLSPFINF	3.40	0.09	5.32	0.56	7.50	0.79

Source: Author's calculations

I proceed with testing of the leverage effects and estimate a threshold GARCH which could capture the leverage effects. The findings in Table 2. 20 **Error! Reference source not found.** show that there is presence asymmetric effects for credit default swap for 10 years , interbank market rate and corporate bond index in foreign currency.

Table 2. 20 Test for leverage effects

Variable	Coefficient	Prob.	Wald Test Coefficient Restrictions
DFIN10Y			F-Stat Prob.
RESID01(-1)	-0.001	0.56	0.24
RESID02(-2)	-0.03	0.20	
DFIN5Y			
RESID01(-1)	0.01	0.50	0.25
RESID02(-2)	-0.02	0.12	

DFIN3Y			
RESID01(-1)	-0.004	0.70	0.18
RESID02(-2)	-0.05	0.09	
DLFINCDS10Y			
RESID1(-1)	-0.03	0.40	0.00
RESID2(-2)	0.12	0.00	
DLFINCDS5Y			
RESID1(-1)	0.12	0.22	0.15
RESID2(-2)	0.10	0.11	
DFININTER			
RESID01(-1)	0.17	0.00	0.00
RESID02(-2)	0.09	0.00	
DLSPFIN			
RESID01(-1)	-0.05	0.45	0.48
RESID02(-2)	-0.08	0.22	
DLSPFINF			
RESID01(-1)	-0.02	0.34	0.10
RESID02(-2)	-0.05	0.44	

Source: Author's calculations

The results for threshold GARCH models are shown in Table 2. **Error! Reference source not found.** and indicate a satisfactory model for credit default swap and interbank market rate. However, third model is not satisfactory as the leverage term is not significant and the model reduces to a GARCH (1,1) model. Both satisfactory models show that there is a positive asymmetric effect coming from good news one period ago.

The results show that there is positive impact of the volatility index on the interbank rate and bond index in foreign currency. As the volatility risk increases, interbank rate increases by 0.03 points and 4 percent the bond index in foreign currency. The results confirm those of GARCH (1,1) model. The increment of the risk is related to higher interbank rate which induces lower liquidity in the domestic money market due to a higher demand will lead to high interbank rate in Finland shown in the “hoarding behavior”. The increase of the risk will increase the bond index which might be related to an anticipation of monetary easing in the near future. ECB policy rate impacts positively the credit default swap for 10 years and the interbank rate. The findings for the swap add to the results given by the GARCH (1,1) model indicating that the risk in the euro area will be reflected in Finnish swaps whereas the impact in interbank rate is similar to that of benchmark model suggesting that monetary policy of ECB is mirrored in Finland's interbank rate. Georgiadis & Gräb (2015) show that scope and size of spillover effects across economies depends on differences in economies' financial openness, the exchange rate regime, the degree of financial and trade integration with the euro area and a countries attractiveness for carry trades. Similar impact is found from (Bluwstein & Canova 2016). As the economic outlook improves, it reduces the spreads of the swap and the bond index in foreign currency while it increases the interbank rate. A 1 percent increase in the economic outlook, reduces the spread by 25 percent and the bond index by 3 percent while it increases the interbank rate by 0.04

points. A better economic outlook improves the probability default of the swap for long-term bond and makes bond index in foreign currency more attractive while the interbank rate increases. The interbank rate increases not only in the case that risk increases, but when the economic outlook increases too. This could be an evidence of the international bank lending channel and the own features of the Finnish banking sector itself. Global risk only affects the interbank rate by reducing it by 0.004 points helping the agents to have more liquidity. ECB announcements increase the interbank rate, but it reduces the bond index in foreign currency. These findings confirm the bank lending channel and indicate that non-standard measures make the Finnish corporate bond indices more attractive. When the policy rate increases, it increases the interbank rate and bond index in foreign currency. Domestic announcement seem to be significant effect in reducing the elevated pressure of swaps and bond index in foreign currency. However, announcements increase the swap of 10 years indicating that an increase of the policy rate is related to higher bond yields, hence, outflow from the country. Italian-German spread has a positive significant impact on the credit default swap for 10 years and coefficients in the variance equation come with the expected sign and magnitude.

Table 2. 21 T-GARCH model

	DLFINCDS10Y	DFININTER	DLSPFINF
Mean Equation			
DLVIX	-0.001	0.03***	0.04***
DECB	0.03***	0.04***	-0.003
DLEUDS	-0.25***	0.04***	-0.03***
DLTED	-1.32E-05	-0.004***	0.001
ECBDUM	-0.002**	0.005***	-0.0004*
DFINRATE	-0.05	0.25***	0.23**
FIDUM	0.002**	-0.002***	-0.0008***
UITGE	1.10E-05***	3.78E-06	1.66E-06
Variance Equation			
Resid(-1)^2	0.02***	0.20***	0.02***
T-GARCH(-1)	0.03***	0.35***	0.007
GARCH	0.90***	0.60***	0.90***

Note: *, **, *** denotes 10% , 5% and 1% level of significance

Source: Author's calculations

After estimating the T-GARCH models, I test if there is any presence of ARCH effects and autocorrelation left in the residuals in Table 2. 22 and the results show I fail to reject the null hypothesis for homoskedasticity and autocorrelation.

Table 2. 22 Diagnostic tests for T-GARCH model

Variable	Test for ARCH effects		Autocorrelation of residuals in levels		Autocorrelation of squared residuals	
	Obs*R-squared	Prob.ChiSquare	Q-Stat	Prob.	Q-Stat	Prob.
DLFINCDS10Y	1.8	0.18	29.40	0.30	4.43	0.68
DFININTER	0.10	0.62	38.50	0.38	3.24	0.63
DLSPFINF	3.10	0.32	7.40	0.54	2.34	0.73

Source: Author's calculations

Overall, I find that Finnish long and medium- term government bonds are good substitutes of the euro area bonds but I find opposite impact of the short-term government bond yield in terms of higher volatility risk in the euro area. The increase of the risk enhances interbank rate and bond indices too.

In the case of improvement of economic outlook there is “flight to quality” from Finland and investors switch to corporate bonds. The same behavior of investors is revealed when the global risk is increased. The impact of ECB rate and its announcements are really significant while its domestic policy rate and its announcements mirror those of ECB.

After Finland, I proceed with the estimation for Iceland. For Iceland all variables are estimated at levels instead of first difference because the variables converge on different algorithms which could find different local maxima of the Log Likelihood Function. I smooth the data through performing a moving average and then log it. Different optimization procedures could lead to different coefficient estimates and different estimates for the standard errors (Brooks 2008). Therefore, in order to ensure the consistency of my findings, and ascertain that my results are robust and satisfactory I estimate the variables at levels.

In Table 2. 23 I show the descriptive statistics for Iceland. It shows that the variable with the lowest mean is the government bond yield for 2 years at 5.92 and the variable with the highest mean is the credit default swap for 10 years at 252.09. The variability ranges from 1.41 government bond yield for 10 years to 236.85 for credit default swap for 4 years. All the variables are skewed to the right and they show excess kurtosis except of exchange rate of Icelandic Krona vis-à-vis euro which is skewed to the left and has a kurtosis lower than 3. Based on Jarque-Bera test I fail to accept the null hypothesis of normal distribution.

Table 2. 23 Summary statistics for Iceland

	IC10Y	IC5Y	IC2Y	ICDS10Y	ICDS4Y	ICINTER	ICTOEUR O	SPIC	SPICF
Mean	6.76	6.21	5.92	252.09	241.17	6.85	148.41	224.13	158.28
Median	6.54	5.68	4.94	199.21	144.34	5.85	153.95	207.74	132.45
Max.	12.67	13.85	16.68	930.86	1129.23	18.45	184.67	506.55	685.06
Min.	4.62	4.01	2.74	0.00	0.00	3.88	94.34	207.74	132.41
Std. Dev.	1.41	1.82	2.78	169.71	236.85	3.58	19.25	61.23	97.91
Skew.	1.16	1.75	1.64	2.12	2.24	2.06	-0.38	3.59	3.74
Kurt.	4.47	5.65	4.99	7.65	7.69	6.11	2.35	14.22	15.66
J-B Test	906.99	2304.38	1764.87	4713.26	5013.18	3182.24	119.41	21082.52	25687.05
Prob.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Source: Author's calculations

In Table 2. 24 I reveal the results for stationarity tests, which indicate that all variables are stationary at first difference.

Table 2. 24 Unit root tests

Levels	T_u	T_t	T	Difference	T_u	T_t	T	Test
LIC10Y	2.67*	4.21***	0.85	DLIC10Y	19.91***	19.91***	19.90***	ADF
	2.77*	4.43***	0.96		74.67***	74.67***	74.65***	PP
LIC5Y	2.85*	2.85	1.05	DLIC5Y	20.96***	20.98***	20.95***	ADF
	3.05**	2.97	1.21		51.75***	51.76***	51.71***	PP
LIC2Y	2.34	2.03	1.25	DLIC2Y	20.35***	20.38***	20.34***	ADF
	2.47	2.14	1.33		59.79***	59.62***	59.78***	PP
LICDS10Y	1.47	4.01	0.49	DLICDS10Y	18.54***	18.55***	18.54***	ADF
	1.48	3.70**	0.60		53.73***	53.72***	53.74***	PP
LICDS4Y	0.99	3.86**	0.84	DLICD4Y	16.31***	16.32***	16.30***	ADF
	0.95	3.96***	0.80		57.46***	57.45***	57.47***	PP
LICNTER	1.92	1.55	1.76*	DLICINTER	19.44***	19.48***	19.38***	ADF
	1.92	1.56	1.75*		50.67***	50.68***	50.65***	PP
LSPIC	4.50***	3.60**	2.02**	DLSPIC	19.26***	19.49***	19.16***	ADF
	4.60***	3.94**	1.73*		46.42***	46.39***	46.40***	PP
LSPICF	6.80***	5.6***	3.02***	DLSPICF	17.41***	17.77***	17.27***	ADF
	5.54***	4.78***	2.12**		56.05***	56.13***	55.99***	PP
LICTOEURO	3.31**	4.83***	0.72	DLICTOEURO	20.47***	20.59***	20.45***	ADF
	3.32**	4.79***	0.72		56.78***	56.85***	56.77***	PP

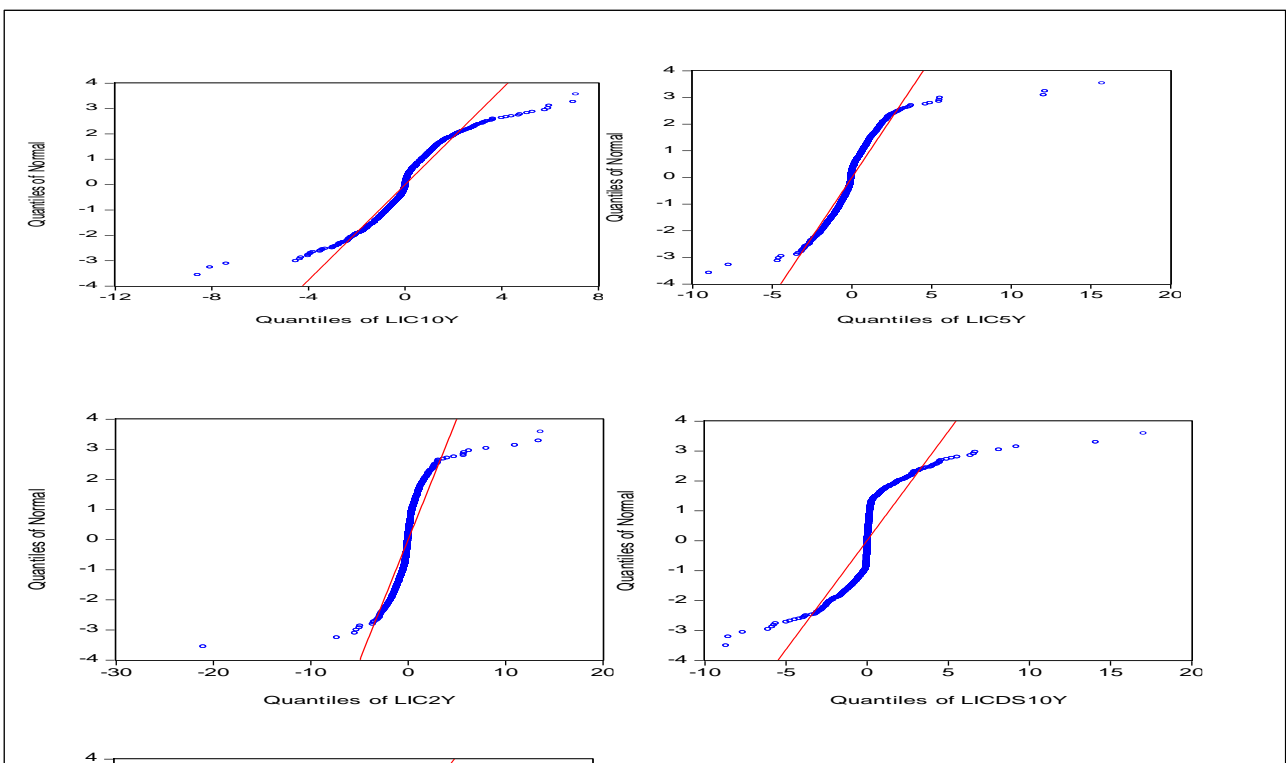
Note: *, **, *** denotes 10% , 5% and 1% level of significance

Source: Author's calculations

In

Figure 2. 10 I show the plots for the residuals of the dependent variables against the quantiles of normal distribution. Even though I log the variables in order to smooth their skewness and approximate the normal distribution all the variables, all variables seem far from following a straight line.

Figure 2. 10 QQ plots for Iceland



On the other hand, it gives evidence of investors which loose appetite in buying swaps while banks accumulate more capital and tend to exhibit risk-reverse behavior in granting loans. Iceland was one of the countries which was severely influenced by the crisis and its GDP declined more than 10 percent in real terms from peak to trough in 2010, and disposable income declined about 20 percent during the same period (Benediktsdottir et al. [2017](#)).

Obviously, the increment of the risk would increase the interbank too, making borrowing more expensive. This gives evidence to the international bank lending channel which will increase the interbank rate due to ECB announcements. An increase of the interbank rate in the euro area could be induced by a reduction in liquidity which may result in higher demand at the local money market if the presence of foreign-owned banks in the country is small. Higher demand will lead to higher interbank rate in Iceland. In the awake of the crisis, the Icelandic economy experienced a boom-bust cycle with unusual interest rates which made the liquidity highly accessible. However, during 2007-2008 due to the rolling over maturing debt became difficult and hence the

interbank lending came to halt. Thus, this is an evidence of higher interbank rates as an incentive of agents to decline the exposure (Boehm & Kusen 2018). Domestic currency against euro appreciates too which is associated with increasing yields of short-term government bond yield due to the exchange rate channel. Thus, the demand for this type of bonds will decrease. The high impact of the volatility index in the interbank rate is the high level of the policy rate as an attempt to inflation targeting. In response to the crisis, the inflation was above the target and the central bank had to keep the rates high exceeding 15 percent at times. Higher rates encourage domestic firms to borrow in foreign currency leading to high inflows in foreign currency. This leads to appreciation of the exchange rate which is clearly shown in my results. The inflows encouraged the economic growth and the inflation further, inducing the Central Bank to increase the policy rate further. As a result a bubble was caused by the interaction of domestic rates, exchange rate appreciation and inflows which in theory should have led to lower domestic prices but in Iceland this was the opposite (Danielsson 2008). The author goes further and shows that one of the main reasons that inflation targeting failed was that foreign currency became part of the local money supply and the exchange rate appreciate leading to the creation of new sectors in the economy. In such case, the depreciation was inevitable as the Central Bank did not prevent the appreciation and build reserves. Moreover, there is negative impact on the corporate bond indices suggesting that Iceland corporate bonds seem more attractive too. The findings are similar to (Andrade et al. 2016) who state that APP was effective in reducing the corporate bond yields through the portfolio rebalancing channel. Even though that Iceland is not part of EU, I find a high influence of ECB policy rate. The impact again is different for long and short-term framework bonds, ECB policy rates negatively impact the long-term bonds while it increases the yields of medium and short-term government bonds. It improves the swap for 10 years similar to (Abbassi & Linzert 2012) but it increases the swap for 4 years. It seems that higher time framework induces high certainty in the economic decisions of investors. The impact of ECB is mirrored in the interbank, it reduces the bond indices and depreciates the domestic currency against euro. There is vast disagreement among researchers when it come to the main reason of default and the relation of Iceland with the ECB. On one hand, (Carey 2011) in his analysis he explains that the currency was not the main obstacle to hinder the collapse and argues that Iceland's banks would have been in trouble even if Iceland would be within the eurozone. Iceland banks had access to liquidity from foreign banks from their foreign subsidiaries. ECB was holding € 4.5 billions of collateralized loans to them while the Icelandic Central Bank was holding €2 billion of collateralized loans to the banks. On the other hand, (Thorhallsson & Kirby 2012) state that s Iceland had difficulty with the EU member states as their citizens lost their savings on the Icelandic banks since the membership of the EEA did not grant Iceland access to the EU institutions. The economic outlook, is related to higher yields which indicates capital flow from Iceland, higher default for the country, higher interbank rate and depreciation of the domestic currency. As the economic outlook in the euro area increases investors run away to "flight to quality" to euro area government bonds. In the case that government bond yields of non-euro area countries increase, CDS spreads

increase due to the confidence channel and the exchange rate channel (Korus 2019) while the corporate bonds seem more attractive and their yields reduce. An increase of the global risk increases the yields of the long and short-term government bonds while it reduces the medium-term bond. The global risk increases the default of the bond for 10 years and depreciates the domestic currency. There is different behavior of government bonds due to the global risk showing that long- and short-time framework indicate uncertainty about the future whilst the medium term bond seems to be a better choice. This kind of selective approach could be to the current upheaval of the risk and anticipation of the increment of the risk in the near future. ECB announcements instead, seem effective in reducing the yield of the long government bond yield whilst it increases the yields of medium and short-term government bond yield. As matter of fact, ECB easing announcements are related to the decline of the government bond yields while the ECB tightening statements are associated to enhancement of bond yields. Icelandic Krona went through two notable experiences, first the deprecation from early 2000 until 2007 and then the appreciation from 2008 which meant an acceleration of its economic growth and strength in exports. In the period that currency appreciated towards euro as a result of economic recovery the central bank was in pressure to lower interest rates and buy foreign exchange (euros). Domestic rate seem to have a significant impact in the economy too. The increase of policy decreases the yields of the bonds, making them good substitute of euro area sovereign bonds. It improves debt liability for the spread for 10 years, but it reduces it for the swap for 5 years. Further, it reduces the interbank rate, it reduces the indices and depreciates the country. The reduction of the bond yields even though the polic rate is increased might be induced by an anticipation of easing in the near future. The reduction of the interbank rate might be induced by the increase in liquidity which results in a lower demand in the local market if the foreign-owned banks in the local market are large enough. Lower demand in the domestic money market will lead to reduction of interbank rates in Iceland (Falagiarda & Reitz 2015). Domestic announcements seem significant in influencing bond yields. As the number of announcements increases it reduces the yield of the medium-term government bond but it increases the yield of the long-term government bond. These different effects could be associated to different views of anticipated announcements in the near future. Moreover, it reduces the index in domestic currency but it increases the index in foreign currency and depreciates the exchange rate. When the financial shock hit the majority of the economies, Iceland followed too, but soon the central bank was forced to increase the rates to 18 percent as a condition of \$2 billion loan from the International Monetary Fund. While the inflation was 7 percent, the economy contracted and the Icelandic economy did not see the benefits of the Fund or either its orthodox monetary policy. High rates were often justified as needed to stabilize the exchange rate and on the other hand, IMF insisted on capital controls (Gylfason 2010). IMF (2011) revealed that the tightening was necessary, but this demand for high rates was unjustified and caused more significant damage . Surprise component affects positively only the medium and short-term government bond yield while the impact in the remaining variables is not significant. In the variance equation, all variables come with the expected sign and magnitude.

Table 2. 25 GARCH model

	LIC10Y	LIC5Y	LIC2Y	LICDS10Y	LICDS4Y	LICINTE R	LSPIC	LSPICF	LICTOEURO
Mean Equation									
LVIX	-0.001***	-0.0002***	0.001**	0.002***	0.005***	0.001**	-2.61E-05***	-0.0005**	-0.0001***
ECB	-0.0006**	0.0002***	0.001**	-0.0001***	0.005***	0.0009**	-0.0001**	-0.001***	0.001***
LEUDS	0.0007**	0.001***	0.006**	0.004***	0.01***	0.006***	-0.0008**	-0.001***	0.002***
LTED	0.0007**	-0.0002***	6.11E-05**	0.0001***	0.0007	0.0004	-4.77E-05***	8.20E-05**	0.0003***
ECBDUM	-8.76E-05***	0.0001***	7.02E-05***	-5.02E-05	0.0005	0.0001	7.50E-05	6.98E-05**	0.0002***
LICRATE	-0.003***	-0.001***	-0.008**	-0.003***	0.002**	-0.005**	-0.0006**	-0.0006**	0.0001***
ICDUM	1.27E-05***	-0.0001***	5.61E-06	-5.59E-05	0.0003	-0.0003	-1.82E-05***	0.0001**	0.0001***
UITGE	4.84E-07	2.70E-07*	6.62E-07***	2.53E-07	2.19E-07	-2.95E-08	4.33E-08	6.49E-08	3.16E-07
Variance Equation									
Resid(-1)^2	0.39***	0.38***	0.37***	0.30***	0.14**	0.15***	0.01***	0.15***	0.15***
GARCH(-1)	0.60***	0.61***	0.62***	0.64***	0.59***	0.59***	0.98***	0.60***	0.60***

Note: *, **, *** denotes 10% , 5% and 1% level of significance

Source: Author's calculations

In Table 2. 26 **Error! Reference source not found.**, I perform the diagnostic tests for testing if there is any ARCH effects and autocorrelation left in the residuals and squared residuals. The results indicate presence of heteroskedasticity and autocorrelation in the residuals.

Table 2. 26 Diagnostic tests for GARCH model

Variable	Test for ARCH effects		Autocorrelation of residuals in levels		Autocorrelation of squared residuals	
	Obs*R-squared	Prob.ChiSquare	Q-Stat	Prob.	Q-Stat	Prob.
LIC10Y	50.19	0.00	6464.7	0.00	69.38	0.00
LIC5Y	25.03	0.00	7031.9	0.00	42.30	0.00
LIC2Y	2.99	0.08	5740.2	0.00	6.63	0.76
LCDS10Y	0.45	0.50	4093.7	0.00	6.66	0.67
LICDS4Y	1566.46	0.00	12519	0.00	8027.6	0.00
LICINTER	1460.86	0.00	16511	0.00	8069.9	0.00
LSPIC	2338	0.00	22792	0.00	17354	0.00
LSPICF	84.13	0.00	17930	0.00	304.37	0.00
LICTOEURO	483.68	0.00	15479	0.00	1324	0.00

Source: Author's calculations

Testing for leverage effects is a requirement, necessary if I would proceed with a threshold GARCH model or a benchmark model GARCH (1,1). The results in Table 2. 27 show that for all variables there is presence of asymmetric effects.

Table 2. 27 Test for the leverage effects

Variable	Coefficient	Prob.	Wald Test Coefficient Restrictions
LIC10Y			F-Stat Prob.
RESID01(-1)	0.36	0.00	0.00
RESID02(-2)	0.21	0.00	
LIC5Y			
RESID01(-1)	0.21	0.00	0.00
RESID02(-2)	0.38	0.00	
LIC2Y			
RESID01(-1)	0.10	0.00	0.00
RESID02(-2)	0.43	0.00	
LICDS10Y			
RESID1(-1)	0.92	0.00	0.00
RESID2(-2)	0.45	0.00	
LICDS5Y			
RESID1(-1)	0.37	0.00	0.00
RESID2(-2)	0.42	0.00	
LICINTER			
RESID01(-1)	0.74	0.00	0.00
RESID02(-2)	0.15	0.00	
LSPIC			
RESID01(-1)	0.64	0.00	0.00
RESID02(-2)	0.32	0.00	
LSPFICF			
RESID01(-1)	0.10	0.00	0.00
RESID02(-2)	0.72	0.00	
LICTOEURO			
RESID01(-1)	0.64	0.00	0.00
RESID02(-2)	0.23	0.00	

Source: Author's calculations

Based on the findings for leverage effects, I proceed with a threshold GARCH model which results are shown in Table 2. 28. The findings show that an increase of the volatility index by 1 percent it increases the medium and short-term government bond yield by 0.05 and 0.1 percent. The increase of the risk increases the spreads of the swaps respectively by 0.2 and 0.3 percent. Further, there is a positive impact of the risk on the interbank rate by 0.07 percent. As the risk increases, it has a negative impact on both indices, and it appreciates the domestic currency vis-à-vis euro by 0.01 percent. The results seem to be similar to those of the GARCH model with the only exception of the medium-term bond in the T-GARCH model, the increase of the volatility index

increases its yield. Hence, the medium and short-term government bond yields are less attractive, Iceland is riskier and there is “flight to quality “from Iceland. The same impact is found in the credit default swaps which increase the default of the bonds, in the interbank rate which shows expensive borrowing due to the halt of lending”, corporate bonds are more attractive, and the domestic currency appreciated against euro. Vegisvir (2012) indicates that even though the currency depreciated slightly for few weeks, it followed an appreciation pattern due to the low inflation. However, the bank forecasted a deprecation as the inflow of foreign currency to tourists diminished. The impact of ECB policy rate is similar to the benchmark model, the only difference is the impact is the long-term government bond and the credit default swap for 10 years. As ECB’s policy rate changes, it makes the Icelandic bonds less attractive indicating the higher risk of the Icelandic economy. The risk is reflected in the swaps too. The improvement of economic outlook in the T-GARCH model reduces the interbank rate. The reduction of the interbank rate indicates that the risk in the market is reduced after the “halt of the lending”. The increase of the global risk makes the short-term government bond yield less attractive; it increases the default of the bonds and reduces the interbank rate. Further, it increases the bond index in domestic currency. There is high impact of ECB announcement in the financial assets of Iceland. ECB announcements make the government bond yield for 3 years more attractive, reduce the interbank rate and depreciate the exchange rate. Moreover, the announcements increase the bond indices. Thus, in this case there is a switch from the corporate bonds to short-term government bond yields. Domestic policy rate makes the government bond yields more attractive and it improves the debt liability. As the policy rate reduces, it reduces the yield of the bonds too. Even though few tentative to reduce the rates, in doing so the central bank was restricted by the IMF which saw the tightening adequate no matter the economic damage caused. The policy rate reduces the interbank too as an attempt to inject liquidity in the economy. It reduces corporate bond indices too and depreciates the domestic currency against euro. Domestic announcements seem effective in influencing the short-term government bond yield, credit default swap for 10 years, it increases corporate bond indices and depreciates the exchange rate. Surprise component affects negatively the interbank rate and positively the medium-term government bond yield and credit default swap for 4 years.

In the variance equation, all variables come with the expected sign and magnitude. The leverage term is not significant for bond yields and bond indices indicating that there is no asymmetric effect coming from one period ago. The leverage term is significant for the swaps, interbank rate and exchange rate which shows that there is positive effect coming from one period ago.

Table 2. 28 T-GARCH model

	LIC10Y	LIC5Y	LIC2Y	LICDS10Y	LICDS4Y	LICINTE R	LSPIC	LSPICF	LICTOEURO
Mean Equation									

LVIX	-0.0001	0.0005***	0.001***	0.002***	0.003***	0.0007***	-0.0003**	-0.0005**	-0.0001***
ECB	0.001***	0.001**	0.001***	0.0002**	0.001***	0.003***	-0.001***	-0.001**	0.001***
LEUDS	0.005**	0.002**	1.52E-05	0.005***	0.008***	-0.002***	-0.001***	-0.001**	0.002***
LTED	0.0004	-0.0004***	-0.0005***	0.0001**	0.0005***	-0.001***	0.0001**	8.20E-0**	0.0003***
ECBUM	0.0001	7.75E06	-0.0003**	0.0002**	0.0005***	-0.0001***	8.84E-05***	6.98E-05**	0.0002***
ICRATE	-0.001*	-0.001**	-0.0007***	-0.002***	-0.0003**	-0.003***	-0.0004**	-0.0006*	0.0001***
ICDUM	9.12E-05	-4.23E-05	0.0001*	-0.0001**	6.47E-05	1.91E-05	0.0001**	0.0001**	0.0001***
UITGE	-2.06E-07	2.88E-07*	2.16E-07	3.17E-07	2.34E-06***	-5.31E-07***	4.66E-08	6.32E-08	-1.94E-07
Variance Equation									
Resid(-1)^2	0.15**	0.82**	0.60**	0.59***	0.29***	0.27***	0.15***	0.15***	0.15**
TGARCH(-1)	-0.05	0.05	0.001	0.06**	0.07***	0.07***	0.05	0.05	0.05***
GARCH	0.59**	0.10**	0.25**	0.39***	0.61***	0.62***	0.60***	0.60***	0.59***

Note: *, **, *** denotes 10%, 5% and 1% level of significance
Source: Author's calculations

In Table 2. 29 **Error! Reference source not found.**, the results support my findings that after estimating a threshold GARCH model there is no ARCH effects left in the residuals and autocorrelation in the squared residuals.

Table 2. 29 Diagnostic tests for T-GARCH model

Variable	Test for ARCH effects		Autocorrelation of residuals in levels		Autocorrelation of squared residuals	
	Obs*R-squared	Prob.ChiSquare	Q-Stat	Prob.	Q-Stat	Prob.
LIC10Y	6.04	0.32	7323.5	0.00	10.50	0.39
LIC5Y	7.07	0.22	7603	0.00	15.73	0.10
LIC2Y	2.16	0.14	8360.6	0.00	3.76	0.95
LICDS10Y	0.16	0.68	4311.2	0.00	3.89	0.95
LICDS4Y	17.04	0.35	6537.7	0.00	26.35	0.70
LICINTER	11.56	0.30	9547	0.00	17.96	0.05
LSPIC	853.49	0.15	19887	0.00	32.20	0.17
LSPICF	676.65	0.18	20321	0.00	52.34	0.19
LICTOEURO	382.20	0.21	15072	0.00	17.38	0.28

Source: Author's calculations

Overall, I find that Icelandic long and medium-term government bonds are attractive and good substitutes of euro-area bonds while short-term government bonds are riskier and are related to “capital outflow” from Iceland. The increase of the swaps indicates an unregulated market and banks which turn to swaps to ensure their financial products whilst the interbank rate revealed “halt lending”. In the case of high global risk and better economic outlook, Icelandic bonds become less attractive and investors switch to euro area bonds and corporate bonds. I find high impact of ECB’s policy rate and its announcements even though Iceland is not part of the EU while domestic announcements impact is limited.

I go ahead and I proceed with the estimation for Norway. In Table 2. 30 I do a summary statistics of the variables for Norway. The mean of the variables spans from 1.32 for Norway policy rate to 117.45 for S&P corporate bond index in foreign currency and standard deviation varies from 0.54 to 18.59. Only bond indices are skewed to the left while other variables are skewed to the right. Credit default swaps, interbank rate and policy rate are the variables that exhibit excess kurtosis. Jarque-Bera test shows that I fail to accept the null hypothesis of normal distribution.

Table 2. 30 Summary statistics for Norway

	NO10Y	NO5Y	NO2Y	NOCD S10Y	NOCD S5Y	NOINTER	NORATE	NOTO EURO	SPNO	SPNO F
Mean	2.41	1.78	1.42	31.15	19.37	2.09	1.32	8.54	97.97	117.45
Median	2.18	1.57	1.41	28.96	17.52	1.72	1.50	8.43	98.01	123.80
Max.	4.38	3.69	3.35	64	62	5.27	4.75	10.10	101.46	147.35
Min.	0.88	0.52	0.39	16	7.77	1.64	0.50	7.27	95.14	87.98
Std. Dev.	0.89	0.80	0.70	8.13	9.18	0.54	0.64	0.75	1.32	18.59
Skew.	0.52	0.54	0.39	1.44	1.73	1.67	0.64	0.06	-0.03	-0.18
Kurt.	2.09	2.05	2.25	5.69	6.22	6.08	4.81	1.66	2.27	1.37
J-B Test	210.91	227.95	130.13	1712.95	2457.48	2273.30	540.15	196.35	57.63	304.64
Prob.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Source: Author’s calculations

In Table 2. 31 I define the unit root tests which shows that all the variables are stationary at the first difference.

Table 2. 31 Unit root tests

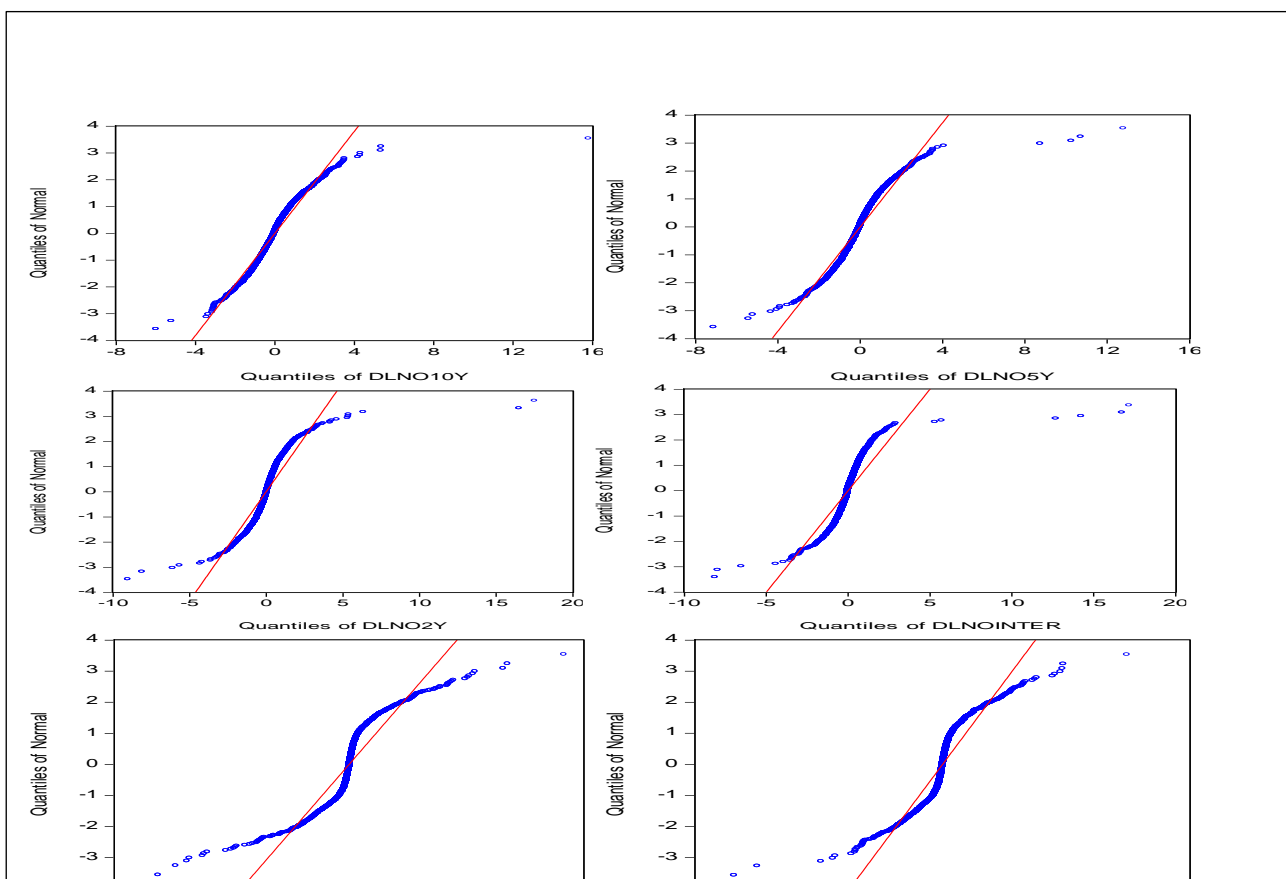
Levels	T_u	T_t	T	Difference	T_u	T_t	T	
LNO10Y	1.75	2.70	1.50	DLNO10Y	36.06***	36.06***	36.05***	ADF
	1.69	2.35	1.58		45.92***	45.91***	45.92***	PP
LNO5Y	2.07	2.64	1.94**	DLNO5Y	20.57***	20.59***	20.55***	ADF
	1.96	2.31	1.94*		45.14***	45.14***	45.15***	PP

LNO2Y	1.91	1.66	2.11**	DLNO2Y	20.73***	20.77***	20.71***	ADF
	1.90	1.78	2.08**		50.03***	50.05***	50.03***	PP
LNOCD510Y	2.13	2.22	0.71	DLNOCD510Y	19.98***	19.98***	19.98***	ADF
	2.23	2.32	0.73		51.08***	51.07***	51.08***	PP
LNOCD55Y	1.90	2.54	1.09	DLNOCD55Y	22.36***	22.35***	22.34***	ADF
	1.89	2.50	1.12		52.27***	52.26***	52.27***	PP
LNOINTER	2.81*	1.75	3.15***	DLNOINTER	17.43***	17.57***	17.30***	ADF
	2.58*	1.79	2.63***		70.60***	71.19***	70.30***	PP
LSPNO	2.18	1.76	0.37	DLSPNO	38.11***	38.14***	38.12***	ADF
	2.24	1.76	0.42		50.78***	50.81***	50.79***	PP
LSPNOF	0.79	1.81	1.24	DLSPNOF	25.83***	25.83***	25.80***	ADF
	0.78	1.88	1.19		55.87***	55.87***	55.82***	PP
LNOTOEURO	1.23	2.03	0.73	DLNOTOEURO	53.84***	53.84***	53.84***	ADF
	1.06	1.87	0.82		54.10***	54.11***	54.09***	PP

Note: *, **, *** denotes 10%, 5% and 1% level of significance
Source: Author's calculations

In Figure 2. 11, I show the plots for the residuals of the dependent variables for Norway against the quantiles of normal distribution. The plots clearly indicate that corporate bond indices and exchange rate vis-à-vis to euro follow more closely a straight line and approximate normal distribution, while other variables do not.

Figure 2. 11 QQ for Norway



Source: Author's calculations

In Table 2. 32 , I report the results for the benchmark model GARCH (1,1) for Norway. The findings show that a one percent increase on the European risk measure (VIX_t) decreases the government bond yields for the long and medium-term by 2 percentage point. The negative yield of sovereign bonds shows that Norway is less risky in comparison to other euro area countries, hence, there is no “flight to quality” from Norway. Further, there is no impact in the swaps giving evidence that Norway is less risky, and less risk is left to be reflected in the spread of the swaps. The results confirm those of (Andrade et al. 2016; Ghysels et al. 2013; Korus 2019). Korus (2019) states that the decline in the bond yields is due to expansionary surprises which have operated through the portfolio rebalancing channel and signalling channel. Thus, Norwegian government bonds are good substitutes of euro area sovereign bonds. The increase of the risk increases the index in foreign currency, which goes against the existing literature. The positive impact of the index could be related with an anticipated easing in the near future. The results are similar to those of (Korus 2019) when estimating the impact of ECB's forward guidance (FWG). The author finds a positive impact too highlighting that these announcements were associated with the decreasing of government bond yields. Additionally, the reduction of government yields is transmitted to increasing the S&P corporate bond indices in Norway. Moreover, as the risk increases it depreciates the Norwegian krone. The findings confirm those of (Korus 2019) for the spillovers effects of ECB FWG statements in Norway. Not surprisingly, this is an evidence that signalling channel works perfectly in Norway. Hence, long- and medium-term government bond yields have been influenced by the signalling channel

as FWG statements have been associated with reduction of government bond yields. Korus (2019) reveals that the positive impact in the corporate bond yields for Norway is due to positive surprises of ECB announcements and the decline of medium and long-term government bonds is reflected in the corporate bonds. Norway has the largest corporate bond market among the Nordics which represents approximately 50 percent of the total outstanding volume (NordicTrustee 2019). The increase of the risk leads to depreciation of Norwegian krone against euro. Korus (2019) divided the programmes of ECB, and estimated separately its impact in Denmark, Norway and Sweden. Except of FWG, the author checked for the impact of Outright Monetary Transactions (OMT) and showed that OMT had a weak spillover in the financial variables of Nordic countries. It is expected that OMT announcements would increase the sovereign yields, but instead my results and those of (Korus 2019) showing a decline in the yields. This suggests that portfolio rebalancing channel and signalling channel has outweighed the negative impact of the confidence channel on government bonds indicating that this channel is not prominent in explaining the transmission of OMT announcements in Norwegian government bonds. Further, the announcements have led to depreciation of Norwegian krone vis-à-vis euro. ECB policy rate has a limited impact in Norway, the only impact is that on the interbank rate. Ellen, Edvard, & Midthjell (2018) in a recent paper investigate the impact of ECB announcements in the effectiveness of domestic policy in small open economies such as Denmark, Norway and Sweden and they state Norway is affected by ECB's monetary policy, but not as much as a country that has given up its monetary autonomy. The authors cannot compare the size of the impact of communication between ECB's spillovers and Norges Bank's domestic effect due to different scaling of the variables, but Norges Bank's communication has a high impact on domestic interest rates. Messelt (2018) states that Norwegian central bank has little control over the interbank and policy rate which could be to different horizons as the policy rate is overnight while the interbank rate for 3 months. Further, there is the change of the risk in the banking system which reflects a risk spread and changing interest rate outlook. The improvement of economic outlook makes the bonds less attractive meaning that as the economic environment gets better investors switch from Norwegian bonds to euro area bonds. Not surprisingly, the swaps reduce indicating debt liability of the country is increased. It increases the interbank rate, reduces the index in domestic currency but it increases the one in foreign currency and appreciates the exchange rate. Korus (2019) finds similar results for Norway when considering the impact of Corporate Sector Purchase Programme (CSPP). However, in comparison to his findings I find a significant impact in the long-term government bond too. CSPP announcements impacted the sovereign bond yields, and the impact of exchange rate channel and confidence channel outweighed the portfolio rebalancing channel and the signalling channel. Moreover, the increase of government bond yields transmitted the decline to the corporate bond index. CSPP announcements were related to better confidence and economic sentiment and led to depreciation of exchange rate and increase of interbank rate. In contrast, I find an appreciation of the exchange rate vis-à-vis euro. The increase of the interbank rate could indicate tightening of the monetary policy, as an attempt to reduce inflation when the rates reached the zero bounds in early

2011. However, it could be related to signalling channel too as investors anticipate an easing in the near future. In principle, the corporate bonds could be affected by ECB's unconventional monetary policies. (Korus 2019) states that there are two cases which could operate through portfolio rebalancing channel: When ECB purchases euro area government bonds or corporate bonds. When ECB purchases euro area government bonds it will have a limited impact in the corporate bonds of Norway. If ECB purchases corporate bonds of euro area countries it will have a strong influence in corporate bond indices, only few corporate bonds of Norway or other countries will be close substitutes. Thus, this will imply decrease of their yields. Signalling channel could be important in the case of corporate bonds in foreign currency which could depend on the commitment of ECB to reduce the rates for a longer framework. If euro area corporate bonds will react due to ECB's commitment it will lead to spillovers in the bonds in Norway while the increase of the confidence in euro area could lead to increase of corporate bonds. The appreciation of the domestic currency might be related to exchange rate channel which could imply an increase of corporate bond index in foreign currency vis-a-vis euro. The increase of the risk makes the short-time government bond less attractive, reduces the interbank rate and the bond index in foreign currency. Further, the increase of the risk reduces the credit default swap for 10 years. There is outflow from Norway for short-term governments bonds while the probability of default for long-term reduces. Norway was one of the countries which felt less the impact of the crisis, but the stagnation experienced was only for one year and the economic growth picked. Norway experienced a banking crisis in 1991-93 which made the banking crisis and the financial authorities to minimise the suffering during the financial crisis. Quick response of the central bank, strong public finances which were helped by the income by oil and gas were few of the reasons of the Norwegian robustness (Aamo 2018). ECB announcements have limited effect in Norway. There is a huge difference between positive and negative announcements. When the policy rate of ECB increases, it increases the yield of Norway's bonds by making them less attractive hence, investors will switch to bonds of other European countries. Ellen, Edvard, & Midthjell (2018) states that ECB's spillovers of monetary policy communications is uncertain while the monetary policy followed by the central bank is stable and persistent. Thus, small economies lose control of their domestic yield curve due to the global financial integration and spillovers from the major central bank, but this does not happen in the case of Norway. However, announcements help to improve the debt liability of the country. The opposite happens when the policy rate reduces (positive announcement). Domestic announcements seem effective in reducing the yields of government bonds by making the bonds more attractive. It reduces the interbank rate as a tentative to help the liquidity of banking sector as a result of higher demand in the local money market. The results confirm those of (Ellen, Edvard, & Midthjell 2018)

To conclude, the Italian German highly decreases the long-term government bond yield and increases the bond index in domestic currency.

The coefficients in the variance equation come with the expected sign and magnitude. However, the variance of the government bond yield for 2 years tends to be explosive or $\alpha_1 + \beta \geq 1$.

Table 2. 32 GARCH model for Norway

	DLNO10Y	DLNO5Y	DLNO2Y	DLNOCDS10Y	DLNOCDS5Y	DLNOINTER	DLSPNO	DLSPNOF	DLNOTOEURO
Mean Equation									
DLVIX	-0.02***	-0.02*	-0.006	-0.01	-0.008	0.008	0.0003	0.03***	0.005***
DECB	0.005	0.0009	0.005	0.05	0.08	0.03**	-0.0003	-0.005	0.004
DLEUDS	0.24***	0.39** *	0.51** *	-0.46***	-0.48***	0.13***	-0.02** *	0.48***	-0.09***
DLTED	0.0004	-0.0006	0.02** *	-0.01*	0.006	-5.49E-05**	0.0001	-0.002*	0.0008
ECBDUM	0.001	0.01**	0.008* *	-0.001	-0.003*	0.003*	-0.0001 **	-0.0003	0.0002
DLNORATE	-0.009	-0.003	0.05	-0.01**	-0.08**	0.11***	-0.0001	0.001	-0.006
NODUM	-0.002**	-0.005*	-0.004* **	-0.0005	0.002	-0.003*	0.0003 **	0.0007	-5.50E-05
UITGE	-1.44E-05***	-1.11E-05	-1.20E-05	2.71E-05	2.85E-06	7.37E-06	1.05E-06**	4.01E-06	-1.44E-06
Variance Equation									
Resid(-1)^2	0.06***	0.06** *	0.69	0.04***	0.02***	0.00***	0.04** *	0.03***	0.03***
GARCH(-1)	0.91***	0.93**	0.42**	0.95***	0.97***	0.99****	0.93** *	0.96***	0.94***

Note: *, **, *** denotes 10%, 5% and 1% level of significance

Source: Author's calculations

Table 2. 33 clearly indicate that credit default swaps, interbank rate and corporate bond index have presence of ARCH effects and autocorrelation hence I proceed with the investigation for leverage effects.

Table 2. 33 Diagnostic tests for GARCH model

Variable	Test for ARCH effects		Autocorrelation of residuals in levels		Autocorrelation of squared residuals	
	Obs*R-squared	Prob.ChiSquare	Q-Stat	Prob.	Q-Stat	Prob.
DLNO10Y	0.00	0.97	3.01	0.98	0.54	1
DLNO5Y	5.82E-05	0.99	9.18	0.51	2.43	0.99

DLNO2Y	0.08	0.77	11.63	0.31	0.81	1
DLNOCD510Y	4.21	0.04	9.70	0.46	31.10	0.00
DLNOCD55Y	31.17	0.00	11.49	0.32	47.25	0.00
DLNOINTER	167.31	0.00	79.19	0.00	170.35	0.00
DLSPNO	21.32	0.00	7.07	0.71	26.21	0.00
DLSPNOF	0.01	0.89	11.34	0.33	11.02	0.35
DLNOTOEURO	3.11	0.07	5.60	0.84	9.99	0.44

Source: Author's calculations

Therefore, in Table 2. 34, I test for the presence of asymmetric effects which defines that only interbank rate has presence of leverage effects. Even though I find leverage effect only for interbank rate, for the variables that show heteroskedasticity and autocorrelation in the residuals I try higher versions of GARCH. I tried GARCH (2,2), and then I tried the threshold GARCH for which I am able to correct the presence of heteroskedasticity and autocorrelations in the residuals and squared residuals which probably comes from the ability of the threshold model to capture the asymmetry of the effects.

Table 2. 34 Test for leverage effects

Variable	Coefficient	Prob.	Wald Test Restrictions	Coefficient
DLNO10Y			F-Stat	Prob.
RESID01(-1)	-0.02	0.94	0.91	
RESID02(-2)	-0.01	0.67		
DLNO5Y				
RESID01(-1)	-0.02	0.94	0.91	
RESID02(-2)	-0.01	0.67		
DLNO2Y				
RESID01(-1)	0.04	0.27	0.14	
RESID02(-2)	0.06	0.10		
DLNOCD510Y				
RESID1(-1)	-0.03	0.38	0.46	
RESID2(-2)	-0.03	0.37		
DLNOCD55Y				
RESID1(-1)	-0.01	0.61	0.25	
RESID2(-2)	-0.06	0.11		
DLNOINTER				
RESID01(-1)	-0.19	0.00	0.00	
RESID02(-2)	-0.27	0.00		
DLSPNO				
RESID01(-1)	-0.01	0.66	0.80	
RESID02(-2)	-0.01	0.62		

DLSPNOF			
RESID01(-1)	0.05	0.19	0.39
RESID02(-2)	-0.01	0.65	
DLNOTOEURO			
RESID01(-1)	-0.001	0.96	0.95
RESID02(-2)	0.01	0.77	

Source: Author's calculations

In Table 2. 35, I estimate a threshold GARCH model which results confirm that there is evidence of asymmetric effects. The leverage term indicates that there is a positive impact coming from one period ago. The findings show that as the risk increases by 1 percent, it reduces the spread of the swaps by 1 and 2 percent, but it increases the interbank rate by 0.4 percentage point. The results are different from those of the GARCH (1,1) which states that the increase of the risk enhances the interbank rate. This could be related to the quick response of Norges Bank which with the authority given by the Ministry of Finance transfers the revenues from the Norwegian Fund and its returns on the governmental budget. The framework of the debt consists in finance net lending by state banks and other government lending programmes, cover redemption of existing debt and ensure efficient government cash reserves. Hence, every risk influencing Norway is quickly “swiped” from the fund which is the backbone of the economy (Norges Bank 2020). The impact in interbank rate and the impact of ECB policy rate is consistent with Ellen, Edvard, & Midthjell (2018). There is evidence that the ECB policy rate and its announcements have limited impact in Norway. Economic outlook increased the debt liability, reduces the interbank rate different from the GARCH model and had the same impact on the corporate bond index as the previous model. When the economic sentiment is higher, it makes the corporate bond index more attractive. There is not impact of the global risk in the variables estimated in the T-GARCH model. Lack of impact could be not only because of the reasons stated above from (Aamo 2018) but from financial openness, exchange rate regime, degree of financial and trade integration with the euro area and a countries attractiveness for carry trades (Georgiadis & Gräb 2015). Policy rate affects only the corporate bond index in domestic currency, meaning that as the policy rate increases it makes the investors to “fly to quality” as the government bonds will become less attractive. Higher the policy rate, the higher will be the bond yield. Domestic announcements influence the corporate bond index but the impact is modest. Surprise component increases the spreads of the swaps and the bond index.

The coefficients in the variance equation are correct and have the proper sign and magnitude.

Table 2. 35 T-GARCH model

	DLNOCDS10Y	DLNOCDS5Y	DLNOINTER	DLSPNO
DLVIX	-0.01***	-0.02***	0.004***	0.0002

DECB	0.001	0.05**	-0.007	-0.0005
DLEUDS	-0.36***	-0.59***	-0.01***	-0.02***
DLTED	-0.002	0.003	-0.0009	0.0002
ECBDUM	-0.0009	-0.001	8.41E-05	-0.0001***
DLNORATE	-0.01	-0.03	0.01	0.0009**
NODUM	2.47E-05	0.0001	-0.0002	8.05E-05*
UITGE	1.74E-05***	2.29E-05***	-1.83E-07	9.99E-07***
Variance Equation				
Resid(-1)^2	0.11***	0.17***	0.34***	0.15***
TGARCH(-1)	0.02***	0.06*	0.40***	0.07***
GARCH	0.88***	0.70***	0.63***	0.64***

Note: *, **, *** denotes 10%, 5% and 1% level of significance

Source: Author's calculations

After estimation, Table 2. 36 ARCH test and Ljung-Box test indicate that after the estimation of threshold GARCH model there is no arch effects and autocorrelation left in the residuals.

Table 2. 36 Diagnostic tests for T-GARCH model

Variable	Test for ARCH effects		Autocorrelation of residuals in levels		Autocorrelation of squared residuals	
	Obs*R-squared	Prob.ChiSquare	Q-Stat	Prob.	Q-Stat	Prob.
DLNOCD10Y	0.79	0.37	8.09	0.61	7.40	0.68
DLNOCD5Y	0.06	0.80	8.03	0.62	1.51	0.99
DLNOINTER	0.02	0.87	28.99	0.00	0.29	1
DLSPNO	0.29	0.58	7.45	0.68	7.50	0.67

Source: Author's calculations

Overall, I find that when the volatility index is high Norwegian long and medium-term government bonds are attractive and these bonds are good substitutes of euro area bonds. When the economic outlook is high Norwegian bonds are less attractive and there is "flight to quality" from Norway to euro area countries. Further, I find limited impact of ECB policy rate and its announcements and the global risk in Norway.

After Norway I proceed with the last country for Nordic region, Sweden, which results for the summary statistics of its variables are shown in Table 2. 37. Sweden's mean variability varies from 0.74 for the Swedish policy rate to 101.73 for the S&P Sweden corporate bond index in foreign currency. Standard deviation is between 0.62 for Sweden krona vis-à-vis to euro and 24.48 for credit default swaps for 5 years. Only S&P Sweden corporate bond indices are skewed to the left while other variables are skewed to the right. All variables show excess kurtosis except of the long and short-term government bond yield and bond index in foreign currency.

Table 2. 37 Summary statistics for Sweden

	SW10Y	SW5Y	SW2Y	SWCD S10Y	SWCD S5Y	SWINT ER	SWRA TE	SPSW	SPSWF	SWTO EURO
Mean	1.88	1.32	0.76	42.59	28.98	1.03	0.74	91.41	101.73	9.45
Median	1.75	1.22	0.83	39.08	19.49	0.75	0.5	91.49	104.43	9.36
Max.	4.56	4.73	4.83	162.5	159	5.6	4.75	93.76	126.54	11.67
Min.	0.04	-0.39	-0.89	10.5	6.5	-0.64	-0.5	87.38	79.65	8.18
Std. Dev.	1.17	1.28	1.31	22.2	24.48	1.54	1.33	1.13	12.77	0.62
Skew.	0.38	0.54	1.02	1.95	2.21	1.17	1.37	-0.58	-0.073	0.64
Kurt.	1.94	2.34	3.83	8.39	8.95	3.86	4.46	3.57	1.55	3.11
J-B	201.87	195.82	588.96	5303.3 5	6584.4 3	752.86	1159.1 4	203.56	251.20	202.60
Prob.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Source: Author's calculations

As in the previous sections, Table 2. 38 I calculate the unit root test at levels and first difference, which shows that all variables are stationary at first difference.

Table 2. 38 Unit root tests

Levels	T_u	T_t	T	Difference	T_u	T_t	T	Test
LSW10Y	1.51	3.15*	1.75*	DLSW10Y	17.76***	17.76***	17.74***	ADF
	1.76	3.77**	1.93**		49.97***	49.96***	49.96***	PP
SW5Y	1.77	2.55	2.51**	DSW5Y	20.76***	20.78***	49.56***	ADF
	1.91	2.50	2.53**		49.53***	49.53***	49.50***	PP
SW2Y	2.38	2.28	2.92***	DSW2Y	51.21***	51.24***	51.16***	ADF
	2.46	2.31	3.02***		51.18***	51.20***	51.14***	PP
LSWCDS10Y	2.42	3.16*	0.01	DLSWCDS10Y	34.05***	34.10***	34.05***	ADF
	2.44	3.15*	0.02		47.16***	47.15***	48.17***	PP
LSWCDS5Y	1.85	3.33***	0.17	DLSWCDS5Y	34.28***	34.33***	34.28***	ADF
	1.89	3.31*	0.19		48.66***	48.66***	48.67***	PP
SWINTER	2.30	1.66	2.90***	DSWINTER	16.82***	16.90***	16.72***	ADF
	2.29	1.69	2.88***		54.15***	54.02***	54.54***	PP
LSPSW	1.98	1.73	0.02	DLSPSW	23.35***	23.37***	23.36***	ADF
	1.95	1.60	0.07		49.16***	49.16***	49.17***	PP
LSPSWF	1.41	2.06	0.89	DLSPSWF	18.36***	18.36***	18.34***	ADF
	1.31	2.01	0.87		55.68***	55.68***	55.67***	PP
LSWTOEURO	1.51	1.51	0.31	DLSWTOEURO	26.27***	26.27***	26.27***	ADF
	1.58	1.59	0.26		53.64***	53.66***	53.65***	PP

Note: *, **, *** denotes 10% , 5% and 1% level of significance

Source: Author's calculations

In Table 2. 39, I report the results for the benchmark model GARCH (1,1) for Sweden. The findings show that as the volatility index increases, it reduces the government bond

yield for 10 years. There is a negative impact of the index in the credit default swap for 5 years too. A one percent increase in the European risk measure (VIX_t) decreases the government bond yields by 4 percent. It reduces the spread of the swap for 5 years by 1 percent and it increases the interbank rate. The decrease of the government bond yield means that Swedish bonds are safe-heavens for the European investors and there is flight to quality from other euro -area countries to Sweden. Korus found similar results for government bond yields in Norway too, stating that ECB announcements of non-standard measures led to reduction of yields mainly via the portfolio rebalancing channel and the signalling channel. Lower yields of government bonds from Sweden may imply an improved debt liability of the respective country which could imply higher debt sustainability and the probability of default of government bonds from these countries of interest may fall. This process could result in declining CDS spreads in non-euro area countries (Korus 2019). Leeper (2018) states that there are lots of reasons why the bond yields turn negative such as economic weakness in the wake of the global financial crisis, aging population etc. On the other hand, (IMF 2016) indicates that negative bond yields could be a “prima facie “evidence that the fiscal policy is improved. Thus, the private sector is showing to the government that is able to pay for the right to lend to the government. It shows that the government is not taking the generous offer of the private sector and the demand for these safe assets is really high. The strong demand will increase the bond prices, by declining the yields. If the government would respond to the demand by increasing the supply of the assets, the yields would rise. Indeed, negative yields are a reflection of a “shortage” of a high demand of assets (IMF 2016).

However, the author found a negative impact on the long-term government bond and interbank rate and a positive impact on the CDS spread when estimating the impact of ECB FWG statements in Sweden. He goes deeper and states that the decrease in the yield came from the FW statements as they were related to decline of government bonds while the increment in the interbank is an evidence of the international bank lending channel. Overall, (IMF 2013b) state that Denmark, Norway and Sweden are considered as “safe heavens”. As the risk increases, it enhances more the interbank rate. In 2007, when the tension began it affected the interbank market rate and participants switched to safe assets, agents became reluctant to lend and borrowed at shorter maturities. However, after Lehman Brother bankrupt, the crisis in Sweden became a fact, the confidence decreases and interbank rates skyrocketed as banks hoarded liquidity while the global liquidity drought became a fact (Riksbank 2010). Sweden is a small open economy and had a concentrated banking sector with operations across borders which made the financial system of Sweden vulnerable to the crisis. Four major banks dominated the market which was approximately 80 percent. The banks had operations abroad and except that, the cross-country linkages especially with the Nordic-Baltic region were really high (Riksbank 2010). Further, there is positive impact in the corporate bond index in foreign currency. Additionally, declining of sovereign bond yields increased the corporate bond index. Sweden’s corporate bond market is the fastest growing, and now represents 40 percent of the total Nordic corporate market (NordicTrustee 2019). Volatility index leads depreciation of

exchange rate. My findings confirm those (Korus 2019) who states that OMT announcements lead to depreciation of exchange rate against euro. This gives evidence to a portfolio and signalling channel which outweighed the negative influence of the confidence channel on government bond. ECB policy rate impact is limited; I find influence only on credit default swap for 10 years indicating that it improves the debt liability for long-term bonds. Sweden is one of those countries which debt management caught attention of the policymakers all over the world (Jonung 2009). Economic outlook increases the government bond yield making Swedish government bonds less attractive; it improved the debt liability for swaps for 5 years and it enhances the interbank rate which could be due to the reasoning mention above. Economic outlook decreases the bond index in domestic currency but it increases the one in foreign currency. Further, it appreciates the exchange rate against euro. The improvement of economic outlook makes the investors turn against the euro bonds and “flight to quality” from Sweden. Based on (Korus 2019) the impact on exchange rate could be ambiguous and it can be affected by the ECB’s unconventional monetary policies via exchange rate channel and signalling channel. The exchange rate channel is important in Norway and Sweden due to flexible exchange rate regime and the global financial integration. Hence, the ECB announcements are related to an appreciation of domestic currency. The increase of global risk has limited impact in Sweden, it increases the medium-term government bond yield, the credit default swap for 10 years, the interbank rate and reduces the bond index in domestic currency. The increment of the global risk makes the bonds less attractive; it decorates the debt liability, and it makes borrowing more expensive. As matter of fact, the interbank rate in Sweden increases in both cases, when the risk is increased and when the economic outlook is improved. However, when the risk increases it makes domestic corporate bonds more attractive. ECB announcements lead to deprecation of the currency and a reduction of the interbank rate. This is evidence that ECB non-standard measures help to remove the elevated pressure in the economy. Overall, (Korus 2019) states that FWG announcements has led to a reduction of the interbank rate via the international bank lending channel. In contrast to his findings, I find that ECB announcements lead to depreciation of local currencies vis-à-vis the euro in Sweden. Policy rate helps to make bonds in foreign currency more attractive. Not surprisingly, as the way how the monetary and fiscal policy operate in Sweden is fascinating. Central Bank of Sweden follows the target of inflation at 2 percent while the government currently pursues a medium-term net-lending target of 1 percent of GDP. Recent Swedish policies has been considered at conflict. On one hand, the aggressive monetary policy as an effort to increase inflation, negative policy rates associated with significant asset purchases which were coupled with an increase of the central bank’s balance sheet. Hence, fiscal policy has been deflationary while monetary policy has been inflationary (Leeper 2018). Riksbank was probably of the only central banks which had to abandon its policy rate temporary in order to “lean against the wind” to focus on inflation target. The expansionary policies that Sweden had to follow employed other tools such as balance sheet and major communicative challenges (Ingves 2019). Domestic policies and the surprise component seem to have had limited influence; the domestic

announcements reduce the interbank rate (easing) while the surprise component makes the bond index less attractive. When it comes to domestic communication (Ingves 2019) states that when a policy takes long in force, its benefits are no longer obvious while in the other hand, if the developments are favorable it's easier to focus on the drawbacks.

As for the variance equation, respective coefficients come with the expected sign and magnitude.

Table 2. 39 GARCH model

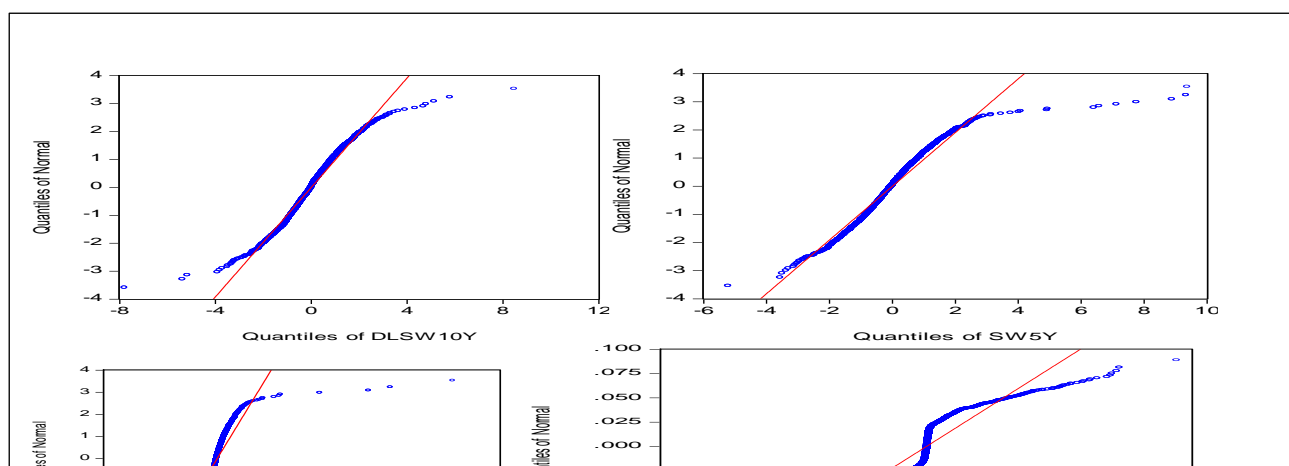
	DLSW10Y	DSW5Y	DSW2Y	DLSWCDS10Y	DLSWCD55Y	DSWINTER	DLSPSW	DLSPSWF	DLSWTOEURO
Mean Equation									
DLVIX	-0.04***	-0.005	0.01	0.006	-0.01**	0.01**	-5.17E-05	0.007***	0.003**
DECB	-0.005	0.02	0.02	0.02**	0.004	0.01	-0.0005	-0.0001	-0.0009
DLEUDS	0.37***	0.84***	0.65***	-0.06	-0.65***	0.04**	-0.01***	0.11****	-0.09***
DLTED	0.004	0.02**	-0.01	0.01***	0.003	0.01**	-0.0002**	-0.0004	-0.0007
ECBDM	0.001	0.002	-0.001	0.001	-0.001	-0.002**	3E-05	-8E-05	0.0004*
DLSWRATE	0.001	-0.003	-0.003	0.004	-0.01	0.01	0.0005	-0.001***	0.004
SWDUM	0.002	0.0005	-0.003	-0.0005	0.001	-0.004**	4.91E-05	-7.10E-05	2.36E-05
UITGE	-1.52E-05	-4.22E-05	-2.35E-05	-2.69E-06	2E-05	7.35E-07	6.60E-07**	4.53E-07	1.03E-06
Var.									
Resid(-1)^2	0.06***	0.00***	0.00***	0.01***	0.05***	0.04****	0.02***	0.03***	0.05***
GARCH(-1)	0.93***	0.99***	0.99***	0.98***	0.94****	0.95***	0.97***	0.95***	0.91***

Note: *, **, *** denotes 10% , 5% and 1% level of significance

Source: Author's calculations

In Figure 2. 12 I show quantile plots of residuals for dependent variables available for Sweden against quantiles of normal distribution. It shows that government bond yield for 10 years and 5 years, corporate bond index in foreign currency and exchange rate vis-à-vis to euro approximate normal distribution while other variables do not.

Figure 2. 12 QQ for Sweden



By performing diagnostic tests after estimating the benchmark model GARCH (1,1), the results in Table 2. 40 indicate that is only credit default swaps that show presence of ARCH effects and autocorrelation in the residuals.

Table 2. 40 Diagnostic tests for GARCH model

Variable	Test for ARCH effects		Autocorrelation of residuals in levels		Autocorrelation of squared residuals	
	Obs*R-squared	Prob.ChiSquare	Q-Stat	Prob.	Q-Stat	Prob.
DLSW10Y	0.001	0.96	11.12	0.34	7.23	0.70
DSW5Y	1.25	0.26	16.85	0.07	4.97	0.89
DSW2Y	0.001	0.96	5.97	0.81	0.07	1
DLSWCDS10Y	42.22	0.00	8.40	0.59	47.60	0.00
DLSWDS5Y	15.07	0.00	9.34	0.49	31.25	0.00
DSWINTER	0.006	0.93	261.85	0.00	3.22	0.97
DLSPSW	1.96	0.16	13.10	0.21	14.52	0.15
DLSPSWF	0.62	0.42	20.59	0.02	4.30	0.93
DLSWTOEURO	1.19	0.27	11.22	0.34	9.36	0.49

Note: *, **, *** denotes 10% , 5% and 1% level of significance

Source: Author's calculations

In Table 2. 41 I calculate the leverage effects which indicates the results for leverage effects and findings show that only interbank rate shows presence asymmetric effects.

Table 2. 41 Test for leverage effects

Variable	Coefficient	Prob.	Wald Test Coefficient Restrictions
DLSW10Y			F-Stat Prob.
RESID01(-1)	0.01	0.78	0.65
RESID02(-2)	0.03	0.38	
DSW5Y			
RESID01(-1)	-0.02	0.49	0.79
RESID02(-2)	-0.001	0.97	
DSW2Y			
RESID01(-1)	-0.02	0.54	0.58
RESID02(-2)	0.03	0.40	
DLSWCDS10Y			
RESID1(-1)	0.01	0.67	0.36
RESID2(-2)	0.05	0.17	
DLSWCDS5Y			
RESID1(-1)	-0.02	0.49	0.14
RESID2(-2)	0.07	0.06	
DSWINTER			
RESID01(-1)	0.25	0.00	0.00
RESID02(-2)	0.22	0.00	
DLSPSW			
RESID01(-1)	-0.02	0.47	0.77
RESID02(-2)	0.00	0.98	
DLSPSWF			
RESID01(-1)	0.02	0.56	0.57
RESID02(-2)	-0.03	0.37	
DLSWTOEURO			
RESID01(-1)	-0.01	0.71	0.11
RESID02(-2)	-0.07	0.04	

Source: Author's calculations

I proceed with a T-GARCH model which results are shown in Table 2. 42. All three results indicate that the models are satisfactory and there is good news coming from one period ago. In comparison to the model GARCH shown in Table 2. 39 the impact in the interbank rate is negative meaning that as the risk increases the interbank market rate is reduced in order to help the heightened pressure. Similar to (Korus 2019) the impact is negative for CDS spreads. As the author states the impact in the interbank rate might come due to FWG announcements. Again, even in the T-GARCH model I do not find evidence of ECB policy rate in the financial assets of Sweden. The improvement of the economic outlook helps to reduce the probability default and the interbank rate as the benchmark model. I find a negative effect in the interbank rate from the global risk too. Further, I do not find evidence of ECB announcements, domestic policy rate and domestic announcements as (Ingves 2019). Surprise

component affects negatively the swap for 10 years but there is a positive impact in the credit default for 5 years.

Table 2. 42 T-GARCH model

	DLSWCDS10Y	DLSWCDS5Y	DSWINTER
Mean Equation			
DLVIX	-0.01***	-0.01***	-0.007**
DECB	0.001	-0.006	-0.002
DLEUDS	-0.08**	-0.56***	-0.11***
DLTED	0.002	0.003	-0.01***
ECBDUM	0.0005	-0.0009	0.0009
DLSWRATE	0.01	-0.01	-0.01
SWDUM	-0.001	0.0005	-0.0002
UITGE	-3.24E-05***	1.28E-05**	1.95E-06
Variance Equation			
Resid(-1)^2	0.17***	0.09***	0.22***
TGARCH(-1)	0.07***	0.05***	0.12***
GARCH	0.75***	0.86***	0.78***

Note: *, **, *** denotes 10% , 5% and 1% level of significance

Source: Author's calculations

ARCH test for heteroskedasticity and Ljung-Box test for autocorrelation in Table 2. 43 show that there is no presence of heteroskedasticity, neither autocorrelation in the residuals.

Table 2. 43 Diagnostic tests for T-GARCH model

Variable	Test for ARCH effects		Autocorrelation of residuals in levels		Autocorrelation of squared residuals	
	Obs*R-squared	Prob.ChiSquare	Q-Stat	Prob.	Q-Stat	Prob.
DLSWCDS10Y	0.19	0.65	5.10	0.88	2.57	0.99
DLSWCDS5Y	1.19	0.27	12.05	0.28	10.61	0.38
DLSWINTER	0.03	0.85	151.31	0.00	0.54	1

Source: Author's calculations

Overall, I find that long-term government bonds in Sweden are adequate substitutes of euro area bonds while the opposite happens for corporate bonds. The increase of economic sentiment makes Swedish government bonds less attractive and there is “flight to quality” to euro area bonds. However, domestic corporate bonds become more attractive while corporate bonds yields in foreign currency are not favorable. To conclude, I find limited impact of ECB policy rate and its announcements and the effect of domestic policy rate and domestic announcements is restricted too.

2.5 Robustness check

In this study, I include three surprise components which are calculated as the spread of Italian, Spanish and Greek bond yield to German government bond yield to check the impact of policies through dummy variables. I use a simple OLS and after that an AR (1)-ARCH (9) model to estimate the impact in the lenses of autoregressive models. For parsimonious and overfitting reasons, I switch to a benchmark model GARCH (1,1)

and then I test for the presence of asymmetric effects. If there is presence of leverage effects, I estimate a threshold GARCH model to confirm the asymmetric effects. After each approach, I test for the heteroskedasticity and autocorrelation in residuals and squared residuals. Different authors use various measures as surprise components (Ehrmann & Fratzscher, 2004, Cahill et al. 2013) use survey data from professional forecasters while Wright (2012) and Falagiarda & Reitz (2015) use future contracts. Instead, I follow the work of Rogers, Scotti & Wright 2014; Haitisma, Unalmis, & De Haan 2016; Chebbi 2019) and I include in my study three surprise components: the first surprise component I have calculated as the difference between the Italian and German long-term government bond yields, the second surprise component is the Spanish-German spread whilst the third is Greek-German spread.

As Denmark has a pegged regime of its exchange rate vis-à-vis euro, it has given up its monetary autonomy hence, I find significant results for ECB policy rate and its announcements. Further, there is high impact of domestic rate and domestic announcements which reflect those of ECB. Looking first at the impact of unconventional monetary surprises measured by the changes in the yield between a vulnerable country and a core country, I show that the coefficients have the expected negative sign in the vast majority of the specifications. The rationale behind shows that the ECB announcements have been effective in reducing the spreads of the countries under stress (such as Italy, Spain and Greece) and have created a better financial environment. Estimating a GARCH model with the first surprise component, Italian-German spread has a negative impact except of bond indices. The second surprise has a negative impact in all variables except of swaps and bond indices while the third component, has a positive impact only in the interbank rate and bond indices.

As Finland is part of the Euro-system, it follows closely the decisions taken by ECB. Further, I find that domestic policy rate and domestic announcements mirror the decisions of the ECB. Valimaki & Obstbaum (2020) state the assumptions that determined the response of the central bank in Finland and the reasons why these assumptions on its response fell one by one. Central bank aim was to control the interest rate using an operational target; there was a stable relationship between the central bank rate and the market rates that have more direct impact on the real economy and third, the central bank can adjust the rates as much as needed to reach the monetary policy target. However, in the wake of the crisis the demand for liquidity grew and banks started to hoard money, leading to weakening of the central bank's control over the short-term rate. The transmission from the short-term risk-free rate to the rates which were relevant for the economy became less efficient. Further, the cost of the financing of small and medium-sized enterprises enhanced in peripheral countries compared to the core one, therefore, even though the accommodation of monetary policy of ECB was increasing, in the countries that were hit by the crisis the monetary conditions tightened. There is a negative impact in the medium and short-term government bond yield and credit default swap for 5 years when the Italian-German spread is used. When using Spanish and Greek-German spread the impact in the majority of the variables is

negative; in the case of Spanish German spread the impact is positive in the credit default swap for 10 years and bond indices while for Greek-German spread the impact is positive for the credit default swap for 5 years and bond indices.

Surprisingly, Iceland that was hardly hit by the crisis has a high influence of ECB policy rate and ECB announcements even though there is no proximity and Iceland is not part of European Union but belongs to European Area. Moreover, there is high influence of domestic announcements in reducing the elevated pressures. Focusing on the surprise components, there is a negative impact on the interbank rate when the Italian-German spread is used. Spanish-German influences negatively only the short-term government bond yield while Greek-German yield affects negatively the bond yields and credit default swap for 5 years. The impact is positively in the remaining variables.

ECB policy rate is significant in increasing the interbank rate for Norway and ECB announcements are significant in increasing the yields of the medium and short-term government bonds. Further, announcements tend to reduce the bond index in local currency. Domestic announcements seem effective in influencing domestic bond index and the bond yields. When the Italian-German spread is used, it reduces the yields of the bonds and the interbank rate. When the Spanish-German spread is used there is a negative impact on the bond yields, interbank rate and exchange rate. Greek-German spread has a negative impact on the long and medium-term government bond yield, interbank rate and exchange rate.

In Sweden, ECB policy rate impacts significantly only the spread of the credit default for 10 years, but ECB announcements seem significant in reducing the interbank market rate. Further, domestic announcements seem effective in reducing the interbank market rate too. The GARCH model estimated with the Italian-German spread affects the bond yields and the credit default swap for 10 years negatively. The second surprise component influences negatively bond yields and exchange rate while the third surprise component has similar results as the second surprise component including even the credit default swaps for 10 years and 5 years.

2.6 Concluding remarks

This chapter focus on estimating the impact of ECB unconventional monetary policies and domestic macroprudential policies in a set of financial variables of Nordic countries using Generalized Autoregressive Heteroskedastic Model (GARCH) and Threshold GARCH Model (TGARCH) using daily data from 2008 to 2018. The findings are similar to (Korus 2019) whose study is more restricted, and I confirm that in the case of the elevated risk Nordic countries tend to be “safe heavens” (IMF 2016). As the volatility risk in the euro area increases, Nordic countries government bonds become safer and there is flight to quality from euro area to Nordic countries. The

opposite happens in the case of short-term government bonds, which are related to capital outflow from Nordic countries to euro area bonds. When the economic outlook improves and the global risk increases, Nordic countries seem to be less attractive. The results support those of (Drejer et al. 2011). Nordic countries belong to the same region and as Andersen (2007) states that Nordic countries belong to the same model and they create a cluster of their own. However, they exhibit high heterogeneity between them. Denmark and Finland indicate significant ECB spillovers as Denmark has given up its monetary autonomy while Finland belongs to the Euro System. Domestic policy rates and domestic announcements mirror those of ECB. Iceland is not a member of EU but is part of Economic Area I find highly significant impact of ECB policy rate and its announcements in Iceland. Norway seem to have a low influence from the financial crisis as it was highly influenced from the crisis of early 90s. Further, Sweden has grabbed the attention of researchers worldwide on the fascinating way how Ministry of Finance and Central Bank have swiped out the crisis. Iceland is not a member of EU but is part of Economic Area I find highly significant impact of ECB policy rate and its announcements in Iceland and limited effect for the other countries. Results for surprise components are similar to those of Rogers, Scotti & Wright 2014; Haitsma, Unalmis, & De Haan 2016; Chebbi 2019) that show that ECB actions were effective in reducing bond yields. Specifically, I show that the vast majority of the coefficients have the expected negative sign in all specifications. Even though the magnitude of the impact is low, the rationale behind is that announcements have caused a reduction in the yield spread between a vulnerable and a core country. Announcements that make investors feel that are better conditions in the financial markets increase the confidence globally which could cause a reversal of the flight to quality in safe assets such as government bonds which can be in higher demand and increase their prices. Hence, I find highly evidence of ECB spillovers of unconventional monetary policies in Nordic. Overall, all the financial assets are affected by non-standard measures. However, in these studies I fail to test for the transmission channels of ECB announcements of unconventional monetary policies in Nordic countries. Moreover, in this study I do not count on the spillovers of non-standard measures in mortgage market and impact distribution of households which are left to be covered in future work.

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CHAPTER 3

ECB'S SPILLOVERS OF UNCONVENTIONAL MONETARY POLICIES IN STOCK MARKETS

3.1 Introduction

The recent financial crisis of 2007-2008 has increased the attention paid among researchers and central bankers on unconventional monetary policies. The measures taken were different, but they all had the same purpose: tackle the immediate risk and contain the current financial turmoil, inject liquidity and stabilize the economy.

Existing contributions to the literature investigate the impact of ECB unconventional monetary policies by focusing on its transmission mechanism, financial asset prices and core macroeconomic variables. For instance, (Abbassi & Linzert 2012) focus on interbank rates; (Beirne et al. 2011) on covered bond markets; (Angelini, Nobili & Picillo 2011) on money market rates; (Peersman 2011) on bank credit volumes; (Giannone et al. 2011) on monetary and credit variables; (Lenza, Pill, & Reichlin 2010) on macroeconomic variables. However, there are only few studies that focus on the impact of ECB non-standard measures on euro stock markets while the literature in Nordic countries remains scant so far. Existing literature focus on the impact of ECB monetary policy shocks in euro stock markets and they provide opposing results. For instance, (Rogers, Scotti, & Wright 2014; Haitsma, Unalmis, & De Haan 2016; Chebbi 2018) find that ECB announcements led to an increase of stock returns. However, (Hosono & Isobe 2014) document a negative impact in stock markets.

In this paper, I seek to shed light on the impact of ECB unconventional monetary policies in Nordic stock markets using daily data from January 2008 to December 2018. The daily frequency allows for a more precise estimation of the influence of nonstandard measures on stock markets. In the literature, the papers which are close to my work are the work of (Haitsma, Unalmis, & De Haan 2016) and (Chebbi 2018).

Haitsma, Unalmis, & De Haan (2016) document the existence of credit channel for the unconventional monetary surprises and they confirm that these surprises affect EURO STOXX 50 index while (Chebbi 2018) investigates the impact of ECB non-standard measures on major European stock markets. The author reveals that a positively surprising shock (a fall in the domestic yield) and an increase in German interest rates increases the stock returns. Further, (Korus 2019) finds that Outright Monetary Transactions (OMT) announcements have influenced benchmark stock indices of Denmark, Norway and Sweden and have operated via confidence and signaling channel.

As stock indices, the data set consists of five European indices that include Denmark (OMXC20), Finland (OMXH25), Iceland (OMIXPI), Norway (OBX) and Sweden (OMXS30). Several papers have tried to capture the surprise component of unconventional monetary policies through surveys professional forecasters (Ehrmann, Fratzscher & Rigobon 2015; Joyce et al. 2011) while (Rogers, Scotti, & Wright 2014) state that these kind of measures do not reflect investors' beliefs and often the data is limited. Further papers focus on the monetary surprise of monetary policy such (Bohl, Siklos, & Sonderman 2018) extract the unexpected monetary policy decisions using EURIBOR future and EONIA swap data together with the survey data that covers the opinions of financial markets. Bredin et al. (2005) capture the monetary surprise based on futures markets data while (Hayo & Niehof 2014) employ the European short-term interest rate as an indicator of monetary policy, and various stock market indices, as indicators of financial markets.

In this study, I try to capture the surprise component by focusing on the asset prices after each announcement of ECB's unconventional monetary policies. I also try to divide my sample in two subsamples: crisis and post-crisis period to investigate the magnitude of the response of stock returns in several periods. In this study, I extend the existing literature on several directions. First, to the best of my knowledge, this work is the first that comprehensively focuses on the effects of ECB nonstandard measures in Nordic stock markets. Second, I try to capture the unconventional monetary policy shocks, by relying on four different proxies that are based on the asset prices on the day of announcements: a) the change in domestic 10-year government bond yields, b) the changes in the spread between German and Italian (Spanish) 10 year bond yields, and c) German long-term government bond yield which is considered a safe euro-denominated asset.⁷² Third, the empirical analysis is based on recent daily data (until 2018) and it includes all types of unconventional monetary policies, not a single event or selected programs as in the case of other studies. Fourth, as the time framework represents a period of 10 years, which includes different market conditions and risk sentiments, it represents different policies and monetary policy tools used, hence, I divide the sample in two subsamples to determine the evolution of the unconventional monetary policies over time.

⁷² Different from (Chebbi 2018) I use the German long-term bond yield not the change of the yield.

Using an Exponential Generalized Autoregressive Conditional Heteroskedastic model, the findings confirm the impact of monetary policy surprises in Nordic stock returns. Second, the results indicate that a positive monetary surprise is associated with a decrease of the yields in the distressed countries and a decrease of the domestic government bond yield, increase the stock market prices. During the crisis period, Nordic countries were associated to a reduction of bond yields, hence, being good substitutes of euro area bonds. There is less risk in the Nordic region hence, there is credit flow in the region and the German government bond yield increases. The opposite happens in the postcrisis period as investors switch to euro area bonds and the yield of Nordic government bond yields increases. Further, the difference in the results for the crisis and postcrisis period indicate that the crisis period has had the most significant effect. I find slight changes among the overall sample and crisis period; I find highly significant effects of ECB announcements and the surprise component in Denmark, Finland and Iceland whilst the impact in Norway and Sweden is limited. To conclude, the results of the overall sample are mainly driven by the first sample while the impact is limited for the second subsample. There is high impact of unconventional monetary policies of ECB in Iceland even though Iceland does not belong to European Union countries but is part of European Union Agreement and European Free trade Association. The findings confirm those of (Haitsma, Unalmis, & De Haan 2016; Chebbi 2018) that ECB's unconventional were effective in reducing the sovereign spreads of the countries under stress, however, instead of a flight to quality to German government bond yields, investors turn to domestic government bond yields. Opposite to (Korus 2019), I find that especially during the crisis period stock markets of Nordic markets were highly affected. To conclude, based on IMF (2016) Nordic countries has been considered as safe heavens.

This paper is organized as follows. Section 3.2 reviews the theoretical framework. Section 3.3 discusses related literature. In Section 3.4 I present the econometric approach, the model and the data whilst in Section 3.5 I discuss the results. Section 3.6 concludes.

3.2 Theoretical framework

In this section the basic theoretical framework will be presented. This section, along with the next section will form the theoretical base on which this chapter is designed.

3.2.1. The Role of Stocks as indicator variable

Stock prices give important information for the policymakers. There are several reasons how stock prices could influence the monetary policy stance. Stock prices could affect the consumption and the investment through Tobin Q effect (Tobin 1969). A reduction of stock prices will make the consumers to reduce their current consumption expenditures. A fall in asset prices will decrease the value of collateral which will make it hard for the investors willing to borrow to obtain credit, hence it reduces the aggregate demand. Bernake & Gertler (1989) and (Bernake & Gilchrist

2000) describe this as financial accelerator, the reduced demand implies lower cash flows and further decreased spending.

Gordon (1962) states that asset prices are forward-looking meaning that they reflect the expected future return of the assets and they are determined by the fundamental variables. If the central bank has no informational disadvantage versus the private sector and the fundamentals are observable, then asset prices do not convey information that might be available somewhere else. Thus, asset prices do not provide additional information to the policymakers. If the policymaker is at informational disadvantage versus the private sector, asset prices can be helpful reflecting the state of the economy. However, the content of the information of asset prices will depend on the policies implemented (Bjørnland & Leitemo 2005). The information and the leading indicator properties of assets are expected to change with the monetary policy. Indeed, asset prices do not reflect only fundamentals, but they include bubble components too. Moreover, the bubble components of assets influence the target variables more than their fundamental part. Hence, asset prices are important indicators of monetary policy (Cecchetti et al. 2000). On the other hand, (Bjørnland & Leitemo 2005) argue that it might be difficult to identify bubble components and the adequate monetary policy response. For instance, (Bernake & Gertler 2001) reveal that identifying the bubble component is difficult and the central bank can be left without possibility to respond to asset prices itself. They use a Keynesian model and find that if the central bank responds only to expected inflation, there are no benefits to respond to asset prices. Bjørnland & Leitemo (2005) show that their model does not model optimizing monetary policy and the central bank behavior is modeled based on an interest rate rule which responds only to few variables such as inflation, output gap and stock market prices. There is lack of unifying theoretical framework of the importance of asset price information in monetary policy, but the theory does not discard the impact of stock markets in policymaking. This is clearly reflected in the empirical contributions to the literature to which I turn in section 3.3.

3.2.2 Monetary policy and stock prices

The most relevant theory for stock price is the discounted cash flow model or the present value model Crowder (2006). The intrinsic value of the stock is defined as the present value of future dividends of cash flows of the company and the price of the stock at the last holding horizon. It is defined by two parts: future cash flows and discounting rate. Thus, monetary policy can influence the stock prices which are linked to interest rate. European Central Bank has various monetary tools available such as open market operations, standing facilities and reserve requirements. Its Governing Council sets the key interest rates for the euro area, the rate on the main refinancing operations, the rate on deposit facility and the rate on the marginal lending facility. It is generally acknowledged among researchers that monetary policy works through two major channels: monetary aggregates and short-term interest rate. An expansionary monetary policy, a rise in money supply or a reduction in the short-term interest rate,

can influence the stock price by reducing the discounting rate and increasing the future cash flow. However, the impact of the expansionary monetary policy on stock market can be negative or positive.

In general, a reduction in the interest rate has a positive impact on stock prices. First, a lower interest rate means a lower discounting rate, indicating higher present value of future flows and stock prices. Second, when the interest rates reduce, saving in banks and investing in bonds or similar instruments becomes less profitable. Investors will switch to stock investment and will increase the demand for stocks. Hence, stock prices will go up. Third, consumers will be able to borrow more to finance their purchases, which will affect firm's revenues and their stock prices. Fourth, companies which have a higher debt will increase their benefits when the rate reduces, leading to higher net income and stock prices.

On the other hand, there are exceptions when a decrease of interest rates and stock prices have a negative relationship. First, certain industries would face a loss if the interest rates are reduced. For instance, banks will generate a lower interest margin which will cause a decrease in their profits and stock prices. Second, when the interest rate is decreased is not attractive for international capital, leading to "flight of the flows" and reduction of the domestic stock market and stock prices. Third, based on (Cornell & French 1983), as the interest rate decreases, there is less incentive to hold stocks, the opportunity cost of holding the money is lower and investors will replace stocks with money. Lower demand for stocks will reduce their prices.

Expansionary monetary policy which means an increase of money supply can also have a negative and positive impact on stock prices. First, a higher money supply will allow the banks to give more loans. Consumers and firms will be able to borrow more which will increase goods demand and investments and then firm's stock prices. Second, as (Cornell & French 1983) states higher money demand hints higher anticipated future output. Higher future output will increase companies' revenues and cash flows, leading to increased stock prices.

Surprisingly, a rise in money supply can have a negative relationship to stock prices. When the money supply is increased, it can increase the pessimistic sentiment in stock markets and investors can perceive it as a signal that economy is entering in hard times leading to negative impact of money supply on stock prices. Lastly, higher money supply will increase the inflation. Hence, as (Nelson 1976) and (Schwert & Fama 1977) state, stock prices will decrease due to the high inflation. Therefore, it cannot be determined ahead a linkage between monetary policy and stock prices.

3.3 Empirical literature

In this section, I give evidence of the empirical literature which is closer to this study. The related literature section highlights existing studies that focus on stock markets through the years, from the earliest one to the most recent study. The work of

(Campbell 1991) and its succeeding studies set the foundations of the literature of stock markets. He uses a vector autoregressive model to break the unexpected stock returns in two components: expected future dividends and expected future returns. The results for US monthly data from 1927-1988 show that one-third of the variance of unexpected returns is attributed to the variance of expected dividends, one-third to the variance of expected returns and one-third to the covariance between two components. Expected returns have significant impact on the stock returns because their impact is persistent: a 1 percent increase of the expected return is related to 4 or 5 percent capital loss. The results consist of estimating the impact of an innovation in the expected return on stock price, holding expected future dividends constant while the component “news about future dividends” is obtained as residual. The author goes ahead and states that the variance of news about future returns, and the covariance between the two types of news, are always important contributors to the variance of unexpected stock returns. More over, shocks to expected future dividends seem to be negatively correlated with shocks to expected future returns, so that there is a positive covariance between the two components of unexpected stock returns. Expected returns have a negative correlation to expected dividends, leading to an increase of stock market in response to dividend news. At a later work, (Campbell & Ammer 1993) decompose the stock and 10-year bond returns in expectations of future dividends, inflation, short-term real interest rates and excess stock and bond returns. The findings indicate that stock and bond returns are driven by future excess stock returns and inflation. Real interest rate has low impact on the returns, even though it affects the short-term nominal rate and the slope of the term structure.

Guo (2002) finds that stock prices respond significantly to unanticipated changes in the federal funds rate target but not to the changes that were anticipated. Moreover, the impact is higher for smaller stocks than for big stocks, when business conditions are bad. However, the impact is not significant when business conditions are improved. The same pattern is found when portfolios based on the book-to-market value are used.

Bomfim (2003) examines the impact of pre-announcement and news effects on stock market in the context of the disclosure of monetary policy decisions. The author also looks at how the actual interest rate decisions influence the stock market volatility. The findings indicate that stock market volatility is low in the days preceding the scheduled policy announcements. The surprise element tends to boost stock market volatility in the short run and positive surprises, higher-than-expected values of the target federal funds rate – tend to have a larger effect on volatility than negative surprises.

Rigobon & Sack (2003) similar to (Rigobon 1999) use an identification heteroskedasticity approach of the stock markets to investigate the reaction of monetary policy to the stock market. The identification consists of the heteroskedasticity of shocks to stock market returns. Hence, shifts in the importance of stock market shocks relative to monetary policy shocks, and the changes in the covariance between the shocks, allow the authors to measure the reaction of interest

rates to changes in stock market prices. The findings suggest monetary policy is highly influenced by the stock market movements: a 5 percent rise (fall) in the S&P 500 index increases the likelihood of a 25-basis point easing (tightening) by about a half. The authors conclude that FED responds to stock price movements only when their impact is needed.

Following a similar approach to (Campbell 1991) and (Campbell & Ammer 1993), (Bernake & Kuttner 2004) focus on the impact that monetary policy has on equity prices and the sources of its reactions. The authors confirm the findings of the former authors that unanticipated monetary policy actions on expected excess returns account for highest part of the response of stock prices. A hypothetical unanticipated 25 basis-point cut in the federal funds target rate leads to a one percent increase in the stock indices.

Bjørnland & Leitemo (2005) investigate the interdependence between US monetary policy and S&P 500 index. The authors confirm a great interdependence between the interest rate and stock prices. A monetary policy shock that raises the federal funds rate by 10 basis points reduces the stock prices by 1.5 percent. Further, a stock price shock that increases the stock prices by one percent increases the monetary policy interest rate by 5 basis points.

Ehrmann, Fratzscher & Rigobon (2005) define a framework that focus on the degree of financial transmission between money, bond, equity markets and exchange rates within and between US and euro area. The results confirm the spillovers within and across asset classes. They underline the dominance of US markets; US markets explain more than 25 percent of movements of euro area financial markets, whereas euro area financial markets explain only 8 percent of US asset price changes.

Andersen et al. (2007) study the response of US, German and British bond, exchange rate and stock markets to US macroeconomic news effects. The authors confirm that there is a significant response of the markets to fundamentals. Equity markets respond differently due to the business cycles. Moreover, the authors document contemporaneous links across all markets and countries.

Bredin et al. (2009) investigate the response of the stock markets to the changes of international monetary policy in the UK and Germany. The authors use an event study to analyze the impact of (un)expected changes in the UK and German/Euro area policy rates in the aggregate and sectoral equity returns. The findings show that the UK monetary policy surprises have a significant and negative influence on both aggregate and industry level of UK and Germany. However, there is no significant impact of German/Euro area monetary policy changes in Germany and UK.

Sondermann, Bohl, & Siklosb (2009) investigate the stock market channel of monetary policy in the euro area. The authors find heterogenous effects of euro area stock

markets to unexpected decisions of ECB's interest rate. They split the markets in two groups, one group has significant reaction and the other which does not have a significant effect to monetary policy shocks. However, for each sub-group there is a high degree of homogeneity. Further, the markets that show significant impact seem to have higher stock market capitalization.

Kurov (2010) studies how decisions of monetary policy affect the investor sentiment and the author defines that the impact on sentiment depends on the market conditions. Actions of monetary policy in bear markets seem to have a crucial impact on stocks that are more sensitive to changes of investor sentiment and credit conditions. To conclude, the findings show that investor sentiments influence monetary actions on stock markets.

Shibamoto & Tachibana (2010) focus on the impact of monetary policy in Japanese equity markets using firm-level data. The main aim is to check whether there is a heterogeneous response of stock markets among firms and if there are firm-specific characteristics related to the heterogeneity. The authors find that a reduction of call-target rate by 1 percent leads to an increase of stock returns by 3 percent on average. The impact is higher for firms with higher capital intensity, high leverage, high interest payment, low openness and low working capital. The effect seems to be higher in the recession period rather than the boom period of the late 1980s.

Gali & Gambetti (2012) investigate the influence of monetary policy shocks on stock prices and the results show that after a short-run decline, stock prices increase persistently in response to a tightening of monetary policy.

Zare, Azali, & Habibullah (2013) investigate the impact of stock market volatility to monetary policy in bull and bear markets over 5 Asian countries. The findings suggest that an increase of the interest rate has a stronger long-run effect on the stock market volatility in bear rather than bull markets.

Hayo & Niehof (2014) in a similar approach to (Rigobon & Sack 2004) investigate the relationship between monetary policy actions of the ECB, the Bank of Japan, the Bank of England, the Bank of Canada and the Federal Reserve Bank and changes in the stock and bond markets. The findings state that the variance of European stock and money market returns increased on days when monetary policy committee meetings are held. There are significant spillovers across central banks after each action and there is significant effect of monetary policy in the financial markets. ECB monetary policy has significant spillovers in the British and Swiss markets but there is no evidence of reverse causality.

Hosono & Isobe (2014) investigate the impact of unconventional monetary policies taken by ECB, FED, BOJ and BOE on long-term interest rates, stock prices and

exchange rates with and without controlling for market expectations. The findings suggest that unconventional monetary policies affected long-term government bonds and exchange rate of the home country; however, there is a significant impact on the corporate bond spreads, stock prices and interbank loan spreads. Further, the announcements that were accompanied by forward guidance had a higher impact rather than announcements without forward guidance.

Norfeldt (2014) estimates the interaction between US stock markets and US monetary policy. The results suggest that the expected and unexpected change in the target rate, growth rate of money supply and the investor sentiment index can explain 21,4 percent of the variation in the returns on DJIA index and 22,5 percent of the variation on S&P500 index.

Fratzcher, Lo Duca, & Straub (2014) show that ECB unconventional monetary policies were effective in asset prices in the euro area and reduce market fragmentation in bond markets. Further, there are significant positive spillovers on the global equity markets and confidence in emerging markets and advanced economies. The authors give evidence that ECB measures reduced credit risk among banks and sovereigns in the G20 countries, however there is no evidence of portfolio rebalancing channel across regions and assets.

Salisu & Ndako (2017) use a GARCH-MIDAS framework to forecast the volatility of European equity markets based on the macroeconomic information such as realized volatility, the level of economic activity and macroeconomic uncertainty. The authors divide the market conditions on Pre-Euro Regime, Pre-Global Financial Crisis Regime and Post-Global Financial Crisis Regime. The results show that macroeconomic variables are good predictors of the return volatility of the European equity markets. Moreover, the in and out-sample forecast results show that the findings are sensitive to data sample and market conditions.

Jiang (2018) investigates the asymmetric effects of monetary policy on the US stock markets in different stages of stock markets and different monetary policy regimes. The findings confirm that there is a time-varying relationship between monetary policy and stock market returns according to the monetary policy regimes and stock market conditions. Bear markets are more influenced by the change in the federal funds rate while bull markets seem to be more influenced by the change of monetary aggregates.

Liao et al. (2018) investigate the impact of US quantitative easing on the volatility of stock and exchange markets and the dynamic correlation between stock and exchange markets in the Asian countries. The results show that QE policies were efficient in reducing the volatility of stock and exchange rate markets. Using a DCC GARCH model, the authors confirm that non-standard policies were efficient in changing the structure of stock and exchange markets. Dynamic correlation coefficients show a

dramatic change during the period of financial crisis and QE policy. Specially, stock indices rise more, and currencies appreciate during QE1.

Salisu & Ogbonna (2018) test for the time variation in the stochastic volatility components of stock returns for G7. The empirical evidence indicate that the trend component of stochastic volatility remains constant over time while transitory component changes over time. The results remain robust nevertheless the frequency of the data.

Shehzad et al. (2020) use a VARX-DCC-MEGARCH model to estimate the returns transmission, volatility spillovers, asymmetry effect and dynamic correlation between China and U.S stock markets and their local stock markets. The findings show that US stock markets influence the overnight returns of Chinese stock markets. Day-time volatility of US markets has significantly spillovers in the overnight volatility of Chinese stock markets and daytime volatility of Chinese stock markets spillovers the overnight volatility of US stock markets. Further, during financial crisis negative daily returns of Chinese stock markets significantly transmit to U.S stock markets. There are significant returns and volatility spillovers between local markets in the US. During the financial crisis, there are volatility spillovers between local stocks in China too, and leverage effect for US and Chinese stock markets.

3.4 Methodology

3.4.1 The econometric approach

In this section I define the two econometric approach used in this chapter, and then I state the mean and the variance equation for both methodologies. In the last subsection, I explain the set of the data used. There is great interest among scholars on the models which conditional variance changes over time. Therefore, a largely used model is the simple Autoregressive Conditional Heteroskedastic (ARCH) model proposed by (Engle 1982) that make the conditional variance of the time prediction error term a function of time, system parameters, exogenous and lagged endogenous variables, and past predictions errors. For each integer t, let ζ_t be a scalar prediction error, b a vector of parameters, x_t a vector of predetermined variables and σ_t^2 the variance of ζ_t for a given information at time t. (Engle 1982) proposed:

$$\zeta_t = \sigma_t z_t \quad (1)$$

$$z_t \sim \text{i.i.d} \quad (2) \text{ with } E(z_t) = 0, \text{Var}((z_t)) = 1$$

and

$$\sigma_t^2 = \sigma^2(\zeta_{t-1}, \zeta_{t-2}, \dots, t, x_t, b) \quad (3)$$

$$= \sigma^2(\sigma_{t-1} z_{t-1}, \sigma_{t-2} z_{t-2}, \dots, t, x_t, b) \quad (b)$$

The systems in Equations (1), (2), (3) can be given a multivariate interpretation in which z_t is an n by one vector and σ_t^2 is an n by n matrix. Nelson (1990) states that any form of the models in Equations (1), (2), (3) could be considered as ARCH model.

The most widely used specifications are the work of (Engle 1982) and (Bollerslev 1986) that make σ_t^2 in linear lagged values of $\zeta_t^2 = \sigma_t^2 z_t^2$ by defining:

$$\sigma_t^2 = \omega + \sum_{j=1}^p \alpha_j z_{t-j}^2 \sigma_{t-j}^2, \quad (4) \text{ and}$$

$$\sigma_t^2 = \omega + \sum_{i=1}^q \beta_i \sigma_{t-i}^2 + \sum_{j=1}^p \alpha_j z_{t-j}^2 \sigma_{t-j}^2 \quad (5)$$

where ω_t , α_j and β_i are non-negative. Since Equation (4) is a special case of Equation (5), (Nelson 1990) considers both Equation (4) and (5) as GARCH models, to distinguish them as special cases of Equation (3). However, ARCH and GARCH model proposed by (Bollerslev 1986) exhibit certain limitations which are overcome with the work of (Nelson 1991). Black (1976) and (Nelson 1991) found a negative relation between stock returns and changes in returns volatility (volatility is increased in response to bad news and is reduced with good news). GARCH models, assume that the magnitude not the positivity or negativity of unanticipated excess returns determines feature σ_t^2 . If the distribution of z_t is symmetric, the change in variance tomorrow is conditionally uncorrelated with excess returns today. In Equations (4) and (5), σ_t^2 is a function of lagged σ_t^2 and lagged z_t^2 , and so invariant to changes in the algebraic sign of the z_t 's, only the size, not the sign, of lagged residuals determines conditional variance. This suggests that a model in which σ_t^2 responds asymmetrically to positive and negative residuals might be preferable for asset pricing applications. Another limitation of GARCH models consists of the negativity constraints to ensure that σ_t^2 remains positive for all t with probability one and these constraints can impose difficulties on estimating GARCH models. Furthermore, as the number of constraints is increased the model goes far more from reality (Nelson 1991). A third limitation of GARCH model is the interpretation of the persistence of shock to conditional variance. The central question in GARCH model is how long the shock on the conditional variance will persist.

Opposite to the approach of (Engle 1982) and (Bollerslev 1986), (Nelson 1991) follows a natural approach that ensures that σ_t^2 remains positive, making the log of σ_t^2 linear in some function of time. Hence, this is the so-called exponential GARCH model:

$$\ln(\sigma_t^2) = \alpha_t + \sum_{k=1}^{\infty} \beta_k g(z_{t-k}) \quad (7) \quad \beta_1 = 1$$

where $\{\alpha_t\}_{t=-\infty, \infty}$ and $\{\beta_k\}_{k=1, \infty}$ are real, non-stochastic and scalar sequences. The author goes ahead and highlights the advantages of exponential GARCH model. Nelson (1991) defines $g(z_t)$ as a linear combination z_t and $|z_t|$:

$$g(z_t) = \theta(z_t) + \gamma[|z_t| - E|z_t|] \quad (8)$$

$\{g(z_t)\}_{t=-\infty, \infty}$ is a zero-mean sequence, the other two components $\theta(z_t)$ and $\gamma[|z_t| - E|z_t|]$ have a mean zero. Assuming the distribution that z_t is symmetric, the two components are orthogonal even though they are not independent. If z_t has a range $0 < z_t < \infty$, $g(z_t)$ is linear with slope $\theta + \gamma$ and over the range $-\infty < z_t \leq 0$, $g(z_t)$ is linear with slope $\theta - \gamma$. Thus, $g(z_t)$ allows the conditional variance to respond asymmetrically to rises and falls in stock prices. Supposing that $\gamma > 0$ and $\theta = 0$, the innovation in $\ln(\sigma_{t+1}^2)$ is positive (negative) when the magnitude of z_t is larger (smaller) than its expected value. Assuming that $\gamma = 0$ and $\theta > 0$, the innovation in conditional variance now is positive (negative) when returns innovations are negative (positive). Thus, the exponential GARCH model meets the first objection raised for the GARCH model. The second objection is that in comparison to GARCH model, there are no inequality constraints hence, the β_k terms can be negative or positive. The final criticism of GARCH model is that is difficult to evaluate if the shocks to variance are persistent or not, while in exponential GARCH $\ln(\sigma_t^2)$ is a linear process, and its stationarity and ergodicity are easily checked.

3.4.2 The model

I follow the approach of (Nelson 1991), to assess the reaction of euro area stock markets to ECB's unconventional monetary policies. Due to its advantages in comparison to other GARCH family models, I use an Exponential General Autoregressive Conditional Heteroskedastic (EGARCH) model which allows volatility asymmetry and negative volatility coefficients. To my best knowledge, my work is close to the work of (Nelson 1991; Haitsma, Unalmis, & De Haan 2016; Chebbi 2018) and I define jointly two models, one for the conditional mean and one for the variance of individual stock returns.

$$r_{i,t} = \delta_0 + \delta_1 r_{i,t-1} + \delta_2 VIX_t + \delta_3 ECB_t + \lambda SURP_t + \varepsilon_t \quad (9)$$

Equation (16) represents the mean equation for each country:

$r_{i,t}$ represents the stock return on day t , $r_{i,t-1}$ defines the stock return one day before.

VIX_t denotes the volatility index.

ECB_t are the announcements of an unconventional ECB monetary policy on day t ; it enters the equation in the form of a dummy variable that takes the value 1 when an announcement is published and 0 otherwise.

$SURP_t$ is the surprise component, there are four surprise components which are calculated as the difference between Italian, Spanish government bond yield and German yield, the change in the domestic government bond yields, and the long-term German yield as a benchmark.

ε_t is the residual term. The conditional variance of the stock returns is defined below:

$$\ln(\sigma_t^2) = \omega + \gamma \ln(\sigma_{t-1}^2) + \alpha \left| \frac{\varepsilon_{t-1}}{\sigma_{t-1}} \right| + \beta \frac{\varepsilon_{t-1}}{\sigma_{t-1}} \quad (10)$$

Equation (17) represents the variance equation where:

σ_t^2 and σ_{t-1}^2 denote the conditional variance of stock return on time t and time $t-1$ respectively.

γ defines the volatility persistence for a given shock and the log transformation ensures a positive variance

β is the variable that captures the asymmetric leverage effect.

3.4.3 Data

I proceed by outlining the data for Nordic stock market indices and then for ECB's unconventional monetary policies and the associated surprises. I use daily data from 1 January 2008 to 31 December 2018 (only for Norway the data begins from 20 October 2009) and the source of the data is Thomson-Reuters DataStream while the source for stock market indices is investing.com. In total, there are 2870 observations for the whole-time framework and the data set includes the following indices: Denmark (OMXC20), Finland (OMXH25), Iceland (OMIXPI), Norway (OBX) and Sweden (OMXS30).

The data for macroprudential policy announcements were collected from the ECB website. There are 229 announcements in total which include press conferences, press releases and public speech. In the spirit of (Glick & Leduc 2012; Wright 2012; Rogers, Scotti, & Wright 2014), I rely on four different approaches to measure the unanticipated component of the ECB's unconventional monetary policies.

I have included ECB announcements of unconventional monetary policy in order to be able to check its spillovers in Nordic countries. I should highlight that with the dummy ECB I seek to capture the anticipated component of its announcements whilst with the surprise component I aim to capture the non-anticipated part. An important issue in this study is the frequency of the unexpected component of monetary policies. Existing literature use the surprise component in intraday frequency arguing that the use of intraday data is more convenient because it captures the reaction of the interest rate only to monetary policy and not to other information. On the other hand, the use of

intraday data is questionable as the information could take time to be digested in the market. Therefore, (Gürkaynak, Sack, & Swanson 2006) support the use of daily data. In the spirit of (Gürkaynak, Sack, & Swanson 2006) and (Chebbi 2018) I use daily data instead of other frequency.

In **Error! Reference source not found.**, I present the current data for the indices with the last closing date 12 March 2021. Sweden stock markets have a higher number of components whilst Icelandic markets even though with a lower number of components it has the highest volume. The opening price is higher for Finland and its day's range too. However, all the stocks reveal a slight decrease of approximately 1 percent and only Sweden stocks have seen a modest rise in percentage.

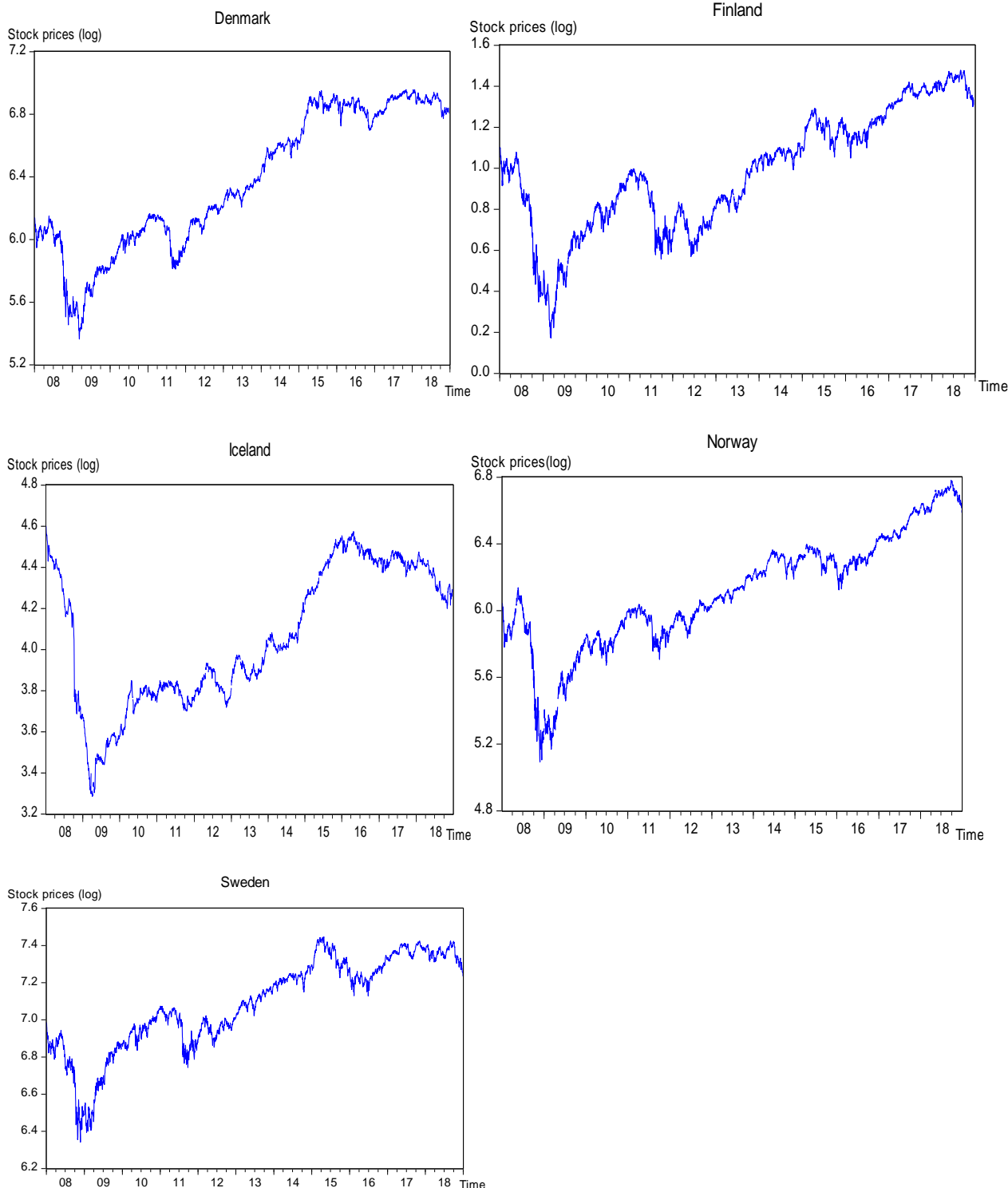
Table 3. 1 Description for Nordic stock returns

	Denmark OMXC20	Finland OMXH25	Iceland OMIXPI	Norway OBX	Sweden OMXS30
No. of Components	20	25	19	25	30
Volume	11,661,859	40,698,880	139,227,692	47,631,215	78,287,977
Open	1,447.84	4,952.09	2,085.22	945.01	2,158.08
Day's Range	1,431.82 - 1,449.52	4,917.11 - 4,955.99	2,070.14 - 2,086.71	939.23 - 946.14	2,152.38 - 2,168.96
Gain/Loss	-16.74	-14.47	-14.90	-0.65	+3.30
Gain/Loss in %	-1.15 %	-0.29%	-0.71%	-0.07%	+0.15

Source: Author's calculations

In Figure 3. 1 I show the stock prices of Nordic countries (at levels) which show a sudden drop in 2008-2009 following the global financial crisis of 2007-2008 while another recession is in 2011-2012 which corresponds to the sovereign debt crisis. Additionally, there is 2015-2016 that corresponds to the refugee crisis which was an exogenous shock to the Nordic economies.

Figure 3. 1 Stock prices of Nordic countries (log)



Source: Author's calculations

In **Error! Reference source not found.**, I present the summary statistics for unconventional monetary policy surprises. I represent the change in domestic 10-year government bond yields, the spread between German and Italian (Spanish) 10-year bond yields and the German 10-year government bond yield. All yields have negative sign, with the Italian (Spanish)-German spreads which have the lowest mean. The change in the Norway and Sweden yield have the lowest standard deviation whilst the spreads seem to have the highest variation. Finland domestic bond yield together with

the spreads are skewed to the left and other variables are skewed to the right. All monetary surprises exhibit kurtosis and Jarque-Bera Test indicates that the variables fail to accept the null hypothesis of normality distribution.

Table 3. 2 Summary statistics for unconventional monetary policy surprises

	Δ Denmark Yield	Δ Finland Yield	Δ Iceland Yield	Δ Norway Yield	Δ Sweden Yield	Δ Italy- Germany	Δ Spain- Germany	German Yield
Mean	-0.001	-0.001	-0.001	-0.001	-0.001	-0.081	-0.081	1.67
Median	-0.001	-0.001	0.000	0.000	-0.001	0.001	0.004	1.50
Maximum	0.349	0.613	4.269	0.562	0.340	942.052	989.023	4.67
Minimum	-0.296	-0.658	-3.363	-0.250	-0.246	-990.017	-990.011	-0.19
Std. Dev.	0.047	0.055	0.175	0.043	0.043	38.619	46.948	1.27
Skewness	0.498	-0.435	3.395	0.925	0.272	-6.302	-3.139	0.47
Kurtosis	7.685	27.639	298.130	15.608	7.787	411.549	336.572	2.01
Jarque- Bera	2728.786	72282.79	103633	19311.81	2760.606	198676	13236649	226.33
Prob.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Source: Author's calculations

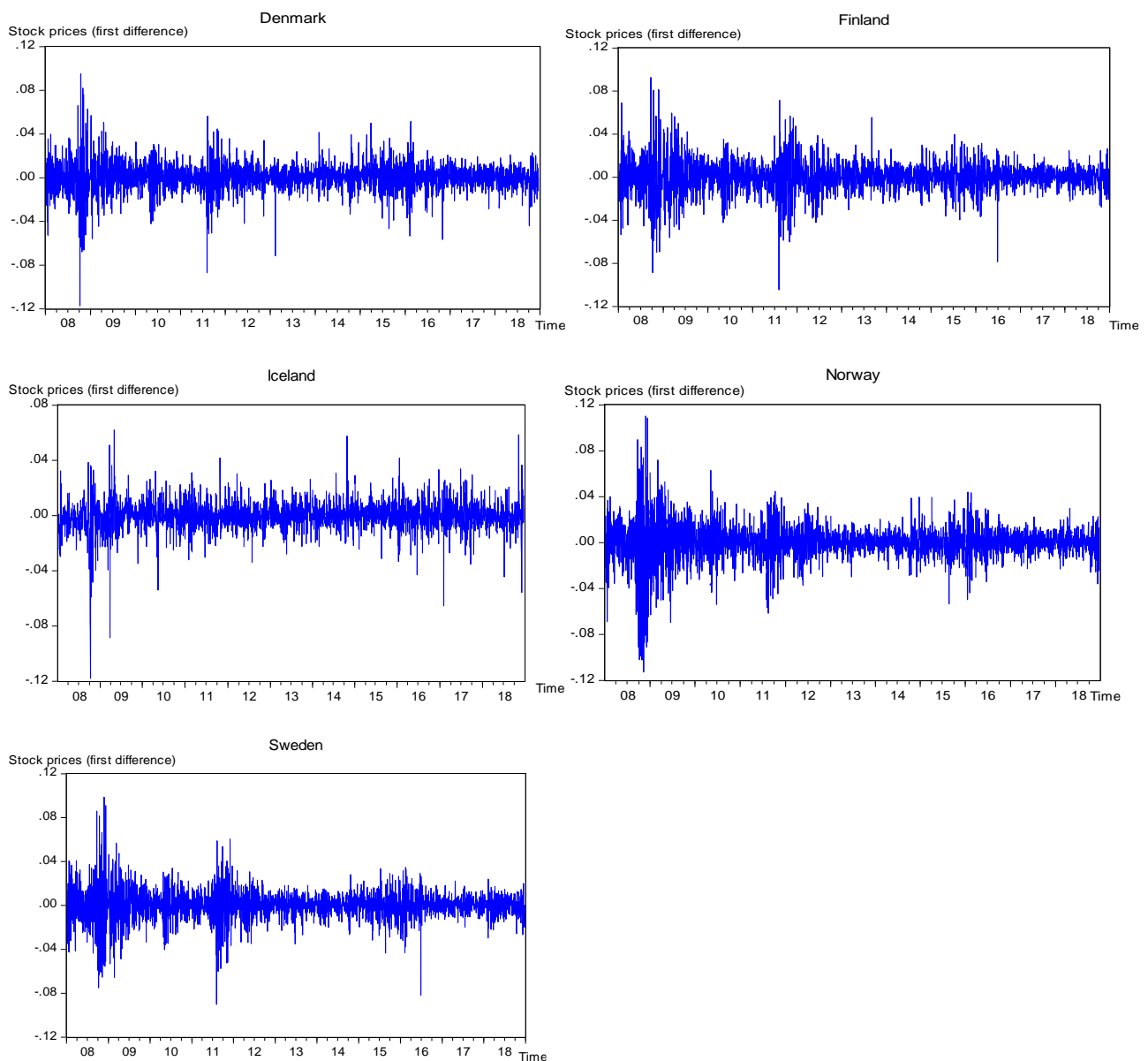
Overall, in **Error! Reference source not found.** I find that ECB unconventional monetary policy, have had a positive surprising effect, as on average I find lower yield spreads and higher German yield.

The idea behind the first approach is that ECB unconventional monetary policies influence the long-term government bond yields, and in response to the announcements, yields move differently across countries. This is shown in **Error! Reference source not found.** as policy announcements are related to a decline of government bond yields in Nordic countries while there is an increase in the German yield. Chebbi (2018) states that considering the information efficiency, any possible information can induce changes on current yields while (Bernake & Kuttner 2004) and (Durham 2005) argue that stock prices react only to surprise components while the effect of expected policy is not significant. Thus, based on efficient market hypothesis I use the change in domestic yields as a reduction of the yield can indicate a positive surprise and vice versa. Joyce et al. (2011) argue that announcement of bond purchase by Bank of England reduced the yields.

In a similar approach to (Rogers, Scotti, & Wright 2014), I use the 1-day change in the spread between German and Italian 10-year bond yields. The reasoning behind this approach is that unconventional monetary policies were aimed to alleviate the pressure

and reduce the spreads of euro area. For instance, on 6 September 2012 ECB announced the “Outright Monetary Transactions (OMT)” and even though it has never applied it helped to reduce the tensions in the markets. Szczerbawicz (2015) similar to (Altavilla, Giannone, & Lenza 2016) and (Krishnamurthy, Nagel, & Vissing-Jorgensen 2018) find that announcement of OMT programme reduced the yields of countries under stress such as Italy and Spain while (Falgiarda & Reitz 2015) argued that ECB unconventional monetary policies were effective in reducing the Italian government bond spread. As (Chebbi 2018) I use an additional measure as surprise measure in order to check on the possibility that non-anticipated policy changes could have for market participants, hence I include in my study the yield of a safe-denominated asset such as German long-term government bond.

Figure 3.2 Stock prices for Nordic countries



Source: Author’s calculations

Figure 3.2 clearly shows the features of an autoregressive model for the return variances; the series indicate that they are clearly volatile and large changes are followed by large changes and small changes are followed by small changes (volatility clustering or volatility pooling).

I include as control variable the volatility index for the euro area VSTOXX index which measures the changes of the risk aversion and is a measure of the risk of the equity market in the euro area. I expect this variable to be negatively related to stock market returns.

Korus (2019) states that the net effect of ECB’s unconventional monetary policies on stock prices of Nordic countries might be ambiguous. Equity prices might be influenced negatively by non-standard measures via the confidence channel and the exchange rate channel. Confidence channel implies a negative effect on equity prices as the improved confidence in the euro area and risky assets in euro area get more attractive than assets in Nordic countries. Further, the improved economic sentiment might be related to higher dividends of euro area equities therefore, assets in euro area are more attractive. Exchange rate channel indicates that the appreciation of domestic currency against euro induces by ECB non-standard measures leads to higher equity prices for foreign investors. Hence, lower demand for Nordic countries equities will reduce their prices. Bernhard & Ebner (2016) on the other hand state that appreciation of domestic currencies against euro is associated with a reduction of competitiveness for international firms. Higher liquidity and lower discount rate expectations will cause higher equity prices of non-euro area countries.

Following the approach of (Granger & Newbold 1974; Dickey 1981; Phillips & Perron 1988) I perform two unit-root tests, Augmented Dickey Fuller Test and Phillips-Perron Test⁷³ to test the stationary of the financial series. The estimation of non-stationary variables can lead to spurious results.⁷⁴ The findings are reported in **Error! Reference source not found.**; the second column defines the model with an intercept and without trend; the third represents the model with an intercept and trend; and the fourth without an intercept and trend. The results show that all variables are stationary at levels, except for German government bond yield which is stationary at first difference at 1 % level of significance.

Table 3. 3 Unit-root test

Levels	T_u	T_t	T	First difference	T_u	T_t	T	Test
Denmark’s Equity Index	52.48* **	52.47* **	52.47** *	Denmark’s Equity Index	64.02***	64.01***	64.03***	ADF
	52.52* **	52.52* **	52.51** *		772.75** *	774.61***	772.98**	PP

⁷³ Augmented Dickey-Fuller Test is performed with Schwarz Information Criterion while Phillips-Perron Test is performed with Newey-West Bandwidth Selection.

⁷⁴ I employ the tests using the log form and then the differences of stock market prices.

Denmark 10-years Government Bond yield	54.11* **	54.10* **	54.07** *	Denmark 10-years Government Bond yield	65.48***	65.47***	65.49***	ADF
	54.20* **	54.20* **	54.14** *		699.29** *	699.07***	699.49** *	PP
Finland's Equity Index	52.32* **	52.33* **	52.33** *	Finland's Equity Index	64.55***	64.54***	64.56***	ADF
	52.56* **	52.58* **	52.57** *		964.39** *	968.30***	963.25** *	PP
Finland 10-years Government Bond yield	63.81* **	63.81* **	63.78** *	Finland 10-years Government Bond yield	66.03***	66.02***	66.04***	ADF
	65.12* **	65.15* **	64.94** *		811.69** *	811.45***	811.87** *	PP
Iceland's Equity Index	56.25* **	56.24* **	56.26** *	Iceland's Equity Index	80.87***	80.86***	80.89***	ADF
	124.14***	124.11***	123.81* **		1407.06* **	1406.78** *	1407.36* **	PP
Iceland 10-years Government Bond yield	72.09* **	72.08* **	72.09** *	Iceland 10-years Government Bond yield	75.14***	75.12***	75.15***	ADF
	70.91* **	70.90* **	70.91** *		1033.08* **	1032.82** *	103.30** *	PP
Norway's Equity Index	50.39* **	50.38* **	50.40** *	Norway's Equity Index	59.67***	59.65***	59.68***	ADF
	50.49* **	50.49* **	50.51** *		1474.92* **	1473.98** *	1475.19* **	PP
Norway 10-years Government Bond yield	46.12* **	46.13* **	46.11** *	Norway 10-years Government Bond yield	61.13***	61.12***	61.14***	ADF
	45.63* **	45.64* **	45.60** *		633.78** *	633.93***	633.38** *	PP
Sweden's Equity Index	56.17* **	56.16* **	56.17** *	Sweden's Equity Index	65.93***	65.92***	65.94***	ADF
	57.21* **	57.20* **	57.21** *		942.86** *	966.26***	922.33** *	PP
Sweden 10-years Government Bond yield	47.55* **	47.55* *	47.52** *	Sweden 10-years Government Bond yield	61.91***	61.90***	61.92***	ADF
	47.39* **	47.38* **	47.38** *		545.88** *	545.78***	546***	PP
Sweden 10-years Government Bond yield	1.86	2.50	2.37**	Sweden 10-years Government Bond yield	52.41***	52.42***	52.38***	ADF
	1.86	2.37	2.47**		52.59***	52.62***	52.51***	PP

Note: *, **, *** denotes 10% , 5% and 1% level of significance

Source: Author's calculations

I follow the work of (Rogers, Scotti, & Wright 2014) and (Chebbi 2018) I divide my sample in two subsamples. Rogers, Scotti & Wright (2014) split the sample in two subsamples: crisis and non-crisis subsamples. Their empirical findings indicate that there is higher impact in the crisis period subsample as the big surprises were all in 2008 and 2009. In a similar approach to (Chebbi 2018) I divide the sample into crisis and noncrisis period. There is disagreement among researchers and scholars on the response of stock markets when there is a division between the crisis and noncrisis period. Hayo & Niehof (2014) state that there is no significant impact of ECB monetary policy on European equity markets when there is a division between the crisis and the precrisis period. Wang & Mayes (2012) state that during the crisis there is a positive response to surprise policy rate increase and a negative response in the precrisis period while (IMF 2013) states that during crisis asset purchases are more effective. Hence,

my subsamples will be the first period that starts on January 01, 2008 till end of June 2012 which corresponds closely to the speech of Draghi in London “whatever it takes” and the second period consists in a calmer area from July 02,2012 to December 31, 2018.

In Error! Reference source not found. I report the summary statistics for unconventional monetary surprises and I divide the sample into crisis and noncrisis periods. The findings show that obviously in the first sample the monetary policy surprises are higher. For instance, for the first half of the sample the average values of the surprises are -0.002 for the domestic government bond yields; Italian and Spanish spreads are 0.003 and 0.004 while the German government bond yield average is 2.97. The results show that there is positive surprise indicating that ECB’s announcements were effective in reducing the yield spreads of the Nordic countries and there was a “flight to quality” to Nordic countries therefore, the yields of German bonds increase. It is interesting to highlight that by a comparison between subsamples, the largest monetary policy surprises are clearly in the first sub-sample.

Table 3. 4 Summary statistics for unconventional monetary policy by European Central Bank: subsamples periods

Panel A: Crisis period: January 01, 2008 to June 29, 2012								
	Δ Denmark Yield	Δ Finland Yield	Δ Iceland Yield	Δ Norway Yield	Δ Sweden Yield	Δ Italy-Germany	Δ Spain-Germany	German Yield
Mean	-0.002	-0.002	-0.002	-0.002	-0.002	0.003	0.004	2.97
Med.	-0.003	-0.001	-0.001	0.00	-0.001	4.44E-16	0.003	3.12
Max.	0.278	0.613	4.269	0.562	0.340	0.670	0.391	4.678
Min.	-0.296	-0.658	-3.363	-0.250	-0.246	-0.723	-1.051	1.162
Std. Dev.	0.057	0.074	0.263	0.054	0.051	0.097	0.094	0.811
Skew.	0.182	-0.543	2.428	1.058	0.069	-0.066	-1.632	-0.184
Kurt.	5.025	20.173	140.614	15.117	6.390	12.610	20.809	2.422
JB Test	207.016	14472.42	926741.1	7395.716	562.7908	4515.046	16023.20	22.903
Prob.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Panel A: Postcrisis period: July 02, 2012 to December 31, 2018								
	Δ Denmark Yield	Δ Finland Yield	Δ Iceland Yield	Δ Norway Yield	Δ Sweden Yield	Δ Italy-Germany	Δ Spain-Germany	German Yield
Mean	-0.0007	-0.0008	-0.0008	-0.0001	-0.0006	-0.144	-0.145	0.783
Med	-0.001	-0.001	0.000	-0.001	-0.001	0.002	0.006	0.574
Max.	0.349	0.254	0.444	0.198	0.309	942.052	989.023	2.048
Min	-0.200	-0.176	-0.489	-0.137	-0.226	-990.017	-990.011	-0.190
Std. Dev.	0.038	0.036	0.058	0.034	0.036	50.106	60.911	0.579
Skew.	1.192	0.724	-0.156	0.460	0.681	-4.853	-2.417	0.514
Kurt.	12.126	7.120	15.092	5.238	8.635	244.490	199.971	1.941
JB Test	6288.15	1348.46	10339.9	413.97	2375.27	4127769	2743368	153.919
Prob.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Source: Author’s calculations

3.5 Results and discussion

In this section, I investigate the impact of non-anticipated and anticipated components of ECB's unconventional monetary policies in Nordic stock market returns using asymmetric conditional volatility approach. I began with the estimation for the full sample and then I divide the sample in crisis and post-crisis sample.

In Table 3. 5 I report the results for the impact of ECB unconventional monetary policies on Denmark stock markets. Phillips (2000) defines the reason that Danish stock market is successful, and he states that the market is a collection of companies which are well positioned. The way how Danish market is composed is completely different from the global market, it is composed of pharmaceutical and health care-companies, a business for which the demand is high in ups and downs of the global economy. I specify the mean equation (see Equation 16) in Panel A and the variance equation (Equation 17) in Panel B. I begin my analysis by considering the monetary surprise as the spread between the Italian and German government bond yield. The results show that ECB's unconventional monetary measures cause a decrease in the spread between Italian (Spanish)-German government bonds and domestic government bonds which lead to an increase in the stock returns. The findings confirm those of (Haitsma, Unalmis, & De Haan 2016) that state European stock indices increase with positive surprises related to ECB announcements. Moreover, it is similar to (Krishnamurthy, Nagel, & Vissing-Jorgensen 2018) that state that ECB announcements reduced the spreads of distressed countries and induced high stock market prices in the euro area. However, I do not get similar results using the German government bond yield. In particular, I find that the increase of the German yield causes the increase of the stock prices. The findings are consistent with those of (Rogers, Scotti, & Wright 2014) and (Chebbi 2018). Further, the increase of the stock returns shows that, among other channels, portfolio rebalancing channel was an important channel for the transmission of ECB unconventional monetary policies: following ECB purchases, investors would tend to move to substitute assets.

Korus (2019) investigated the impact of forward guidance (FWG) announcements in a set of financial variables of Nordic countries. The author found that these announcements influenced long-term government bond yields through the signaling channel and increased of Danish stock markets. Moreover, the sign of the volatility index, is negative and highly significant, indicating that as the economic sentiment increases, stock prices go up. Not surprisingly, I find significant effect of ECB's unconventional monetary policies in Denmark as it has given up its monetary policy authority (Ellen, Edvard, & Midthjell 2018).

Since there are no restrictions on the sign of the coefficients in the EGARCH model, the variance coefficients seem to be satisfactory. The findings suggest that the conditional shock (ω_i) is statistically significant and positive. I find that the coefficient (γ_i) that measures the asymmetry of shocks is statistically significant implying that

stock market returns have asymmetric effects. The coefficient on β , which measures shock persistence, is close to one and highly significant and it implies that the impact of shocks to stock markets have long-lasting effects.

Table 3. 5 Effects of unconventional monetary policy announcements by European Central Bank on Denmark stock returns: Full sample period

Panel A: Mean Equation	Yield spreads		Long-term (10 year) government bond yields	
	Δ Italian spread	Δ Spanish spread	Δ Domestic bond yield	German bond yield
Constant	0.0001*	0.0001*	0.0002*	-1.43E-05
Stock return _{t-1}	-0.001	-0.003	-0.002	-0.003
Volatility index	-0.03***	-0.02***	-0.04***	-0.05***
ECB announcements	-0.005***	-0.005***	-0.003***	-0.002***
Surprise component	-1.50E-03	-2.41E-06*	-0.003*	0.0002**
Panel B: Variance Equation				
Constant	-0.36***	-0.40***	-0.40***	-0.39***
Conditional shock	0.14***	0.14***	0.15***	0.15***
Volatility persistence	-0.02***	-0.03***	-0.02***	-0.04***
Asymmetric effect	0.90***	0.90***	0.93***	0.92***

Note: *, **, *** denotes 10%, 5% and 1% level of significance

Source: Author's calculations

In .

Table 3. 6 I show the response of Danish stock markets in both samples, the first sample which starts on 1 January 2008 till 29 June, 2012 whilst the second sample consists from 2 July 2012 until 2018. The sign of surprise components is similar to those of the full sample while the impact in the second sample seems to be limited. In the second sample, I find a significant effect of volatility index and ECB unconventional monetary policies which indicates that ECB impact is present even though there is no impact of surprise components. The impact of ECB is obvious which supports the findings of (Korus 2019). On the other hand, (Jensen, Mikkelsen, & Spange 2017) highlight that large asset purchases of ECB have reduced the long-term government bond yields in euro area and neighboring countries too. The authors state that Danish yields tracked those of Germany yields closely as a consequence of its fixed exchange rate. Their interpretation is that spillovers to the Danish term spread from a monetary policy shock in the euro are comes from the rebalancing of investors' portfolios as Danish government bonds are close substitutes to bonds issued by "core" euro area countries. When investors purchase Danish government bonds there is an increase in Danish bond prices as in the euro area. In contrast, I find a positive impact on the German government bond yield which indicates that in terms of financial risk Danish bonds are

more attractive. In comparison to the second sample, I find a negative impact in the German government bond yield whilst the impact in the other surprise components is not significant. The findings on the second sample confirm those of IMF (2016) stating that ECB unconventional monetary policies did not have a significant response in the 10-year rates.

The coefficients in the variance equation are all significant which reveals that the equation is correctly specified. Further, the coefficient of asymmetric effect shows that the shocks are persistent and do not die out quickly.

Table 3. 6 Effects of unconventional monetary policy announcements by European Central Bank on Denmark stocks: Divided samples

Crisis period : January 01, 2008, to June 29, 2012				
Panel A: Mean Equation	Yield spreads		Long-term (10 year) government bond yields	
	ΔItalian spread	ΔSpanish spread	ΔDomestic bond yield	German bond yield
Constant	0.0001	0.0001	0.0001	0.0002
Stock return _{t-1}	-0.003	-0.002	-0.002	-0.006
Volatility index	-0.003**	-0.002*	-0.001***	-0.010***
ECB announcements	-0.0004**	-0.0003**	-0.004**	-0.0007*
Surprise component	-0.03***	-0.04***	-0.002**	2.50E-06*
Panel B: Variance Equation				
Constant	-0.13***	-0.08***	-0.28***	-0.21***
Conditional shock	0.11***	0.10***	0.18***	0.12***
Volatility persistence	-0.05***	-0.04***	-0.03***	-0.01***
Asymmetric effect	0.94***	0.93***	0.91***	0.87***
Postcrisis period: July 02, 2012, to December 31, 2018				
Panel A: Mean Equation	Yield spreads		Long-term (10 year) government bond yields	
	ΔItalian spread	ΔSpanish spread	ΔDomestic bond yield	German bond yield
Constant	0.002	0.001	0.002	1.50E-06
Stock return _{t-1}	-0.002	-0.001	-0.001	-0.003
Volatility index	-0.02***	-0.02***	-0.03***	-0.04***
ECB announcements	-0.0001**	-0.0004**	-0.0003**	-0.008**
Surprise component	2.05E-05	3.20E-06	-0.002	-0.0001**
Panel B: Variance Equation				
Constant	-0.99***	-0.81***	-0.78***	-0.70***
Conditional shock	0.15***	0.15***	0.14***	0.13***

Volatility persistence	-0.04***	-0.03***	-0.03***	-0.01***
Asymmetric effect	0.95***	0.97***	0.96***	0.98***

Note: *, **, *** denotes 10% , 5% and 1% level of significance

Source: Author's calculations

In Error! Reference source not found. I show the impact of ECB unconventional monetary policies on Finland stock returns. The results for both spreads, Italian (Spanish)-German spread and domestic government bond yields indicate similar results to those of Danish stocks. I find a negative yield of distressed countries and domestic government bonds and a positive impact for German government bonds. The results are similar to those of (Chebbi 2018) who state that ECB's unconventional monetary policies were effective in declining the yields and a higher economic sentiment, has caused "flight to quality" to Nordic countries. Thus, capital flows in Nordic government bond yields have caused a higher German yield. Newby & Orjansiemi (2015) state that as Finland is part of the EU and mirrors ECB's decisions, its reaction to the crisis was a reflection of ECB Council's announcement in 2015 on the launch of Expanded Asset Purchase Programme (EAPP). The announcement rose the Euro Equity Index and German government bond yield and reduced the Spanish government bonds by 0.25 percentage point. The same impact was on the Finnish long-term government bond yields by a 0.13 percentage points. Thus, a reduction of the yields of distressed countries and domestic government bond yields leads to increase of Finnish stock markets. The reason of resilience of Finnish stock markets is the information technology (IT) sector which seems to be the "bone" of Finnish economy. In the past 3 decades, Finnish economy went through serious banking crisis therefore, the crisis of 2007-2008 did not lead to a depression as the other economies. Due the few idiosyncratic developments, Finnish economy lost a decade of growth from 2007 to 2017 (Valimaki & Obstbaum 2020). World Today News (2020) states that the recent crisis that are affecting the world such as US-China trade wars, tensions in Middle East and Brexit has led to uncertainty. However, Finland economy is seen as safe and resilient (even though not immune) because of the crisis in the past. Hence, Finnish economy is seen as an opportunity of a bear market providing buying opportunities for value investors.⁷⁵ Different from other economies, Finland stands better given its strong fundamentals. Its strategic location and resilience to political instabilities made Finland to be considered as the gateway of Europe and when there is instability in Europe, there will be a diversion of funds to Helsinki stock. Large-cap companies listed offer the investors the opportunity of diversification and truly global investment. Nokia seems to be the best value stock traded in the OMXH stock exchange due to its fundamentals and technical perspective. Overall, Finnish stock market provides the best option for investors to grow the cash with low risk and it has proven its resilience before other economies in the Eurozone, Asia and US (World Today News 2020).

⁷⁵ A bearish economy is an opportunity to buy, especially when the long term growth forecast is bright (World Today News, 2020)

Table 3. 7 Effects of unconventional monetary policy announcements by European Central Bank on Finland stock returns: Full sample period

Panel A: Mean Equation	Yield spreads		Long-term (10 year) government bond yields	
	Δ Italian spread	Δ Spanish spread	Δ Domestic bond yield	German bond yield
Constant	0.002**	0.001**	0.0004**	0.0003
Stock return _{t-1}	0.01*	0.01**	0.01*	0.01*
Volatility index	-0.09***	-0.08***	-0.08***	-0.10***
ECB announcements	-0.0006***	-0.0005***	-0.0003***	-0.0007***
Surprise component	-1.44E-06***	-1.001E-06**	-0.01***	0.0003***
Panel B: Variance Equation				
Constant	-0.22***	-0.32***	-0.31***	-0.34***
Conditional shock	0.15***	0.18***	0.17***	0.18***
Volatility persistence	-0.08***	-0.01***	-0.02***	-0.01***
Asymmetric effect	0.87***	0.97***	0.97***	0.97***

Note: *, **, *** denotes 10%, 5% and 1% level of significance

Source: Author's calculations

In Table 3. **8Error! Reference source not found.** I show the results for Finland stock returns for the divided samples. The findings show that in the crisis period there is a negative impact in the Italian (Spanish) spread and Finnish government bond yield while there is a positive impact in the German government bond yield. This indicates that ECB anticipated announcements has had a negative impact in reducing the government bond yields of distressed countries. Further, Finnish bonds are good substitutes of euro area bonds hence, when the risk is high there is capital outflow from other euro area countries to Nordic countries. The opposite happens in the postcrisis period in which I do not find impact on surprise components. There is a positive impact on the domestic government bond yields and negative impact in German bond yield indicating that after the financial crisis, when the economic sentiment is increased investors switch to euro area bonds. Hence, Finnish yields increase while German bonds become attractive, and its yields decrease. The results of the crisis period are similar to those of the full sample, highlighting that crisis sample highly influences those of the full sample. The coefficient in the volatility index and ECB announcements are negative in both samples indicating that Finland, as part of the EU will mirror the decisions of ECB. Moreover, the sign of the risk is negative as expected.

The coefficients in the variance equations are highly significant and it indicates that the shocks in the Finnish stocks do not die out quickly.

Table 3. 8 Effects of unconventional monetary policy announcements by European Central Bank on Finland stock returns: Divided samples

Crisis period: January 01, 2008, to June 29, 2012				
Panel A: Mean Equation	Yield spreads		Long-term (10 year) government bond yields	
	Δ Italian spread	Δ Spanish spread	Δ Domestic bond yield	German bond yield
Constant	-0.0001	-0.0003	-0.0001	-0.0001
Stock return _{t-1}	-0.002	-0.022**	-0.014	-0.013
Volatility index	-0.154***	-0.121***	-0.123***	-0.180***
ECB announcements	-0.0002**	-0.0003**	-0.0008***	0.0001**
Surprise component	-0.011***	-0.010***	-0.030***	0.021***
Panel B: Variance Equation				
Constant	-0.230***	-0.118***	-0.154***	-0.203***
Conditional shock	0.87***	0.078***	0.100***	0.118***
Volatility persistence	-0.032***	-0.035***	-0.037***	-0.053***
Asymmetric effect	0.90***	0.92***	0.92***	0.95***
Postcrisis period: July 02, 2012, to December 31, 2018				
Panel A: Mean Equation	Yield spreads		Long-term (10 year) government bond yields	
	Δ Italian spread	Δ Spanish spread	Δ Domestic bond yield	German bond yield
Constant	0.0001*	0.0002*	0.0002*	0.0028
Stock return _{t-1}	0.02**	0.03**	0.07**	0.01**
Volatility index	-0.05***	-0.04***	-0.03***	-0.04***
ECB announcements	-0.008*	-0.003*	-0.002*	-0.002**
Surprise component	-2.58E-05	-1.22E-05	0.012***	-0.0003*
Panel B: Variance Equation				
Constant	-0.32***	-0.32***	-0.25***	-0.24***
Conditional shock	0.24***	0.24***	0.23***	0.25***
Volatility persistence	0.03	0.05	0.001	0.005
Asymmetric effect	0.84***	0.84***	0.81***	0.80***

Note: *, **, *** denotes 10% , 5% and 1% level of significance

Source: Author's calculations

In Table 3. 6, I define the results for ECB impact on Iceland stock returns. Iceland's stock market is a new market in comparison to other Nordic markets. Icelandic stock market foundation was settled in early 2000s with the first company registered electronically. However, the number of companies were both few in number and small in size, on account of Iceland's economy. Majority of them were family firms or with

small shareholders with restricted capital. Further, there was no organized securities market while privatization began late, and restrictions applied to foreign investments in Icelandic industry (Gudjónsdóttir 2000). Before the crisis, Icelandic stock markets rose up to 900 percent (Boyes 2009) whilst in the wake of the crisis Icelandic stock market shot up 9 times which is near to a world record (Wade & Sigurgeirsdóttir 2011). In October 2008, Icelandic economy collapsed. Three largest banks collapsed due to foreign debt, which made the investors to run out of Iceland. Almost every business collapsed, mortgage costs doubled, while housing prices fell. Kimberly (2020) states that krona went approximately 10 percent whilst stock market fell approximately 95 percent. Hardarson (2014) defined that after the collapse of the Icelandic stock market certain measures need to be taken in order to support the companies and the economy. The first measure was the swift abolition of capital controls, by locking the domestic capital it increases the risk of asset price bubbles. This will create reluctance for the foreign capital to enter the market under capital controls, even if there are no restrictions for the flow of foreign investment. On one hand, this will weaken the market as it may counteract the threat of price bubbles created by the locked-in domestic capital. On the other hand, it reduces the opportunity of Icelandic companies to raise capital domestically for expansion abroad. Therefore, Iceland's stock market is composed mostly of companies that use funds domestically such as service companies. Another issue unaddressed is the legislature related to securities lending and short selling. If the facilitation of short selling would be done prior to the meltdown, it would have highlighted the weaknesses of the system and slow down or halted the expansion of the banks at an earlier stage. Indeed, the legislation of securities trading does not impose restrictions on short selling but in practice short selling is restricted because pension funds by law are not allowed to lend securities. These issues could lead to relocation of companies and especially the largest part abroad. If the capital control is relaxed, probably companies might opt to expand from their base in Iceland. However, the concept of stock exchange to help small companies grow got lost. Small companies do not see listing as an adequate financing whilst advisors thought that these companies do not fit for listing. As a result, the agents of a country, investors, companies and the economy suffer. However, OMX is playing a great role in the Nordics to help the small companies grow. Moreover, the structure of the market is changed, and the legislation framework helped companies to be listed and to gain access to financing. These supporting actions were the gamechanger for the companies in Iceland. The most practice measure is "IPO taskforce" which aim was to pinpoint and provide support to concrete actions that would make more attractive for the companies to list and finance themselves (Hardarson 2014). Iceland's economy survived the bankruptcy and the collapse by a rebound by tourism which could overheat the economy once again. Therefore, that's the reason that small Iceland is vulnerable to boom-and-bust cycles. Icelandic economy has been relied on fishing and aluminum smelting, as a result the fishing industry is vulnerable to the reduction of global fish stocks caused by overfishing and climate change (Kimberly 2020). In my study period, I find a negative impact of the Italian (Spanish) spreads and domestic government bond yields on stocks of Iceland which are consistent with the findings of

(Haitsma, Unalmis, & De Haan 2016; Krishnamurthy, Nagel, & Vissing-Jorgensen 2018; Chebbi 2018).

Table 3. 9 Effects of unconventional monetary policy announcements by European Central Bank on Iceland stocks returns: Full sample period

Panel A: Mean Equation	Yield spreads		Long-term (10 year) government bond yields	
	Δ Italian spread	Δ Spanish spread	Δ Domestic bond yield	German bond yield
Constant	-0.002***	-0.001***	-0.002***	-0.003***
Stock return _{t-1}	-0.18***	-0.15***	-0.16***	-0.22***
Volatility index	-0.07***	-0.03***	-0.02***	-0.02***
ECB announcements	0.008***	0.0036***	0.0002*	0.001***
Surprise component	-2.13E-06*	-2.22E-06*	-0.06***	0.002***
Panel B: Variance Equation				
Constant	-2.12***	-2.20***	-1.42***	-2.28***
Conditional shock	0.60***	0.65***	0.20***	0.76***
Volatility persistence	-0.15***	-0.18***	-0.53***	-0.18***
Asymmetric effect	0.44***	0.41***	0.52***	0.40***

Note: *, **, *** denotes 10%, 5% and 1% level of significance

Source: Author's calculations

When I divide the sample, in crisis and postcrisis period, obviously the results of the crisis are similar to those of the full sample, giving evidence that the crisis period has had a significant in the full sample. In the postcrisis period, the increase of government bond yields increases the stocks whilst the opposite happens with the German yield.

Table 3. 10 Effects of unconventional monetary policy announcements by European Central Bank of Iceland stock returns: Divided samples

Crisis period: January 01, 2008, to June 29, 2012				
Panel A: Mean Equation	Yield spreads		Long-term (10 year) government bond yields	
	Δ Italian spread	Δ Spanish spread	Δ Domestic bond yield	German bond yield
Constant	-0.002***	0.0001**	-0.001***	0.007***
Stock return _{t-1}	-0.089***	-0.075	-0.10***	-0.033*
Volatility index	-0.050***	0.005***	-0.05***	-0.002**
ECB announcements	0.009**	0.0001*	0.09**	0.0002**
Surprise component	-0.004***	-0.002**	-0.005*	0.0003***
Panel B: Variance Equation				

Constant	-3.25***	-2.28***	-3.33**	-2.32***
Conditional shock	0.89***	0.39***	0.79***	0.29***
Volatility persistence	-0.28***	-0.10***	-0.43***	-0.10***
Asymmetric effect	0.39***	0.42***	0.40***	0.38***
Postcrisis period: July 02, 2012, to December 31, 2018				
Panel A: Mean Equation	Yield spreads		Long-term (10 year) government bond yields	
	Δ Italian spread	Δ Spanish spread	Δ Domestic bond yield	German bond yield
Constant	-0.0002	0.0003***	0.001***	0.003***
Stock return _{t-1}	-0.11***	-0.14***	-0.17***	-0.40***
Volatility index	-0.03***	-0.08***	-0.03***	-0.04***
ECB announcements	-2.18E-05	0.0007	-0.002***	-0.006***
Surprise component	1.25E-06	1.29E-06	0.001**	-0.01***
Panel B: Variance Equation				
Constant	-2.43***	-3.04***	-3.64***	-3.33***
Conditional shock	0.10***	0.50***	0.53***	0.78***
Volatility persistence	-0.18***	-0.09***	-0.45***	-0.56***
Asymmetric effect	0.18***	0.33***	0.38***	0.34***

Note: *, **, *** denotes 10% , 5% and 1% level of significance

Source: Author's calculations

Overall, the sign of the volatility index and ECB announcement is as expected showing that even though Iceland is not part of the EU, I find high significance of ECB's spillovers of unconventional monetary policy in Iceland.

Another major market is the Norwegian Stock Market which is relatively small, it includes the most influential companies and neglected market and with more than 190 years history, it reached approximately 2022 billion total market capitalization (Shan & Sijia 2015). Over the last 20 years Norwegian stock market has been of the world's best performing (Arctic Asset Management 2018). Norwegian markets have a disparity of returns in connection to Nordic markets do not have correlation due to industries and sectors in the different markets. However, Norwegian equity market is a great place to invest with companies that are profitable, internationally competitive with historical returns and a robust market structure. Oslo index is dominated by energy companies with over 50 companies listed and is one of the largest sectors in terms of market cap. Energy sector companies consist in the oil sector with a large proportion such as shipping and maritime companies (IPE 2010). In 2018 energy sector composed 17 percent of the market whilst financial sector 18 percent. Country's sovereign credit rating is AAA+ with stable outlook which comes as a result of its sovereign wealth fund of 1 trillion dollars. Further, its banks are the world's best capitalized (Arctic

Asset Management 2018). Johansen (2020) highlights that Norwegian public sector is strong and large, however, even though the vast majority of the fund is secured through oil income, local economy is less influenced by the oil price. Norwegian companies have less to do with the economy, and to a large degree sell goods and services in international markets, decoupled from oil. Oil sector is only 20 percent of the weight of the market, meaning that 80 percent is less correlated to the oil price. Furthermore, the currency acts as a stabilizer to cushion other sectors as oil price falls. Medleva (2019) considers Norway as a land of prosperity, a country with trade surplus, therefore the country is a safe and easy spot for investments. The advantages that the economy and stock market offer are political stability and transparency; clear and modern laws; high public sector organization; innovative workplace; competent labour force; strong capacity of buying of the population and strong support of the economy on foreign investments accompanied with abundant resources and world class industries within gas, oil, energy, seafood and maritime sector. In Table 3. 11 and Table 3. 12 I show the results for the Norwegian stock market for the full sample and for divided samples. The results for the full sample show that there is a negative impact on the yield of distressed countries and Norwegian government bond yield and a positive impact in the German yield. Korus (2019) states FWG announcements lead to an increase of stock market in Norway which was associated to a decline of government bonds. The positive surprise of German government yield indicates that there is “flight to quality” from Germany and there is capital flow to Nordic government bond yields reflecting a rise in the German long-term yields.

The coefficients in the Panel B are satisfactory, indicating that variables are significant. However, the degree of persistence is not high indicating that shocks on Norway stock market die out quickly.

Table 3. 11 Effects of unconventional monetary policy announcements by European Central Bank on Norway stock returns: Full sample period

Panel A: Mean Equation	Yield spreads		Long-term(10 year) government bond yields	
	Δ Italian spread	Δ Spanish spread	Δ Domestic bond yield	German bond yield
Constant	0.003***	0.0004***	0.002***	0.003***
Stock return _{t-1}	0.19***	0.15***	0.17***	0.18***
Volatility index	-0.003**	-0.002*	-0.005*	-0.002**
ECB announcements	0.002**	0.003**	0.004**	0.002**
Surprise component	-2.33E-06**	-2.28E-06**	-0.01***	0.0002*
Panel B: Variance Equation				
Constant	-2.52***	-2.22***	-3.13***	-3.2***
Conditional shock	0.92***	0.89***	0.90***	0.94***
Volatility persistence	0.44***	0.41***	0.48***	0.53***

Asymmetric effect	0.48***	0.55***	0.47***	0.48***
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Note: *, **, *** denotes 10% , 5% and 1% level of significance

Source: Author's calculations

In Table 3. 11 and Table 3. 12, I report the findings for the crisis and postcrisis period for Norwegian stock markets. The findings show similar results to those of Denmark, Finland and Iceland. Volatility index and ECB announcements have the expected sign and are both highly significant. In the crisis period Nordic government bonds during crisis are better substitutes of euro area government bonds. The demand on the euro area bonds falls (including German government bond yields) leading to a rise of its yields. Therefore, the stocks will increase when the government bond yield will decrease. The opposite happens in the postcrisis period, as the risk reduces there is a switch to German government bond yields. Hence, the postcrisis is related to capital outflow from Nordic countries to euro area bonds. I find limited impact of ECB announcements in Norway.

Table 3. 12 Effects of unconventional monetary policy announcements by European Central Bank of Norway stock returns: Divided samples

Crisis period: January 01, 2008, to June 29, 2012				
Panel A: Mean Equation	Yield spreads		Long-term (10 year) government bond yields	
	Δ Italian spread	Δ Spanish spread	Δ Domestic bond yield	German bond yield
Constant	-0.001	-0.002	-0.003	0.003
Stock return _{t-1}	0.12	0.13	0.11	0.08
Volatility index	-0.03**	-0.02**	-0.04**	-0.03**
ECB announcements	0.0003	0.0007	0.0003*	0.001*
Surprise component	-0.009***	-0.008***	-0.023***	0.0019***
Panel B: Variance Equation				
Constant	-0.30***	-0.30***	-0.39***	-0.99***
Conditional shock	0.10***	0.95***	0.94***	0.84***
Volatility persistence	-0.19***	-0.12***	-0.20***	-0.27***
Asymmetric effect	0.90***	0.96***	0.90***	0.91***
Postcrisis period: July 02, 2012, to December 31, 2018				
Panel A: Mean Equation	Yield spreads		Long-term (10 year) government bond yields	
	Δ Italian spread	Δ Spanish spread	Δ Domestic bond yield	German bond yield
Constant	0.002***	0.002***	0.001***	0.003***
Stock return _{t-1}	0.09***	0.06***	0.08***	0.10***
Volatility index	0.003***	0.001**	0.003***	0.002***

ECB announcements	-0.001	-0.002	-0.002	0.001*
Surprise component	-2.36E-06	-2.21E-06	0.01***	-0.008***
Panel B: Variance Equation				
Constant	-3.42***	-4.27***	-3.33***	-2.39***
Conditional shock	0.10***	0.08***	0.04***	0.03***
Volatility persistence	0.48***	0.46***	0.36***	0.46***
Asymmetric effect	0.45***	0.45***	0.48***	0.50***

Note: *, **, *** denotes 10% , 5% and 1% level of significance

Source: Author's calculations

I go ahead and estimate ECB's spillovers of unconventional monetary policies in Sweden. Swedish economy has fascinated the researchers and academics all over the world in the way how it ditched the negative rates when the other main central bank was still at the lowest bound. Riksbank is one of the oldest banks in the world and the first after ECB which reduces its rate into negative territory. Swedish stock market is one of the eight stock exchanges that belongs to Nasdaq Nordic, a subsidiary of Nasdaq that operates stock exchanges in Nordic and Baltic countries and provides access to 80 percent of the Nordic and Baltic securities market. It lists approximately 310 companies and has a market cap of \$ 1.3 trillion. Dahlquist & Robertsson (2001) study the ownership in Swedish firms and the authors state that investors from abroad prefer securities in large firms that pay low dividends and have low debts levels. Moreover, foreign investors show a preference for firms with a wide spread of ownership and firms that participate in the international markets to a large extent. Similar to (Dahlquist & Robertsson 2001), (Holm 2006) investigates if the relations between the degree of foreign ownership and firm-specific characteristics have changed due to the changes of Swedish stock market. The findings suggest that foreign investors have changed a certain preference for securities in firms with high market value. Moreover, investors from outside Sweden seem more attracted to firms with a lower systematic risk; larger shares in firms with smaller debts compared to their equity and in firms that have better ability to manage current payments. In Table 3. 13 I report the results for the impact of ECB announcements on Sweden stock returns. Overall, I find similar results for Sweden to other Nordic countries. The sign of the Italian (Spanish) spread, and government bond yields is negative while the impact of German bond yield is positive. The results support those of (Korus 2019) who states that FWG increase stock markets.

Table 3. 13 Effects of unconventional monetary policy announcements by European Central Bank on Sweden stock returns: Full sample period

Panel A: Mean Equation	Yield spreads		Long-term(10 year) government bond yields	
	Δ Italian spread	Δ Spanish spread	Δ Domestic bond yield	German bond yield
Constant	5.45E-05	5.E-05	-2.54E-05	-0.0002

Stock return _{t-1}	-0.03	-0.01	-0.03	-0.01
Volatility index	-0.005***	-0.004***	-0.001*	-0.003***
ECB announcements	-0.0006**	-0.0002**	-0.0006***	-0.0005*
Surprise component	-4.22E-06**	-2.45E-06**	-0.01**	0.0001**
Panel B: Variance Equation				
Constant	-0.20***	-0.19***	-0.18***	-0.13***
Conditional shock	0.15***	0.11***	0.09***	0.08***
Volatility persistence	-0.05***	-0.04***	-0.05***	-0.05***
Asymmetric effect	0.92***	0.91***	0.94***	0.91***

Note: *, **, *** denotes 10% , 5% and 1% level of significance

Source: Author's calculations

The coefficients in the variance equation come all with the expected sign and magnitude and indicate the presence of the asymmetric effects, while the coefficient on the shock persistence shows that shocks to Sweden stocks do not die quickly. The results for Sweden stocks in Table 3. 1, in both samples indicate that Swedish government bonds are good substitutes of euro area bonds, hence, the demand of Swedish government bonds will increase, the price of bonds will increase while the yield will fall. I find negative sign for the volatility index and the dummy for ECB announcements. The findings for both samples are similar to overall sample. However, there is no significant effect of the non-anticipated component in the postcrisis period. Korus (2019) stated that FWG announcements were the effective in influencing the long-term government bond through the signaling channel. Moreover, as expected FWG announcements lead to increase of stock market indices in the countries of interest. Alsterlind et al. (2015) highlights that Riksbank operated through four specific channels which support the findings of (Korus 2019). The channels are: Signaling channel based on which the purchase signals expansive monetary policy; premium channel, the purchases reduce the supply of bonds, by increasing their prices and reduce their yields; portfolio channel which operates through the purchases that might have contagion effects to the prices of other assets and liquidity channel because of the purchases, the liquidity surplus of the banks associated to Riksbank increases. Except of (Korus 2019), my results confirm those of Sandgren & Soumaoro (2018) found evidence of ECB influencing the yield curve, implying that ECB influences the expectations of Swedish economy. Hence, the Riksbank monetary policy is highly impacted by the ECB monetary shocks whilst for the stock markets ECB repo rate has a significant impact in the Swedish stock markets.

Table 3. 1 Effects of unconventional monetary policy announcements by European Central Bank of Sweden stock returns: Divided samples

Crisis period: January 01, 2008, to June 29, 2012		
Panel A: Mean Equation	Yield spreads	Long-term (10 year) government bond yields

	Δ Italian spread	Δ Spanish spread	Δ Domestic bond yield	German bond yield
Constant	-0.0001	-0.0003	-0.0002	0.0003
Stock return _{t-1}	-0.030	-0.033**	-0.032	-0.032
Volatility index	-0.002**	-0.0001**	0.0008***	-0.005
ECB announcements	0.0002***	0.0001***	0.0003***	0.0002***
Surprise component	-0.020***	-0.018***	-0.038***	0.0008*
Panel B: Variance Equation				
Constant	-0.20***	-0.18***	-0.22***	-0.22***
Conditional shock	0.10***	0.11***	0.10***	0.11***
Volatility persistence	-0.112***	-0.089***	-0.085***	-0.09***
Asymmetric effect	0.90***	0.89***	0.89***	0.87***
Postcrisis period: July 02, 2012, to December 31, 2018				
Panel A: Mean Equation	Yield spreads		Long-term (10 year) government bond yields	
	Δ Italian spread	Δ Spanish spread	Δ Domestic bond yield	German bond yield
Constant	3.60E-05	2.10E-05	2.29E-05	-2.24E-05
Stock return _{t-1}	0.0002	-0.003	-0.0004	-0.003
Volatility index	-0.003***	-0.002***	-0.003***	-0.002***
ECB announcements	-0.002	-0.002	-0.005	-0.004**
Surprise component	-2.23E-06	-2.45E-06	-0.05***	0.008**
Panel B: Variance Equation				
Constant	-0.36***	-0.42***	-0.35***	-0.35***
Conditional shock	0.10***	0.10***	0.10***	0.10***
Volatility persistence	-0.10***	-0.15***	-0.09***	-0.11***
Asymmetric effect	0.93***	0.97***	0.95***	0.93***

Note: *, **, *** denotes 10% , 5% and 1% level of significance

Source: Author's calculations

Overall, I find that ECB's unconventional monetary policies were effective in reducing the yields of countries under stress. Further, it helped to reduce the yields of Nordic countries and there is "flight to quality" from Germany, euro area bonds to Nordic bonds. Hence, Nordic countries tend to be adequate substitutes of euro area bonds in terms of financial risk.

3.6 Conclusion

In this study I estimate the impact of ECB's unconventional monetary policies in stock market prices of Nordic countries from January 01, 2008 to December 31, 2018. By

contrast to the existing studies, I have used recent data while prior studies focus mostly on 2008-2012 period and in the most known programs, while I cover all types of unconventional monetary policies. As the whole framework represents different market sentiments and conditions, I divide the sample in two subsamples: crisis and postcrisis period. I capture the anticipated component of ECB unconventional monetary policy through a dummy while the surprise component is represented by four different measures. The surprise component consists of the change in the spread between the German and Italian (Spanish) 10-year government bond yields, the change in the domestic government bond yield and the yield of German government bond yield.

This chapter reveals the following findings: Firstly, using an Exponential Generalized Conditional Autoregressive Heteroskedastic model, the findings confirm the impact of monetary policy surprises in Nordic stock returns. Second, the results indicate that a positive monetary surprise is associated with a decrease of the yields in the distressed countries and a decrease of the domestic government bond yield, increase the stock market prices. During the crisis period, Nordic countries were associated to a reduction of bond yields, hence, being good substitutes of euro area bonds. There is less risk in the Nordic region hence, there is credit flow in the region and the German government bond yield increases. The opposite happens in the postcrisis period as investors switch to euro area bonds and the yield of Nordic government bond yields increases. Further, the difference in the results for the crisis and postcrisis period indicate that the crisis period has had the most significant effect. I find slight changes among the overall sample and crisis period; I find highly significant effects of ECB announcements and the surprise component in Denmark, Finland and Iceland whilst the impact in Norway and Sweden in the postcrises period is limited. To conclude, the results of the overall sample are mainly driven by the first sample while the impact is limited for the second subsample. There is high impact of unconventional monetary policies of ECB in Iceland even though Iceland does not belong to European Union countries but is part of European Union Agreement and European Free trade Association. The findings confirm those of (Haitsma, Unalmis, & De Haan 2016) and (Chebbi 2018) that ECB's unconventional were effective in reducing the sovereign spreads of the countries under stress, however, instead of a flight to quality to German government bond yields, investors turn to domestic government bond yields. Opposite to (Korus 2019), I find that especially during the crisis period stock markets of Nordic markets were highly affected.

The findings of this chapter have great importance for the investors and the policymakers. Agents should try to understand and predict the decisions of ECB in the euro area in their portfolio choice as I reveal significant response of stock prices to the surprise component of announcements. Further, the investors should take in account all the relevant information (sovereign spreads, domestic government bond yields or a benchmark asset such as German government bond yields). The magnitude of the impact should be considered based on the heterogeneity of the countries and the

difference on the response on the crisis and postcrisis period. The chapter has confirmed that ECB unconventional monetary policies were successful in reducing the spreads of distressed countries and increased the stock prices. Hence, when planning an asset purchase programme, the authorities should coordinate their actions to get better response and absorption of the news from the market participants.

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APPENDIX

Table 1. 1 ECB's unconventional monetary policy

Date	Description
10/01/2008	GovC meeting, US dollar liquidity providing operations
07/02/2008	GovC meeting, renewal of two suppl. LTROs
06/03/2008	GovC meeting
11/03/2008	The GovC decided to conduct US dollar liquidity providing operations
28/03/2008	The GovC decided to conduct supplementary 6 month LTROs
10/04/2008	GovC meeting
02/05/2008	The GovC decided to enhance US dollar liquidity providing operations
08/05/2008	GovC meeting
05/06/2008	GovC meeting
03/07/2008	GovC meeting
30/07/2008	The GovC decided to enhance US dollar liquidity providing operations
31/07/2008	The GovC decide to renew two LTROs
07/08/2008	GovC meeting
04/09/2008	GovC meeting, renewal of two LTROs
18/09/2008	The GovC decided to enhance US dollar liquidity providing operations
26/09/2008	The GovC decided to enhance US dollar liquidity providing operations
29/09/2008	The GovC decided to double the temporary swap lines with the Fed
02/10/2008	GovC meeting
07/10/2008	The GovC decided to enhance a LTROs and expand US dollar liquidity providing operations

08/10/2008	The GovC decided to adopt a fixed rate tender procedure with full allotment
13/10/2008	The GovC decided to conduct US dollar liquidity providing operations
15/10/2008	The GovC decide to expand the list of assets eligible as collateral, enhance the provision of LTROs and provide US dollar liquidity using forex swaps
16/10/2008	ECB agree with Magyar Nemzeti Bank to provide liquidity in euro
17/10/2008	Specifications for the expansion of collateral
27/10/2008	Swap line among Central Bank of Denmark and ECB
06/11/2008	GovC meeting
12/11/2008	Specifications for the expansion of collateral
17/11/2008	Specifications for the expansion of collateral
21/11/2008	Swap line among Central Bank of Poland and ECB
26/11/2008	Specifications for the expansion of collateral
04/12/2008	GovC meeting
18/12/2008	The GovC decided that MROs will continue to be carried out through FRTFA for as long as needed
19/12/2008	The GovC decided to conduct US dollar liquidity providing operations
15/01/2009	GovC meeting
16/01/2009	Cooperation among ECB and Swiss National Bank to provide liquidity
20/01/2009	Adjustment measures for newly issued asset-backed securities and for uncovered bank bonds
03/02/2009	The GovC decided to extend the temporary swap lines with the Fed
05/02/2009	GovC meeting
05/03/2009	The GovC decided to continue the FRTFA for MROs and LTROs for as long as needed
19/03/2009	The GovC decided to conduct US dollar liquidity providing operations
02/04/2009	GovC meeting
06/04/2009	The GovC decided to establish temporary reciprocal currency arrangement with the Fed
07/05/2009	GovC decided to proceed with the ECS, they decide purchasing euro-denominated bonds in the euro area and to conduct LTROs with maturity of one year
04/06/2009	The GovC decided for the technical modalities of CBPP1
10/06/2009	Swap line activated among Sveriges Riksbank and ECB
25/06/2009	The GovC decided to extend the liquidity swap arrangements with the Fed
02/07/2009	GovC meeting
06/08/2009	GovC meeting
03/09/2009	GovC meeting
24/09/2009	The GovC decided to conduct US dollar liquidity providing operations
08/10/2009	GovC meeting
05/11/2009	GovC meeting
20/11/2009	Amendments for asset-backed securities in Eurosystem credit operations
03/12/2009	The GovC decided to continue conducting its MROs as FRTFA for as long as needed, and to enhance the provision of LTROs
14/01/2010	GovC meeting
18/01/2010	ECB discontinues the Swiss franc liquidity-providing operations

27/01/2010	ECB and other banks decide to discontinue the swap facilities
04/02/2010	GovC meeting
04/03/2010	The GovC decided to continue conducting its MROs as FRTFA for as long as needed, and to enhance the provision of LTROs
08/04/2010	GovC meeting
06/05/2010	GovC meeting
10/05/2010	The GovC decided to proceed with the SMP, to reactivate the temporary liquidity swap lines with the Fed, to adopt a FRTFPA in the regular 3-month LTROs, and conduct new special LTROs
10/06/2010	The GovC decided to adopt a FRTFPA in the regular 3-month LTROs
08/07/2010	GovC meeting
28/07/2010	ECB reviews risk control measures in its collateral framework
05/08/2010	GovC meeting
02/09/2010	The GovC decided to continue conducting its MROs as FRTFPA for as long as needed and to conduct 3-month LTROs as FRTFPA
07/10/2010	GovC meeting
09/10/2010	New provisions for the framework for implementation of monetary policy in the euro area
04/11/2010	GovC meeting
02/12/2010	The GovC decided to continue conducting its MROs as FRTFPA for as long as needed and to conduct 3-month LTROs as FRTFPA
16/12/2010	ECB introduces ABS loan-by-loan information requirements in the Eurosystem collateral framework
17/12/2010	The ECB announced a temporary swap facility with the Bank of England
21/12/2010	The GovC decided to extend the liquidity swap arrangements with the Fed
13/01/2011	GovC meeting
03/02/2011	GovC meeting
03/03/2011	The GovC decided to continue conducting its MROs as FRTFPA for as long as needed and to conduct 3-month LTROs as FRTFPA
07/04/2011	GovC meeting
05/05/2011	GovC meeting
09/06/2011	The GovC decided to continue conducting its MROs as FRTFPA for as long as needed and to conduct 3-month LTROs as FRTFPA
29/06/2011	The GovC decided to extend the liquidity swap arrangements with the Fed
07/07/2011	GovC meeting
04/08/2011	The GovC decided to continue conducting its MROs as FRTFPA for as long as needed and to conduct 3-month LTROs as FRTFPA and to conduct a liquidity providing supplementary LTRO with a maturity of 6 months as a FRTFPA
08/08/2011	The GovC decided to implement its SMP for Italy and Spain
25/08/2011	The GovC decided to extend the liquidity swap arrangements with the BOE
08/09/2011	Monetary policy decision
15/09/2011	The GovC conducts 3 Us dollar liquidity-providing operations in coordination with other central banks
06/10/2011	GovC meeting , the GovC decided to to continue conducting its MROs as FRTFPA, for as long as necessary and to conduct 3-month LTROs as FRTFPA, to conduct 2 liquidity-providing supplementary LTROs with a maturity of 12 and 13 months as FRTFPA, and to launch new covered bond purchase
03/11/2011	GovC meeting. The GovC decided upon the technical modalities of CBPP2

30/11/2011	The GovC decided in cooperation with other central banks the establishment of a temporary network of reciprocal swap lines
08/12/2011	GovC meeting. The Govc decided to conduct two LTROs with a maturity of 3 years and to increase collateral availability
21/12/2011	Results of first 3-year LTRO
12/01/2012	GovC meeting
09/02/2012	GovC meeting . The GovC approved specific national eligibility criteria and risk control measures for the temporary acceptance in a number of countries of additional credit claims as collateral in Eurosystem credit operations.
28/02/2012	Results of second 3-year LTRO
08/03/2012	GovC meeting
04/04/2012	GovC meeting
03/05/2012	GovC meeting
06/06/2012	GovC meeting. The GovC decided to continue to conduct its MROs as FRTPFAs for as long as necessary, and to conduct 3-month LTROs as FRTPFAs
22/06/2012	The GovC took further measures to increase collateral availability for counterparties
05/07/2012	GovC meeting
06/07/2012	ECB announces implementation of loan-level data reporting requirements for asset-backed securities ^[11]
26/07/2012	Dragji's London Speech
02/08/2012	GovC meeting. The GovC announced that it may undertake outright open market operations of a size of adequate to reach its objective
27/08/2012	Asmussen's Hamburg Speech supporting the new bond purchase program
06/09/2012	GovC meeting. GovC announced the technical details of OMTs and decided on additional measures to preserve collateral availability
12/09/2012	The GovC decided to extend the liquidity swap arrangements with the BOE
04/10/2012	GovC meeting
31/10/2010	End of CBPP2
08/11/2012	GovC meeting
27/11/2012	ECB announces rescheduling of loan-level data reporting requirements
06/12/2012	GovC meeting , the GovC decided to to continue conducting its MROs as FRTPFAs, for as long as necessary and to conduct 3-month FRTPFAs
13/12/2012	The GovC decided to extend the liquidity swap arrangements with the Fed
10/01/2013	Govc meeting, decision that the interest rate on the main refinancing operations and the interest rates on the marginal lending facility and the deposit facility will remain unchanged
07/02/2013	Govc meeting, decision that the interest rate on the main refinancing operations and the interest rates on the marginal lending facility and the deposit facility will remain unchanged
21/02/2013	The GovC decided to publish the Eurosystem's holdings of securities acquired under the SMP
07/03/2013	Govc meeting, decision that the interest rate on the main refinancing operations and the interest rates on the marginal lending facility and the deposit facility will remain unchanged
22/03/2013	Collateral rule changed for some uncovered gov-guaranted bank bonds
04/04/2013	Govc meeting, decision that the interest rate on the main refinancing operations and the interest rates on the marginal lending facility and the deposit facility will remain unchanged
02/05/2013	GovC decided to continue conducting its MROs as fixed rate tender procedures with full allotment for as long as necessary, and at least until the end of 6th maintenance period of 2014. GovC decided to conduct three-month longer-term refinancing operations (LTROs) as fixed rate tender procedures with full allotment.
06/06/2013	Govc meeting, decision that the interest rate on the main refinancing operations and the interest rates on the marginal lending facility and the deposit facility will remain unchanged

04/07/2013	Key interest rates will remain at present or lower levels for an extended period (Draghi's Press conference)
18/07/2013	ECB further reviews its risk control framework allowing for a new treatment of asset-backed securities
01/08/2013	Govc meeting, decision that the interest rate on the main refinancing operations and the interest rates on the marginal lending facility and the deposit facility will remain unchanged
05/09/2013	Govc meeting, decision that the interest rate on the main refinancing operations and the interest rates on the marginal lending facility and the deposit facility will remain unchanged
16/09/2013	The Govc decided, in agreement with Bank of England, to extend the liquidity swap arrangement with the BOE
27/09/2013	ECB adopts decisions to follow up on the review of its risk control framework
02/10/2013	Govc meeting, decision that the interest rate on the main refinancing operations and the interest rates on the marginal lending facility and the deposit facility will remain unchanged
10/10/2013	ECB establishes a bilateral currency swap agreement with People's Bank of China
31/10/2013	ECB establishes standing swap arrangements with other central banks
07/11/2013	GovC decided to continue conducting its MROs as fixed rate tender procedures with full allotment for as long as necessary, and at least until the end of 6th maintenance period of 2015. GovC decided to conduct three-month longer-term refinancing operations (LTROs) as fixed rate tender procedures with full allotment.
08/11/2013	ECB announces details of refinancing operations with settlement in the period from 9 July 2014 to 7 July 2015
05/12/2013	Govc meeting, decision that the interest rate on the main refinancing operations and the interest rates on the marginal lending facility and the deposit facility will remain unchanged
09/01/2014	GovC meeting
06/02/2014	GovC meeting
06/03/2014	GovC meeting
03/04/2014	GovC meeting
08/05/2014	GovC meeting, Draghi's press conference
05/06/2014	GovC meeting in which was decided to conduct a series of LTROs to improve the bank lending to the non-financial private sector in the euro area excluding loans to households for house purchase. The GovC decided to conduct the main and three-month LTROs as fixed rate tender procedures with full allotment for as long as necessary. GovC decided to extend the existing list of eligibility of additional assets as collateral, notably under the additional credit claims framework, at least until September 2018 and to intensify preparatory work related to outright purchases of asset-backed securities.
17/06/2014	GovC decided to continue offering seven-day US dollar liquidity-providing operations
03/07/2014	GovC decided for more technical details for the series of targeted TLTROs
29/07/2014	ECB publishes legal act relating to targeted longer-term refinancing operations
07/08/2014	GovC meeting
04/09/2014	GovC decided to purchase a broad portfolio of simple and transparent ASBs with underlying assets consisting of claims against the euro-area non financial private sector under an ABS purchase programme. GovC decided that the Eurosystem would purchase a broad portfolio of euro-denominated bonds issued by MFIs domiciled in the euro area under a new covered purchase programme.
18/09/2014	ECB allots 82.6 Euro billion in first targeted longer-term refinancing operation
02/10/2014	The ECB announced operational details of asset-backed securities and covered bond purchase programmes
06/11/2014	GovC meeting
07/11/2014	ECB suspends early repayments of the three-year LTROs during the year-end period
17/11/2014	Draghi's Speech
26/11/2014	Constancio's Speech
04/12/2014	Draghi's Press Conference Speech + Monetary decision

22/01/2015	GovC announced the expanded asset purchase programme, the interest rate for the remaining six LTROs would be equal to the rate on the Eurosystem's MROs prevailing at the time when each TLTRO is conducted
25/02/2015	Draghi's Speech "The programme is intended to last until end-September 2016. In any case, it will last until the Governing Council sees a sustained adjustment in the path of inflation which is consistent with its aim of achieving inflation rates below, but close to, 2% over the medium term.
05/03/2015	GovC meeting
23/03/2015	Draghi's Speech "We intend to carry out our purchases at least until end-September 2016, and in any case until we see a sustained adjustment in the path of inflation which is consistent with our aim of achieving inflation rates below, but close to, 2% over the medium term"
26/03/2015	Draghi's Speech ".We intend to pursue these purchases at least until the end of September 2016 and in any case until we see an inflation path that is sustainably approaching our objective"
29/03/2015	ECB and Bank of England announce measures to enhance financial stability in relation to centrally cleared markets in the EU
15/04/2015	GovC meeting
17/04/2015	Draghi's Speech "We intend to purchase private and public securities until end-September 2016. In any case, we will continue the purchases until the Governing Council sees a sustained adjustment in the path of inflation which is consistent with its aim of achieving inflation rates below, but close to, 2% over the medium term.
20/04/2015	Constancio's Speech " The purchases under the expanded asset purchase programme are intended to be carried out until end-September 2016, and in any case until the Governing Council sees a sustained adjustment in the path of inflation which is consistent with its aim of achieving inflation rates below, but close to, 2% over the medium term."
14/05/2015	Draghi's Speech "To that effect, we will implement in full our purchase programme as announced and, in any case, until we see a sustained adjustment in the path of inflation. After almost 7 years of a debilitating sequence of crises, firms and households are very hesitant to take on economic risk. For this reason quite some time is needed before we can declare success, and our monetary policy stimulus will stay in place as long as needed for its objective to be fully achieved on a truly sustained basis"
03/06/2015	GovC meeting
15/06/2015	Draghi's Speech " We need to keep a steady monetary policy course and firmly implement those measures, including our expanded asset purchase programme. It is our clear intention to purchase private and public sector securities of EUR 60 billion per month on average until the end of September 2016 and, in any case, until we see a sustained adjustment in the path of inflation that is consistent with our aim of achieving inflation rates below, but close to, 2% over the medium term"
03/07/2015	Constancio's Speech " Our main policy rates will stay low for a prolonged period of time, as indicated by our forward guidance, and our balance sheet will keep expanding until we see a sustained adjustment in the path of inflation. Managing the business cycle and ensuring price stability will be the central focus of monetary policy over the medium-term, as our mandate demands."
16/07/2015	GovC meeting
25/08/2015	Constancio's Speech " The Governing Council explicitly committed to purchasing a total amount of EUR 60 billion every month from March 2015 until at least until September 2016. Furthermore, the Governing Council has kept the programme open-ended by committing to keep it in place until we see a sustained adjustment in the path of inflation that is consistent with our medium-term inflation objective.
03/09/2015	GovC meeting

16/09/2015	Communication on Emergency Liquidity Assistance
23/09/2015	Eurosystem adjusts purchase process in ABS programme
22/10/2015	GovC meeting "We intend to purchase private and public securities until the end of September 2016, or beyond if necessary, and, in any case, until we see a sustained adjustment in the path of inflation that is consistent with our aim of achieving inflation rates below, but close to, 2% over the medium term"
28/10/2015	Constancio's Speech "Our main policy rates will stay low for a prolonged period of time, in line with our forward guidance and the asset purchase programmes will keep our balance sheet expanding until we see a sustained adjustment in the path of inflation"
09/11/2015	Increase of the PSPP issue share limit to limit undue concentration that could undermine market liquidity and create a blocking minority in relation to collective action clauses
12/11/2015	GovC meeting
16/11/2015	Constancio's Speech "Our main policy rates will stay low for a prolonged period of time, in line with our forward guidance and the asset purchase programmes will keep our balance sheet expanding until we see a sustained adjustment in the path of inflation"
26/11/2015	ECB and the People's Bank of China successfully test bilateral currency swap arrangement
03/12/2015	GovC meeting
04/12/2015	Draghi's Speech " The monthly purchases of €60 billion under the APP are now intended to run until the end of March 2017, or beyond, if necessary, and in any case until the Governing Council sees a sustained adjustment in the path of inflation consistent with its aim of achieving inflation rates below, but close to, 2% over the medium term. We will also reinvest the principal payments on the securities purchased under the APP as they mature, for as long as necessary "
21/01/2016	Govc Meeting
01/02/2016	Draghi's Speech "We extended the envisaged end-date for our monthly purchases to the end of March 2017, while maintaining its conditionality on the inflation outlook, and we announced that we will reinvest the principal payments of our purchased assets once they mature, for as long as necessary. We also decided to continue conducting the main refinancing operations and three-month longer-term refinancing operations as fixed rate tender procedures with full allotment for as long as necessary, and at least until the end of the last reserve maintenance period of 2017"
10/03/2016	Decision on decreasing the MRO and marginal lending facility rate by 5 basis point while deposit rate by 10 basis points, expand the ASAP, increase the list of the collateral and implement new series of four targeted longer-term refinancing operations, add CSPP to APP
15/04/2016	Draghi's Speech "The ECB's asset purchases are being expanded in terms of both size and composition: the monthly purchase volume has been increased from €60 billion to €80 billion and the universe of eligible assets now includes non-bank corporate bonds. Purchases are intended to run until the end of March 2017 – or beyond, if necessary – , and in any case until the Governing Council sees a sustained adjustment in the path of inflation to levels close to 2% over the medium term. Taking into account the current outlook for price stability, the Governing Council expects the ECB's key policy rates to remain at present or lower levels for an extended period of time, well past the horizon of the net asset purchases"
21/04/2016	The policy rates will remain unchanged and details on a corporate sector purchase programme (CSPP) to the asset purchase programme (APP) were published
03/05/2016	Legal acts relating to the second series of targeted longer-term refinancing operations (TLTRO-II)
02/06/2016	Main policy rates will remain unchanged, decision on purchases under corporate sector purchase programme (CSPP) and the conduct of the first operation of the new series of targeted longer-term refinancing operations.
15/06/2016	Constancio's Speech : "We have progressively expanded the scope and size of our purchases as well as the horizon, which is intended to run until the end of March 2017, or beyond, if necessary, and in any case until there is a sustained adjustment in the path of inflation"
21/07/2016	GovC meeting
08/09/2016	GovC meeting
27/09/2016	ECB and People's Bank of China extend bilateral currency swap arrangement
05/10/2016	Changes of collateral eligibility criteria and risk control measures for unsecured bank bonds

07/10/2016	Draghi's Speech "We have confirmed our forward guidance on asset purchases and our policy interest rates, indicating that the ECB intends to run asset purchases until the end of March 2017 or beyond, if necessary, and in any case until the Governing Council sees a sustained adjustment in the path of inflation towards levels below, but close to, 2% over the medium term"
09/10/2016	Constancio's Speech: "Governing Council tasked the relevant Eurosystem committees to evaluate the options that will ensure a smooth implementation of our purchase programme until March 2017, or beyond, if needed"
20/10/2016	GovC meeting
03/11/2016	ECB reviews its risk control framework for collateral assets
08/12/2016	GOvC meeting, introduction of cash collateral for PSPP and adjustment of parameters for APP
15/12/2016	Adjustment of purchase process in ABS purchase programme
19/01/2017	GovC Meeting, decision for the interest rate on the main refinancing operations and the interest rates on the marginal lending facility and the deposit facility will remain unchanged and on monthly pace of asset purchase.
06/02/2017	Draghi's Speech: " We decided to extend the asset purchase programme beyond March 2017, with the intention of conducting our purchases until the end of December 2017 or beyond, if necessary, and in any case until the Governing Council sees a sustained adjustment in the path of inflation consistent with its inflation aim"
09/03/2017	GovC Meeting, decision for the interest rate on the main refinancing operations and the interest rates on the marginal lending facility and the deposit facility will remain unchanged and on monthly pace of asset purchase.
06/04/2017	Draghi's Speech"Net asset purchases will continue until the end of December 2017, or beyond, if necessary, and in any case until we see a sustained adjustment in the path of inflation consistent with our inflation aim. It also confirmed its expectation that key ECB interest rates will remain at present or lower levels for an extended period of time, and well past the horizon of our net asset purchases."
21/04/2017	Draghi's Speech "We continue to expect the key ECB interest rates to remain at present or lower levels for an extended period of time, and well past the horizon of the net asset purchases. Until the end of last month our monthly purchases of public and private sector securities under the asset purchase programme (APP) amounted to €80 billion on average. They are now intended to continue at a monthly pace of €60 billion until the end of December 2017, or beyond, if necessary, and in any case until the ECB's Governing Council sees a sustained adjustment in the path of inflation consistent with its inflation aim. The net purchases will be made alongside reinvestments of the principal payments from maturing securities purchased under the APP. If the outlook becomes less favourable, or if financial conditions become inconsistent with further progress towards a sustained adjustment in the path of inflation, we stand ready to increase our asset purchase programme in terms of size and/or duration"
27/04/2017	GovC Meeting, decision for the interest rate on the main refinancing operations and the interest rates on the marginal lending facility and the deposit facility will remain unchanged and on monthly pace of asset purchase.
10/05/2017	Draghi's Speech "Net asset purchases currently amount to €60 billion per month, and are intended to run until the end of December 2017, or beyond, if necessary"
08/06/2017	GovC Meeting, decision for the interest rate on the main refinancing operations and the interest rates on the marginal lending facility and the deposit facility will remain unchanged and on monthly pace of asset purchase.
20/07/2017	GovC Meeting, decision for the interest rate on the main refinancing operations and the interest rates on the marginal lending facility and the deposit facility will remain unchanged and on monthly pace of asset purchase.
07/09/2017	GovC Meeting, decision for the interest rate on the main refinancing operations and the interest rates on the marginal lending facility and the deposit facility will remain unchanged and on monthly pace of asset purchase.
12/09/2017	Constancio's Speech"The Eurosystem has already purchased more than 2 trillion euros of public and private assets and we intend to purchase assets at a monthly pace of 60 billion euros until December 2017, or beyond, if necessary, and in any case until the Governing Council sees a sustained adjustment in the path of inflation consistent with our inflation aim"

13/10/2017	We expect the key ECB interest rates to remain at present levels for an extended period of time, and well past the horizon of the net asset purchases. Our asset purchase programme (APP), at the current monthly pace of €60 billion, is intended to run until the end of December this year, or beyond, if necessary, and in any case until the Governing Council sees a sustained adjustment in the path of inflation consistent with its inflation aim.
26/10/2017	Govc Meeting, decision for the interest rate on the main refinancing operations and the interest rates on the marginal lending facility and the deposit facility will remain unchanged and on monthly pace of asset purchase. Further, the Eurosystem will continue to reinvest the principal payments from maturing securities purchased under the APP for an extended period of time after the end of its net asset purchases, and in any case for as long as necessary and the main refinancing operations and the three-month longer-term refinancing operations will continue to be conducted as fixed rate tender procedures with full allotment.
17/11/2017	Draghi's Speech" We decided to reduce the pace of our monthly asset purchases from €60 billion to €30 billion, while extending the horizon of those purchases until end of September 2018, or beyond, if necessary, and in any case until we see a sustained adjustment in the path of inflation"
20/11/2017	Draghi's Speech " Net asset purchases are intended to continue at a monthly pace of €30 billion until the end of September 2018, or beyond, if necessary, and in any case until the Governing Council sees a sustained adjustment in the path of inflation consistent with its inflation aim"
14/12/2017	GovC Meeting, decision for the interest rate on the main refinancing operations and the interest rates on the marginal lending facility and the deposit facility will remain unchanged and on monthly pace of asset purchase.
25/01/2018	GovC Meeting, decision for the interest rate on the main refinancing operations and the interest rates on the marginal lending facility and the deposit facility will remain unchanged and on monthly pace of asset purchase.
05/02/2018	Draghi's Speech" Our net asset purchase programme, running at a monthly pace of €30 billion, will continue until the end of September 2018, or beyond, if necessary, and in any case until the Governing Council sees a sustained adjustment in the path of inflation consistent with its inflation aim. In parallel, we will reinvest the principal payments from maturing securities purchased under the expanded asset purchase programme for an extended period of time after the end of those purchases, and in any case for as long as necessary. We expect our key interest rates to remain at their present levels for an extended period of time, and well past the horizon of our net asset purchases".
08/03/2018	GovC Meeting, decision for the interest rate on the main refinancing operations and the interest rates on the marginal lending facility and the deposit facility will remain unchanged and on monthly pace of asset purchase.
09/04/2018	Constancio's Speech" We extended the intended horizon of our asset purchases until the end of September 2018, or beyond, if necessary, and in any case until the Governing Council sees a sustained adjustment in the path of inflation consistent with its inflation aim. Moreover, we decided to extend the fixed rate tender procedures with full allotment, at least until the end of 2019 and reiterated our forward guidance on the key ECB interest rates and on our reinvestment policy".
26/04/2018	GovC Meeting, decision for the interest rate on the main refinancing operations and the interest rates on the marginal lending facility and the deposit facility will remain unchanged and on monthly pace of asset purchase.
14/06/2018	GovC Meeting, decision for the interest rate on the main refinancing operations and the interest rates on the marginal lending facility and the deposit facility will remain unchanged and on monthly pace of asset purchase.
19/06/2018	Draghi's Speech" We intend to maintain our policy of reinvesting the principal payments from maturing securities purchased under the asset purchase programme (APP) for an extended time after the end of net purchases, and in any case for as long as necessary to maintain favourable liquidity conditions and an ample degree of monetary accommodation. We conveyed our expectation that the key ECB interest rates will remain at their present levels at least through the summer of 2019, and in any case for as long as necessary to ensure that the evolution of inflation remains aligned with our current expectations of a sustained adjustment path".

09/07/2018	Draghi's Speech "We intend to maintain our policy of reinvesting the principal payments from maturing securities purchased under the APP for an extended period of time after the end of our net asset purchases, and in any case for as long as necessary to maintain favourable liquidity conditions and an ample degree of monetary accommodation. And we expect key ECB interest rates to remain at their present levels at least through the summer of 2019 and in any case for as long as necessary to ensure that the evolution of inflation remains aligned with our current expectations of a sustained adjustment path".
26/07/2018	GovC Meeting, decision for the interest rate on the main refinancing operations and the interest rates on the marginal lending facility and the deposit facility will remain unchanged and on monthly pace of asset purchase.
13/09/2018	GovC Meeting, decision for the interest rate on the main refinancing operations and the interest rates on the marginal lending facility and the deposit facility will remain unchanged and on monthly pace of asset purchase.
24/09/2018	Draghi's Speech "Our enhanced forward guidance on the key ECB interest rates, which we expect to remain at present levels at least through the summer next year, and in any case for as long as necessary to ensure the continued convergence of inflation towards our aim; second, the residual net asset purchases that we will be conducting until the end of this year; and third, the reinvestment of the sizeable stock of acquired securities".
12/10/2018	Draghi's Speech "The Governing Council confirmed that it continues to expect the key ECB interest rates to remain at their present levels at least through the summer of 2019, and in any case for as long as necessary to ensure the continued sustained convergence of inflation to levels that are below, but close to, 2% over the medium term".
25/10/2018	GovC Meeting, decision for the interest rate on the main refinancing operations and the interest rates on the marginal lending facility and the deposit facility will remain unchanged and on monthly pace of asset purchase.
08/11/2018	Draghi's Speech "Monetary stimulus will continue to be provided by the guidance we have given namely that we expect to keep interest rates at their present levels at least through the summer of 2019 and to maintain the stock of assets on our balance sheet by reinvesting maturing bonds purchased under the asset purchase programme for an extended period of time after the end of our net asset purchases".
16/11/2018	Draghi's Speech "The Governing Council therefore continues to anticipate that, subject to incoming data confirming our medium-term inflation outlook, net asset purchases will come to an end in December 2018. To ensure that inflation continues to move towards our aim in a sustained manner, a significant degree of monetary policy stimulus will be maintained, even after the end of net asset purchases. This will be provided by the enhanced forward guidance pertaining to the path of interest rates and by the sizeable stock of acquired assets and the associated reinvestments".
13/12/2018	GovC Meeting, decision for the interest rate on the main refinancing operations and the interest rates on the marginal lending facility and the deposit facility will remain unchanged and on monthly pace of asset purchase.

Source: European Central Bank website

Table 1. 2 Macroprudential policies, Denmark

03/01/2008	The interest rates remain unchanged
04/02/2008	The interest rates remain unchanged
04/03/2008	The interest rates remain unchanged
02/04/2008	The interest rates remain unchanged
06/05/2008	The interest rates remain unchanged
09/05/2008	New secured lending facility
16/05/2008	Interest rate increase and swap facility with Seðlabanki Íslands, The lending rate and the rate for certificate of depositors are increased from 4.25 to 4.35 while the discount rate and the rate on banks current accounts remains unchanged.
03/06/2008	The interest rates remain unchanged

03/07/2008	Rates will be increased by 0.25
11/07/2008	Approved liquidity for Roskilde Bank A/S
04/08/2008	The interest rates remain unchanged
24/08/2008	Takeover of Roskilde Bank A/S
02/09/2008	The interest rates remain unchanged
24/09/2008	Swap lines with Federal Reserve
26/09/2008	Temporary extension of lending facilities
29/09/2008	Extension of swap facilities with FED
02/10/2008	The interest rates remain unchanged
07/10/2008	Adjustment of the lending facilities and increase of rate by 0.25
08/10/2008	Agreement on national guarantee and interest rates unchanged
24/10/2008	Increase of lending and deposits rate from 5 to 5.5 percent.
27/11/2008	Cooperation with ECB to provide liquidity in euro
04/11/2008	The interest rates remain unchanged
06/11/2008	Reduction of interest rates by 0.5
20/11/2008	Extension of facilities with Seðlabanki Íslands
02/12/2008	The interest rates remain unchanged
04/12/2008	Reduction of lending and certificate rates by 0.75 while the discount rate and the rate on banks current accounts reduced by 0.50.
16/12/2008	Swap facility with Latvijas Banka
19/12/2008	Reduction of lending and certificate rates by 0.50.
05/01/2009	The interest rates remain unchanged
15/01/2009	Reduction of interest rates by 0.75
03/02/2009	The interest rates remain unchanged and extension of swap facilities with FED
03/03/2009	Rates remain unchanged
05/03/2009	Reduction of interest rates by 0.75
09/03/2009	Reduction of supplementary rates
02/04/2009	Reduction of interest rates by 0.25
04/05/2009	The interest rates remain unchanged
07/05/2009	Reduction of interest rates by 0.35
03/06/2009	The interest rates remain unchanged
04/06/2009	Reduction of lending rates by 0.1 while the other rates by 0.2.
26/06/2009	Extension of swap facilities with FED
02/07/2009	The interest rates remain unchanged
04/08/2009	The interest rates remain unchanged
13/08/2009	Reduction of interest rates by 0.1
27/08/2009	Reduction of interest rates by 0.2
02/09/2009	The interest rates remain unchanged
24/09/2009	Reduction of interest rates by 0.1
28/09/2009	Reduction of certificates of deposits by 0.15 while the current account rate is reduced by 0.1. Lending rate and discount rate remain unchanged.
02/10/2009	The interest rates remain unchanged
03/11/2009	The interest rates remain unchanged

02/12/2009	The interest rates remain unchanged
10/12/2009	The interest rates are reduced by 0.05 while the discount rate remains unchanged.
05/01/2010	The interest rates remain unchanged
07/01/2010	The interest rates are reduced by 0.05 while the discount rate remains unchanged.
14/01/2010	The interest rates are reduced by 0.1 while the discount rate is reduced by 0.25.
02/02/2010	The interest rates remain unchanged
02/03/2010	The interest rates remain unchanged
25/03/2010	Reduction of current account and certificate rates by 0.1 while the lending rate and the discount rate remain unchanged
07/04/2010	The interest rates remain unchanged
04/05/2010	The interest rates remain unchanged
19/05/2010	Reduction of current account and certificate rates by 0.1 while the lending rate and the discount rate remain unchanged
26/05/2010	Reduction of current account and certificate rates by 0.1 while the lending rate and the discount rate remain unchanged
02/06/2010	The interest rates remain unchanged
02/07/2010	The interest rates remain unchanged
03/08/2010	The interest rates remain unchanged
17/08/2010	Nordic and Baltic authorities sign an agreement of cooperation
02/09/2010	The interest rates remain unchanged
04/10/2010	The interest rates remain unchanged
14/10/2010	Increase of current account and certificate rates by 0.1 while the lending rate and the discount rate remain unchanged
28/10/2010	Increase of current account and certificate rates by 0.1 while the lending rate and the discount rate remain unchanged
02/11/2010	The interest rates remain unchanged
02/12/2010	The interest rates remain unchanged
04/01/2011	The interest rates remain unchanged
02/02/2011	The interest rates remain unchanged
02/03/2011	The interest rates remain unchanged
04/04/2011	The interest rates remain unchanged
07/04/2011	The interest rates increase by 0.25
03/05/2011	The interest rates remain unchanged
06/06/2011	The interest rates remain unchanged
21/06/2011	Technical cooperation among central bank and FSA
04/07/2011	The interest rates remain unchanged
07/07/2011	The interest rates increase by 0.25
08/07/2011	Report on supplementeray reference rate
02/08/2011	The interest rates remain unchanged
16/08/2011	Extension of collateral basis
25/08/2011	Reduction of current account and certificate rates by 0.1 while the lending rate and the discount rate remain unchanged
02/09/2011	The interest rates remain unchanged
15/09/2011	Reduction of current account and certificate rates by 0.1 while the lending rate and the discount rate remain unchanged
30/09/2011	New credit facilities
04/10/2011	The interest rates remain unchanged

02/11/2011	The interest rates remain unchanged
03/11/2011	Reduction of certificates of deposits, current account rate, lending rate by 0.35 while discount rate is reduced by 0.25
02/12/2011	The interest rates remain unchanged
08/12/2011	Reduction of lending rate by 0.4, rate of certificates of deposits, current account rate and the discount rate are reduced by 0.25,0.3 and 0.75 respectively and new instruments to access the long-term financing.
15/12/2011	Reduction of lending rates and certificates of deposits by 0.1, the current account is reduced by 0.05 while the discount rate remains changed.
03/01/2012	The interest rates remain unchanged
16/01/2012	Conditions for 3-year loans
02/02/2012	The interest rates remain unchanged
02/03/2012	The interest rates remain unchanged
03/04/2012	The interest rates remain unchanged
02/05/2012	The interest rates remain unchanged
24/05/2012	Lending rates, interest rates on certificates of deposits and current account are reduced by 0.1. Discount rate remains unchanged.
31/05/2012	Lending rates, interest rates on certificates of deposits and current account are reduced by 0.15 while discount rate is reduced 0.5.
04/06/2012	The interest rates remain unchanged
03/07/2012	The interest rates remain unchanged
05/07/2012	Lending rates, interest rates on certificates of deposits and current account are reduced by 0.25. Discount rate remains unchanged.
02/08/2012	The interest rates remain unchanged
04/09/2012	The interest rates remain unchanged
02/10/2012	The interest rates remain unchanged
12/10/2012	Loan agreement with IMF
02/11/2012	The interest rates remain unchanged
04/12/2012	The interest rates remain unchanged
03/01/2013	The interest rates remain unchanged
24/01/2013	Lending rate and rate on certificate of deposits are increased by 0.1 while the discount rate and the current account rate remain unchanged.
04/02/2013	The interest rates remain unchanged
04/03/2013	The interest rates remain unchanged
03/04/2013	The interest rates remain unchanged
08/04/2013	The Systemic Risk Council had its first meeting which aim is to prevent and reduce systemic financial risks
02/05/2013	Lending rates are reduced by 0.1 while other rates remain unchanged.
04/06/2013	The interest rates remain unchanged
24/06/2013	Systemic Risk Council recommendations for the phase-in of the capital and liquidity requirements and recommendations for Systematically Important Financial Institutions
02/07/2013	The interest rates remain unchanged
02/08/2013	The interest rates remain unchanged
03/09/2013	The interest rates remain unchanged
26/09/2013	The Council decides to start to initiate its work on capital requirements and household borrowings
02/10/2013	The interest rates remain unchanged
04/11/2013	The interest rates remain unchanged
07/11/2013	Solution to mortgage banks' refinancing problem

02/12/2013	The interest rates remain unchanged
03/12/2013	The interest rates remain unchanged
03/01/2014	The interest rates remain unchanged
06/01/2014	The Council recommended that the Danish framework for the countercyclical capital buffer is proposed to be phased-in gradually from 2015 to 2019.
04/02/2014	The interest rates remain unchanged
04/03/2014	The interest rates remain unchanged
27/03/2014	The Council discussed aspects of a supervisory diamond for mortgage banks, deferred-amortisation loans and other regulatory initiative.
02/04/2014	The interest rates remain unchanged
24/04/2014	The interest rate on certificates of deposit is increased by 0.15 percentage point. The lending rate, the discount rate and the current account rate are unchanged.
02/05/2014	The interest rates remain unchanged
03/06/2014	The interest rates remain unchanged
06/06/2014	The interest rates remain unchanged
02/07/2014	The interest rates remain unchanged
04/08/2014	The interest rates remain unchanged
02/09/2014	The interest rates remain unchanged
04/09/2014	The interest rate on certificates of deposit is reduced by 0.10 percentage point. The lending rate, the current account rate and the discount rate are unchanged.
30/09/2014	The Council ensures that a restriction is imposed on the mortgage banks' mortgage loans with deferred amortisation at high loan-to-value, LTV, ratios.
01/10/2014	Junior Covered Bonds and bonds issued by Danish Ship Finance will be omitted from the collateral basis
02/10/2014	The interest rates remain unchanged
04/11/2014	The interest rates remain unchanged
02/12/2014	The interest rates remain unchanged
18/12/2014	The Systemic Risk Council recommends that countercyclical capital buffer stays at 0 percent from 1 January 2015
05/01/2015	The interest rates remain unchanged
19/01/2015	Lending rate and interest rate on certificates of deposit are reduced by 0.15 percentage point while the discount rate and the current account rate are unchanged.
22/01/2015	Interest rate on certificates of deposit is reduced by 0.15 percentage point.
30/01/2015	Suspension of government bonds
03/02/2015	Interest rate on certificates of deposit is reduced by 0.15 percentage point to -0.50 per cent.
05/02/2015	Interest rate on certificates of deposit is reduced by 0.25 percentage points to -0.75 per cent. The lending rate, the discount rate and the current account rate remain unchanged at 0.05 per cent, 0.0 per cent and 0.0 per cent, respectively.
03/03/2015	The interest rates remain unchanged
27/03/2015	The Systemic Risk Council recommends that countercyclical capital buffer stays at 0 percent and recommendation on restriction of deferred amortization on mortgage loans
07/04/2015	The interest rates remain unchanged
05/05/2015	The interest rates remain unchanged
19/05/2015	Switches of government bonds
02/06/2015	The interest rates remain unchanged
19/06/2015	The Systemic Risk Council recommends that countercyclical capital buffer stays at 0 percent.
02/07/2015	The interest rates remain unchanged
04/08/2015	The interest rates remain unchanged
26/08/2015	Resumption of government bond issuance

02/09/2015	The interest rates remain unchanged
22/09/2015	The Systemic Risk Council recommends that countercyclical capital buffer stays at 0 percent.
02/10/2015	The interest rates remain unchanged
03/11/2015	The interest rates remain unchanged
02/12/2015	The interest rates remain unchanged
03/12/2015	The interest rates remain unchanged
15/12/2015	The Systemic Risk Council recommends that countercyclical capital buffer stays at 0 percent
05/01/2016	The interest rates remain unchanged
07/01/2016	The interest rate on certificates of deposit is increased by 0.10 percentage point.
02/02/2016	The interest rates remain unchanged
02/03/2016	The interest rates remain unchanged
10/03/2016	The interest rates remain unchanged
04/04/2016	The interest rates remain unchanged
03/05/2016	The interest rates remain unchanged
02/06/2016	The interest rates remain unchanged
30/03/2016	The Systemic Risk Council recommends that countercyclical capital buffer stays at 0 percent.
21/06/2016	The Systemic Risk Council recommends that countercyclical capital buffer stays at 0 percent.
04/07/2016	The interest rates remain unchanged
02/08/2016	The interest rates remain unchanged
02/09/2016	The interest rates remain unchanged
21/09/2016	The Systemic Risk Council recommends that countercyclical capital buffer stays at 0 percent.
04/10/2016	The interest rates remain unchanged
10/10/2016	Loan agreement with IMF
02/11/2016	The interest rates remain unchanged
02/12/2016	The interest rates remain unchanged
14/12/2016	The Systemic Risk Council recommends that countercyclical capital buffer stays at 0 percent
03/01/2017	The interest rates remain unchanged
02/02/2017	The interest rates remain unchanged
02/03/2017	The interest rates remain unchanged
30/03/2017	The Systemic Risk Council recommends that countercyclical capital buffer stays at 0 percent
04/04/2017	The interest rates remain unchanged
02/05/2017	The interest rates remain unchanged
02/06/2017	The interest rates remain unchanged
21/06/2017	The Systemic Risk Council recommends that countercyclical capital buffer stays at 0 percent
04/07/2017	The interest rates remain unchanged
02/08/2017	The interest rates remain unchanged
04/09/2017	The interest rates remain unchanged
26/09/2017	The Systemic Risk Council recommends that countercyclical capital buffer stays at 0 percent
03/10/2017	The interest rates remain unchanged
02/11/2017	The interest rates remain unchanged
20/11/2017	Recommendation for SIFs
04/12/2017	The interest rates remain unchanged

20/12/2017	The countercyclical buffer reach 0.5 percent from 31 March 2017
03/01/2018	The interest rates remain unchanged
02/02/2018	The interest rates remain unchanged
02/03/2018	The interest rates remain unchanged
04/04/2018	The interest rates remain unchanged
09/04/2018	The countercyclical capital buffer remains 0.5 percent
02/05/2018	The interest rates remain unchanged
04/06/2018	The interest rates remain unchanged
26/06/2018	The Council recommends that the buffer rate is currently kept unchanged at 0.5 per cent.
03/07/2018	The interest rates remain unchanged
02/08/2018	The interest rates remain unchanged
04/09/2018	The interest rates remain unchanged
25/09/2018	Increase of the buffer from 0.5 to 1 percent from September 2019
02/10/2018	The interest rates remain unchanged
02/11/2018	The interest rates remain unchanged
04/12/2018	The interest rates remain unchanged
18/12/2018	The Council recommends that the buffer rate is currently kept unchanged at 0.5 per cent.

Source: Central Bank of Denmark and Danish Systemic Risk Council

Table 1. 3 Macroprudential policies, Finland

24/06/2008	The reference rate is 4,5 % for the period 1 July – 31 December 2008. The penalty interest rate for the same period is thus 11,5 %
30/12/2008	The reference rate is 2.5 % for the period 1 January – 30 June 2009. The penalty interest rate for the same period is thus 9.5 %
30/06/2009	The reference rate is 1 % for the period 1 July – 31 December 2009. The penalty interest rate for the same period is thus 8
29/12/2009	The reference rate is 1 % for the period 1 January – 30 June 2009. The penalty interest rate for the same period is thus 8 %
30/06/2010	The reference rate is 1% for the period 1 July – 31 December 2010. The penalty interest rate for the same period is thus 8%
28/12/2010	The reference rate is 1% for the period 1 January – 30 June 2011. The penalty interest rate for the same period is thus 8%
30/06/2011	The reference rate is 1.5% for the period 1 July – 31 December 2011. The penalty interest rate for the same period is thus 8.5%
27/12/2011	The reference rate is 1% for the period 1 January – 30 June 2012. The penalty interest rate for the same period is thus 8%
26/06/2012	The reference rate is 1.0% for the period 1 July – 31 December 2012. The penalty interest rate for the same period is thus 8.0%
28/12/2012	The reference rate is 1.0% for the period 1 January – 30 June 2013. The penalty interest rate for the same period is thus 8.0%
25/06/2013	The reference rate is 0.5% for the period 1 July – 31 December 2013. The penalty interest rate for the same period is thus 7.5%
30/12/2013	The reference rate is 0,5% for the period 1 January – 30 June 2014. The penalty interest rate for the same period is thus 7,5%
24/06/2014	The reference rate is 0.5% for the period 1 July – 31 December 2014. The penalty interest rate for the same period is thus 7.5%
30/12/2014	The reference rate for the period 1 January – 30 June 2015 is 0.5%. The penalty interest rate for the same period is thus 7.5%
30/06/2015	The reference rate for the period 1 July – 31 December 2015 is 0.5%. The penalty interest rate for the same period is thus 7.5%
16/03/2015	Countercyclical capital buffer (CCB) set at 0 %

30/06/2015	Countercyclical capital buffer (CCB) set at 0 %
06/07/2015	Additional capital requirement (O-SII buffer) set for four credit institutions, in force 7 January 2016.
29/09/2015	Countercyclical capital buffer (CCB) set at 0 %
21/12/2015	Countercyclical capital buffer (CCB) set at 0 %
29/12/2015	The reference rate for the period 1 January – 30 June 2016 is 0.5%. The penalty interest rate for the same period is thus 7.5%
22/03/2016	Countercyclical capital buffer (CCB) set at 0 %
14/06/2016	Countercyclical capital buffer (CCB) set at 0 % and preparations on going article 458 of the Capital Requirements Regulation: stricter national measures to address macroprudential or systemic risk
28/06/2016	The reference rate for the period 1 July – 31 December 2016 is 0.0%. The penalty interest rate for the same period is thus 7.0%
27/09/2016	Countercyclical capital buffer (CCB) set at 0 % and preparations on going article 458 of the Capital Requirements Regulation: stricter national measures to address macroprudential or systemic risk
21/12/2016	Countercyclical capital buffer (CCB) set at 0 % and preparations on going article 458 of the Capital Requirements Regulation: stricter national measures to address macroprudential or systemic risk
27/12/2016	The reference rate for the period 1 January – 30 June 2017 is 0.0%. The penalty interest rate for the same period is thus 7.0%
28/03/2017	Countercyclical capital buffer (CCB) set at 0 % and preparations on going article 458 of the Capital Requirements Regulation: stricter national measures to address macroprudential or systemic risk
27/06/2017	The reference rate for the period 1 July – 31 December 2017 is 0.0%. The penalty interest rate for the same period is thus 7.0%
27/06/2017	Countercyclical capital buffer (CCB) set at 0 % and conditional decision regarding minimum risk weight
22/12/2017	The reference rate for the period 1 January – 30 June 2018 is 0.0%. The penalty interest rate for the same period is thus 7.0%
26/09/2017	Countercyclical capital buffer (CCB) set at 0 % and article 458 of the Capital Requirements Regulation: stricter national measures to address macroprudential or systemic risk in force in January 2018
21/12/2017	Countercyclical capital buffer (CCB) set at 0 % and conditional decision regarding minimum risk weight, additional capital requirement (O-SII buffer) set for four credit institutions, in force 1 July 2018.
19/03/2018	Countercyclical capital buffer (CCB) set at 0 %, maximum LTV lowered to 85 % for others than first time home buyers. In force 1 July 2018 and systemic risk buffer rate of 1 % set by Eesti Pank reciprocated to be applied to balance sheet items located in Estonia as of 1 January 2019
28/03/2018	Countercyclical capital buffer (CCB) set at 0 %, maximum LTV lowered to 85 % for others than first time home buyers. In force 1 July 2018 and systemic risk buffer rate of 1 % set by Eesti Pank reciprocated to be applied to balance sheet items located in Estonia as of 1 January 2020
26/06/2018	The reference rate for the period 1 July – 31 December 2018 is 0.0%. The penalty interest rate for the same period is thus 7.0%
29/06/2018	Countercyclical capital buffer (CCB) set at 0 %, G-SII buffer set for Nordea on a conditional basis, in force 1 January 2020, additional capital requirement (O-SII buffer) set for three credit institutions on a conditional basis, in force 1 January 2019 and a systemic risk buffer set for three credit institutions at a higher level and for other credit institutions at 1%, in force 1 July 2019.
26/09/2018	Countercyclical capital buffer (CCB) set at 0 %
18/12/2018	The reference rate for the period 1 January – 30 June 2019 is 0.0%. The penalty interest rate for the same period is thus 7.0%
20/12/2018	Countercyclical capital buffer (CCB) set at 0 %, the application of the lowest risk weight limit in Sweden was approved. Entered into force 31.12.2018 and the G-SII buffer requirement for Nordea was lifted, coming into force on 1.1.2020.

Source: Central Bank of Finland and Finland Supervisory Authority

Table 1. 4 Macroprudential policies, Iceland

14/01/2008	Expansion of eligible collateral
14/02/2008	Committee decision to leave the policy rate unchanged

25/03/2008	Amendments to central bank rules to facilitate financial market transactions especially interbank market for Icelandic krónur and decrease of interest rates
03/04/2008	Certificates of deposits eligible in Clearstream
10/04/2008	Decision to increase the interest rate by 0.5 % to 15.5%
16/05/2008	Swap facility with Central Bank of Sweden, Norway and Denmark
22/05/2008	Policy rate left unchanged at 15.5%
04/06/2008	New rules on foreign exchange balance of financial institutions
19/06/2009	Issuance of certificates of deposits
03/07/2008	Policy rate left unchanged
08/09/2008	Exchange of certificates of deposits
11/09/2008	Policy rate left unchanged at 15.5%
29/09/2008	The Government of Iceland provides Glitnir with new equity
02/10/2008	Increase of issue of certificates of deposits and increase of foreign exchange reserves
07/10/2008	Foreign exchange rate market measures
10/10/2008	Currency swap agreements and attempts to reinforce the foreign exchange reserves and temporary modifications in currency outflow
14/10/2008	The Central Bank of Iceland draws on swap facility arrangements
15/10/2008	The Board of Governors of the Central Bank of Iceland has decided to lower the policy interest rate by 3.5% to 12%.
16/10/2008	Temporary foreign exchange arrangements
21/10/2008	Central Bank of Iceland collateralized loans
27/10/2008	Iceland takes decisive action with the launch of an economic stabilization plan in conjunction with the IMF
28/10/2008	The Board of Governors of the Central Bank of Iceland has decided to raise its policy interest rate by 6 percentage points to 18%
06/11/2008	The Board of Governors of the Central Bank of Iceland has decided to hold the Bank's policy interest rate unchanged at 18%.
20/11/2008	IMF Executive Board Approves US\$2.1 Billion Stand-By Arrangement for Iceland and extend swap facility with Nordic countries
28/11/2008	New foreign exchange regulation
03/12/2008	Interbank foreign exchange rate market
16/12/2008	Amended Rules on Foreign Exchange
17/12/2008	Changes to Central Bank of Iceland interest rates
29/01/2009	The Board of Governors of the Central Bank of Iceland has decided to hold the Bank's policy interest rate unchanged at 18%.
04/03/2009	Decision to issue three-months certificate of deposits in order to increase the supply of short-term instruments on the market
19/03/2009	The Monetary Policy Committee has decided to lower the Central Bank of Iceland's policy rate by 100 basis points to 17.0 percent.
21/03/2009	Changes in Iceland's savings bank operations in order protect the interests of savings bank customers
08/04/2009	The Monetary Policy Committee (MPC) has voted to lower the policy rate by 1.5 percentage points to 15.5%.
06/05/2009	Foreign borrowings by domestic entities
07/05/2010	The Monetary Policy Committee has decided to lower the Central Bank of Iceland's policy rate by 250 basis points to 13.0 percent. Overnight lending rates will also be lowered by 250 basis points. Other Central Bank interest rates will be lowered by 300 basis points.
04/06/2009	The Monetary Policy Committee has decided to lower the Central Bank of Iceland's policy rate by 100 basis points to 12.0 percent. Overnight lending rates will also be lowered by 100 basis points. Other Central Bank interest rates will remain unchanged.
30/06/2009	New Rules on Central Bank of Iceland Facilities for Financial Undertakings

01/07/2009	Loan agreements signed between Iceland and Denmark, Finland and Sweden respectively, and between Seðlabanki Íslands, guaranteed by Iceland and Norges Bank, guaranteed by Norway.
02/07/2009	The Monetary Policy Committee of the Central Bank of Iceland has decided to hold the policy interest rate unchanged at 12.0%.
31/07/2009	Capital account liberalisation strategy approved to improve economic stability
13/08/2009	The Monetary Policy Committee (MPC) has voted to keep the policy rate unchanged at 12% and the deposit rate unchanged at 9.5%.
24/09/2009	Policy rate left unchanged and issuance of 208-days certificates of deposits
28/10/2009	Extend agreement with IMF
31/10/2009	First stage of capital account liberalisation
05/11/2009	The Monetary Policy Committee (MPC) has voted to lower the deposit rate (current account rate) by 0.5 percentage points to 9%.
10/12/2009	The Monetary Policy Committee (MPC) has voted to change Central Bank interest rates as follows. The deposit rate (current account rate) will be lowered by 0.5 percentage points to 8.5%. The Central Bank will continue to issue 28-day certificates of deposit (CDs) with a maximum bid rate of 9.75%, which is 0.5 percentage points lower than before. The seven-day collateral lending rate will be lowered by 1 percentage point to 10%, and the overnight lending rate will be lowered by 1.5 percentage points to 11.5%.
21/12/2009	First tranche of loans from Nordic countries to Iceland
27/01/2010	The Monetary Policy Committee (MPC) has voted to lower Central Bank interest rates by 0.5 percentage points. The deposit rate (current account rate) will be lowered to 8%. The maximum bid rate for 28-day certificates of deposit (CDs) will be 9.25%. The seven-day collateral lending rate will be 9.5% and the overnight lending rate 11%.
17/03/2010	The Monetary Policy Committee (MPC) has voted to lower Central Bank interest rates by 0.5 percentage points. The deposit rate (current account rate) will be lowered to 7.5%. The maximum bid rate for 28-day certificates of deposit (CDs) will be 8.75%. The seven-day collateral lending rate will be 9% and the overnight lending rate 10.5%.
25/03/2010	The Central Bank purchases Treasury Bonds
16/04/2010	The Second Review of Iceland's economic programme with IMF
05/05/2010	The Monetary Policy Committee (MPC) has voted to lower Central Bank interest rates by 0.5 percentage points. The deposit rate (current account rate) will be 7.0%, and the maximum bid rate for 28-day certificates of deposit (CDs) will be 8.25%. The seven-day collateral lending rate will be 8.5% and the overnight lending rate 10.0%.
19/05/2010	Banque centrale du Luxembourg and the liquidator of Landsbanki Luxembourg S.A. sign an agreement with Central Bank of Iceland
28/05/2010	Central Bank of Iceland signs an agreement concerning Avens B.V. Eurobonds
31/05/2010	Pension funds purchase Treasury's HFF bonds to strengthen FX reserves
09/06/2010	The People's Bank of China and the Central Bank of Iceland signed a bilateral currency swap agreement
16/06/2010	Offers to sell securities for cash
22/06/2010	Treasury buys back EUR bonds and currency reserves reinforced
23/06/2010	The Monetary Policy Committee (MPC) has voted to lower Central Bank interest rates by 0.5 percentage points. The deposit rate (current account rate) will be 6.5% and the maximum bid rate for 28-day certificates of deposit (CDs) will be 7.75%. The seven-day collateralised lending rate will be 8% and the overnight lending rate 9.5%
17/08/2010	Nordic and Baltic Ministries, Central Banks and Supervisory Authorities sign Agreement on Financial Stability
18/08/2010	The Monetary Policy Committee (MPC) of the Central Bank of Iceland has decided to lower the Bank's interest rates by one percentage point. The deposit rate (current account rate) will be 5.5%, and the maximum bid rate for 28-day certificates of deposit (CDs) will be 6.75%. The seven-day collateralised lending rate will be 7.0% and the overnight lending rate 8.5%.
19/09/2010	FIH to be sold to a consortium of ATP, PFA, Folksam and CP Dyvig
22/09/2010	The Monetary Policy Committee (MPC) of the Central Bank of Iceland has decided to lower the Bank's interest rates by 0.75 percentage points. The deposit rate (current account rate) will be 4.75%, and the maximum bid rate for 28-day certificates of deposit (CDs) will be 6.0%. The seven-day collateralised lending rate will be 6.25% and the overnight lending rate 7.75%.

30/09/2010	Third review of Iceland IMF's programme approved
03/11/2010	The Monetary Policy Committee (MPC) of the Central Bank of Iceland has decided to lower the Bank's interest rates by 0.75 percentage points. The deposit rate (current account rate) will be 4.0%, and the maximum bid rate for 28-day certificates of deposit (CDs) will be 5.25%. The seven-day collateralised lending rate will be 5.5% and the overnight lending rate 7.0%
08/12/2010	The Monetary Policy Committee (MPC) of the Central Bank of Iceland has decided to lower the Bank's interest rates. The deposit rate (current account rate) is lowered by 0.5 percentage points, to 3.5%, and the maximum bid rate for 28-day certificates of deposit (CDs) and the seven-day collateralised rate are lowered by 1.0 percentage point each, to 4.25% and 4.5% respectively. Finally, the overnight lending rate is lowered by 1.5 percentage points, to 5.5%.
30/12/2010	Contractual agreements concerning the debt of five savings banks
06/01/2011	Financial Supervisory Authority and Central Bank of Iceland conclude improved cooperation agreement
28/01/2011	Central Bank of Iceland payment intermediation
02/02/2011	The Monetary Policy Committee (MPC) of the Central Bank of Iceland has decided to lower the Bank's interest rates by 0.25 percentage points. The deposit rate (current account rate) is lowered to 3.25%, the maximum bid rate for 28-day certificates of deposit (CDs) to 4.0%, the seven-day collateralised lending rate to 4.25% and the overnight lending rate to 5.25%.
16/03/2011	The interest rates remain unchanged
15/04/2011	Treasury to prepay foreign-denominated bonds
20/04/2011	The Monetary Policy Committee (MPC) of the Central Bank of Iceland has decided to keep the Bank's interest rates unchanged. The deposit rate (current account rate) will remain 3.25%, the maximum bid rate for 28-day certificates of deposit (CDs) 4.0%, the seven-day collateralised lending rate 4.25%, and the overnight lending rate 5.25%.
06/05/2011	Treasury prepays bonds for 346 million euros (57 b.kr.)
23/05/2011	Central Bank of Iceland offers to buy Icelandic krónur
15/06/2011	The Monetary Policy Committee (MPC) of the Central Bank of Iceland has decided to keep the Bank's interest rates unchanged. The deposit rate (current account rate) will remain 3.25%, the maximum bid rate for 28-day certificates of deposit (CDs) 4.0%, the seven-day collateralised lending rate 4.25%, and the overnight lending rate 5.25%.
16/06/2011	The Central Bank of Iceland is offering to purchase euros
06/07/2011	Central Bank of Iceland offers to purchase Icelandic krónur
28/07/2011	ESÍ sells stake in Sjóvá-Almennar tryggingar
02/08/2011	The Central Bank of Iceland is offering to purchase euros
17/08/2011	The Monetary Policy Committee (MPC) of the Central Bank of Iceland has decided to raise the Bank's interest rates by 0.25 percentage points. The current account rate will therefore be 3.5%, the maximum rate on 28-day certificates of deposit (CDs) 4.25%, the seven-day collateralised lending rate 4.50%, and the overnight lending rate 5.5%.
21/09/2011	Unchanged interest rates
02/11/2011	The Monetary Policy Committee (MPC) of the Central Bank of Iceland has decided to raise the Bank's interest rates.
07/12/2011	The interest rates remain unchanged
03/01/2012	Bilateral loans between the Nordic countries and Iceland were negotiated in connection with the Icelandic authorities' IMF-supported economic programme
12/01/2012	The Central Bank of Iceland is offering to purchase euros
24/01/2012	Decision by ESÍ ehf. Board regarding loans to holders of guarantee capital in Sparisjóður Svarfdæla
08/02/2012	Policy rate left unchanged
14/03/2012	The Central Bank of Iceland is offering to purchase euros in exchange for Icelandic krónur for long-term investment in the Icelandic economy,
21/03/2012	The Monetary Policy Committee (MPC) of the Central Bank of Iceland has decided to raise the Bank's interest rates by 0.25 percentage points.
16/05/2012	The Monetary Policy Committee (MPC) of the Central Bank of Iceland has decided to raise the Bank's interest rates by 0.5 percentage points.

13/06/2012	The Monetary Policy Committee (MPC) of the Central Bank of Iceland has decided to raise the Bank's interest rates by 0.25 percentage points.
26/07/2012	Foreign currency auctions to remove the capital controls and attract foreign capital for long- term investments
30/07/2012	The Central Bank of Iceland has decided to increase its regular purchase of foreign exchange from market makers on the interbank market
22/08/2012	The Monetary Policy Committee (MPC) of the Central Bank of Iceland has decided to keep the Bank's interest rates unchanged.
27/08/2012	Prudential regulations to protect the financia system against the risks
05/09/2012	Foreign currency auctions
03/10/2012	The Monetary Policy Committee (MPC) of the Central Bank of Iceland has decided to keep the Bank's interest rates unchanged.
14/11/2012	The Monetary Policy Committee (MPC) of the Central Bank of Iceland has decided to raise the Bank's interest rates by 0.25 percentage points.
20/11/2012	Foreign currency auctions to remove the capital controls and attract foreign capital for long- term investments
12/12/2012	The Monetary Policy Committee (MPC) of the Central Bank of Iceland has decided to keep the Bank's interest rates unchanged.
21/12/2012	Foreign currency auctions
04/01/2013	The Central Bank of Iceland has decided to suspend temporarily its regular purchases of foreign currency from market makers in the foreign exchange market
06/02/2013	The Monetary Policy Committee (MPC) of the Central Bank of Iceland has decided to keep the Bank's interest rates unchanged.
12/02/2013	Foreign currency auctions
19/02/2013	Foreign currency auctions
20/03/2013	The Monetary Policy Committee (MPC) of the Central Bank of Iceland has decided to keep the Bank's interest rates unchanged.
22/03/2013	Foreign currency auctions
07/05/2013	Foreign currency auctions
15/05/2013	The Monetary Policy Committee (MPC) of the Central Bank of Iceland has decided to keep the Bank's interest rates unchanged.
12/06/2013	The Monetary Policy Committee (MPC) of the Central Bank of Iceland has decided to keep the Bank's interest rates unchanged.
23/07/2013	Foreign currency auctions
21/08/2013	The Monetary Policy Committee (MPC) of the Central Bank of Iceland has decided to keep the Bank's interest rates unchanged.
04/09/2013	Foreign currency auctions
30/09/2013	The People's Bank of China and the Central Bank of Iceland have renewed its bilateral currency swap agreement.
02/10/2013	The Monetary Policy Committee (MPC) of the Central Bank of Iceland has decided to keep the Bank's interest rates unchanged.
22/10/2013	Foreign currency auctions
06/11/2013	The Monetary Policy Committee (MPC) of the Central Bank of Iceland has decided to keep the Bank's interest rates unchanged.
02/12/2013	New liquidity rules for credit institutions
11/12/2013	The Monetary Policy Committee (MPC) of the Central Bank of Iceland has decided to keep the Bank's interest rates unchanged.
16/12/2013	Announcement on arrangements for the listing and sale of ESI assets
19/12/2013	Foreign currency auctions
30/12/2013	Interaction among the Treasury and the central bank
31/12/2013	Drómi, ESI, and Arion Bank conclude settlement agreements
05/02/2014	Foreign currency auction
12/02/2014	The Monetary Policy Committee (MPC) of the Central Bank of Iceland has decided to keep the Bank's interest rates unchanged.

19/03/2014	The Monetary Policy Committee (MPC) of the Central Bank of Iceland has decided to keep the Bank's interest rates unchanged.
31/03/2014	Foreign currency auction
15/05/2014	Foreign currency auction
21/05/2014	The Monetary Policy Committee (MPC) of the Central Bank of Iceland has decided to keep the Bank's interest rates unchanged.
11/06/2014	The Monetary Policy Committee (MPC) of the Central Bank of Iceland has decided to keep the Bank's interest rates unchanged.
17/06/2014	Rules on Foreign Exchange amended to mitigate the effects of halting unauthorised saving abroad
11/07/2014	The Central Bank of Iceland has decided to increase regular, weekly, foreign currency purchases in the interbank foreign exchange market
15/07/2014	Foreign currency auction
22/07/2014	Central Bank of Iceland prepaid loans granted from its Nordic
20/08/2014	The Monetary Policy Committee (MPC) of the Central Bank of Iceland has decided to keep the Bank's interest rates unchanged.
11/09/2014	Agreement on insurance contracts providing for saving abroad; cf. the Rules on Foreign Exchange
01/10/2014	The Monetary Policy Committee (MPC) of the Central Bank of Iceland has decided to keep the Bank's interest rates unchanged.
07/10/2014	New agreement on insurance contracts providing for saving abroad
05/11/2014	The Monetary Policy Committee (MPC) of the Central Bank of Iceland has decided to lower the Bank's interest rates by 0.25 percentage points.
04/12/2014	The Central Bank of Iceland has adopted new rules on commercial banks' foreign currency funding ratios.
05/12/2014	Financial Supervisory Authority and Central Bank of Iceland renew cooperation agreement
10/12/2014	The Monetary Policy Committee (MPC) of the Central Bank of Iceland has decided to lower the Bank's interest rates by 0.5 percentage points.
21/02/2015	Amended terms for the purchase of foreign currency
04/02/2015	The Monetary Policy Committee (MPC) of the Central Bank of Iceland has decided to keep the Bank's interest rates unchanged.
06/03/2015	Amended terms for the purchase of foreign currency
18/03/2015	The Monetary Policy Committee (MPC) of the Central Bank of Iceland has decided to keep the Bank's interest rates unchanged.
13/05/2015	The Monetary Policy Committee (MPC) of the Central Bank of Iceland has decided to keep the Bank's interest rates unchanged.
09/06/2015	Announcement concerning capital account liberalisation measures
10/06/2015	The Monetary Policy Committee (MPC) of the Central Bank of Iceland has decided to raise the Bank's interest rates by 0.5 percentage points.
19/08/2015	The Monetary Policy Committee (MPC) of the Central Bank of Iceland has decided to raise the Bank's interest rates by 0.5 percentage points.
18/09/2015	Exemptions and foreign exchange transactions related to Icesave
30/09/2015	The Monetary Policy Committee (MPC) of the Central Bank of Iceland has decided to keep the Bank's interest rates unchanged.
28/10/2015	Central Bank concludes assessment of preliminary composition proposals
04/11/2015	The Monetary Policy Committee (MPC) of the Central Bank of Iceland has decided to raise the Bank's interest rates by 0.25 percentage points.
09/12/2015	The Monetary Policy Committee (MPC) of the Central Bank of Iceland has decided to raise the Bank's interest rates by 0.25 percentage points.
10/02/2016	The Monetary Policy Committee (MPC) of the Central Bank of Iceland has decided to keep the Bank's interest rates unchanged.
18/02/2016	The final exemption for settlement of the failed banks' estates has been granted
16/03/2016	The Monetary Policy Committee (MPC) of the Central Bank of Iceland has decided to keep the Bank's interest rates unchanged.
11/05/2016	The Monetary Policy Committee (MPC) of the Central Bank of Iceland has decided to keep the Bank's interest rates unchanged.

25/05/2016	Foreign currency auction
01/06/2016	The Monetary Policy Committee (MPC) of the Central Bank of Iceland has decided to keep the Bank's interest rates unchanged.
04/06/2016	New policy instrument to temper and affect the composition of capital inflows
09/06/2016	Amended rules in exchange for foreign currency
10/06/2016	Purchase of foreign currency through selling state-securities
13/06/2016	Amended rules in exchange for foreign currency
22/06/2016	Purchase of foreign currency through selling state-government bonds
24/08/2016	The Monetary Policy Committee (MPC) of the Central Bank of Iceland has decided to lower the Bank's interest rates by 0.5 percentage points.
31/08/2016	Temporary authorisation for withdrawals
05/10/2016	The Monetary Policy Committee (MPC) of the Central Bank of Iceland has decided to keep the Bank's interest rates unchanged.
21/10/2016	Amendments for foreign exchange
01/11/2016	Amended Rules on Special Reserve Requirements for New Foreign Currency Inflows
16/11/2016	The Monetary Policy Committee (MPC) of the Central Bank of Iceland has decided to keep the Bank's interest rates unchanged.
14/12/2016	The Monetary Policy Committee (MPC) of the Central Bank of Iceland has decided to lower the Bank's interest rates by 0.25 percentage points. T
21/12/2016	The People's Bank of China and the Central Bank of Iceland have renewed their bilateral currency swap agreement.
31/12/2016	Amendments for foreign exchange
08/02/2017	The Monetary Policy Committee (MPC) of the Central Bank of Iceland has decided to keep the Bank's interest rates unchanged.
24/02/2017	Exemptions for derivatives trading for hedging purposes
12/03/2017	Amended Rules on Special Reserve Requirements for New Foreign Currency Inflows
15/03/2017	Rules of foreign exchange
31/03/2017	New Central Bank rules on Liquidity Coverage Requirements
04/04/2017	Central bank offers to purchase offshore króna assets
05/05/2017	Central bank offers to purchase offshore króna assets
17/05/2017	The Monetary Policy Committee (MPC) of the Central Bank of Iceland has decided to lower the Bank's interest rates by 0.25 percentage points.
18/05/2017	Suspension of regular foreign currency purchase
06/06/2017	The Bank has decided that, from the 2 June 2017 interest payment date, the annual interest rate on the certificates of deposit will be unchanged at 0.5%.
23/06/2017	Central bank offers to purchase offshore króna assets
26/06/2017	Amendments to the Rules on Foreign Exchange - Restrictions on carry trade-related risk and foreign issuance of króna-denominated bonds
23/08/2017	The Monetary Policy Committee (MPC) of the Central Bank of Iceland has decided to keep the Bank's interest rates unchanged.
04/10/2017	The Monetary Policy Committee (MPC) of the Central Bank of Iceland has decided to lower the Bank's interest rates by 0.25 percentage points.
15/11/2017	The Monetary Policy Committee (MPC) of the Central Bank of Iceland has decided to keep the Bank's interest rates unchanged.
13/12/2017	The Monetary Policy Committee (MPC) of the Central Bank of Iceland has decided to keep the Bank's interest rates unchanged.
07/02/2018	The Monetary Policy Committee (MPC) of the Central Bank of Iceland has decided to keep the Bank's interest rates unchanged.
09/02/2018	New Memorandum of Understanding for financial stability in the Nordic and Baltic countries
14/03/2018	The Monetary Policy Committee (MPC) of the Central Bank of Iceland has decided to keep the Bank's interest rates unchanged.
16/05/2018	The Monetary Policy Committee (MPC) of the Central Bank of Iceland has decided to keep the Bank's interest rates unchanged.

01/06/2018	The Bank has decided that interest rate on certificates of deposits shall be unchanged at 0.5%.
05/06/2018	Change in credit institutions' minimum reserve requirements
13/06/2018	The Monetary Policy Committee (MPC) of the Central Bank of Iceland has decided to keep the Bank's interest rates unchanged.
29/08/2018	The Monetary Policy Committee (MPC) of the Central Bank of Iceland has decided to keep the Bank's interest rates unchanged.
03/10/2018	The Monetary Policy Committee (MPC) of the Central Bank of Iceland has decided to keep the Bank's interest rates unchanged.
11/10/2018	Merger of Central Bank of Iceland and Financial Supervisory Authority in preparation - Inflation targeting to remain the principal objective of monetary policy
02/11/2018	Amended Rules on Special Reserve Requirements for New Foreign Currency Inflows
07/11/2018	The Monetary Policy Committee (MPC) of the Central Bank of Iceland has decided to raise the Bank's interest rates by 0.25 percentage points.
07/12/2018	Liberalization of capital controls on offshore króna holders and reserve requirement on capital inflows
12/12/2018	The Monetary Policy Committee (MPC) of the Central Bank of Iceland has decided to keep the Bank's interest rates unchanged.

Source: Central Bank of Iceland and Iceland Supervisory Authority

Table 1. 5 Macroprudential policies, Norway

23/01/2008	Decision to maintain its key policy rate and overnight lending rate unchanged at 5.25 per cent and 6.25 per cent.
13/03/2008	Decision to maintain its key policy rate and overnight lending rate unchanged at 5.25 per cent and 6.25 per cent.
13/04/2008	Decision to maintain its key policy rate and overnight lending rate unchanged at 5.25 per cent and 6.25 per cent.
23/04/2008	Decision to increase the rates by 0.25.
16/05/2008	Swap facility agreement with the Central Bank of Iceland, Sedlabanki Islands.
28/05/2008	Decision to maintain its key policy rate and overnight lending rate unchanged at 5.50 per cent and 6.50 per cent.
25/06/2008	Decision to increase the rates by 0.25.
13/08/2008	Decision to maintain its key policy rate and overnight lending rate at unchanged at 5.75 per cent and 6.75 per cent.
24/09/2008	Decision to maintain its rates unchanged and announcement of swap facilities with US Federal Reserve
29/09/2008	Announcement of expanding swap facilities with US Federal Reserve
12/10/2008	Two-year F-loan for small banks
15/10/2008	Decision to reduce its key policy rate and overnight lending rate by 0.5 percentage point.
29/10/2008	Easing of collateral requirements and decision to reduce the rates by 0.50 percentage point.
14/11/2008	The swap arrangement for securities and two-year F-loan
17/12/2008	Decision to reduce its key policy rate and overnight lending rate by 1.75 percentage points.
03/02/2009	Extension of swap facilities with US Federal Reserve and other central banks
04/02/2009	Decision to reduce its key policy rate and overnight lending rate by 0.50 percentage point to 2.5 and 3.5.
25/03/2009	Decision to reduce its key policy rate and overnight lending rate by 0.50 percentage point.
06/05/2009	Decision to reduce its key policy rate and overnight lending rate by 0.50 percentage point.
17/06/2009	Decision to reduce its key policy rate and overnight lending rate by 0.25 percentage point.
26/06/2009	Extension of swap facilities with US Federal Reserve
01/07/2009	Lending agreement with Sedlabanki Islands
12/08/2009	Decision on interest rates to remain unchanged
23/09/2009	Decision on interest rates to remain unchanged
25/09/2009	Speech by Governor Svein Gjedrem for Norges Bank's regional network, Region East, Oslo,

22/10/2009	Circulation for comment regarding collateral for loans from Norges Bank
28/10/2009	Decision to increase the key policy rate and overnight lending rate by 0.25 percentage point to 1.50 per cent and 2.5 per cent.
04/11/2009	Speech by Deputy Governor Jan F. Qvigstad for Sparebank 1 Fredrikstad
16/12/2009	Decision to increase the key policy rate by 0.25 percentage point to 1.75 per cent.
03/02/2010	Decision for the key policy rate and overnight lending rate to remain unchanged at 1.75 and 2.75 per cent.
03/03/2010	Decision on interest rates to remain unchanged and the guidelines for collateral for loans in Norges Bank
24/03/2010	Decision on interest rates to remain unchanged at 1.75 and 2.75 per cent.
05/05/2010	Decision to increase the key policy rate by 0.25 percentage point to 2 per cent and the overnight lending rate at 3 per cent.
23/06/2010	Decision on interest rates to remain unchanged at 2 and 3 per cent
11/08/2010	Decision on interest rates to remain unchanged at 2 and 3 per cent
22/09/2010	Decision on interest rates to remain unchanged at 2 and 3 per cent
27/10/2010	Decision on interest rates to remain unchanged at 2 and 3 per cent
15/12/2010	Decision on interest rates to remain unchanged at 2 and 3 per cent
26/01/2011	Decision on interest rates to remain unchanged at 2 and 3 per cent
16/03/2011	Decision on interest rates to remain unchanged at 2 and 3 per cent
12/05/2011	Decision to increase the key policy rate and overnight lending rate by 0.25 percentage point to 2.25 per cent and 3.25 per cent.
22/06/2011	Decision on interest rate to remain unchanged at 2.25 and 3.25 per cent
10/08/2011	Decision on interest rate to remain unchanged at 2.25 and 3.25 per cent
21/09/2011	Decision on interest rate to remain unchanged at 2.25 and 3.25 per cent
19/10/2011	Decision on key policy rate, overnight lending rate and reserve rate to remain 2.25,3.25 and 1.25 respectively
14/12/2011	Decision to reduce the rates by 0.5 per cent
14/03/2012	Decision to reduce the key policy rate, overnight lending rate and reserve rate by 0.25 per cent
10/05/2012	Decision on interest rates, key policy rate, overnight lending rate and reserve rate to remain unchanged at 1.5,2.5 and 0.5 respectively.
14/05/2012	Adjustments to the new capital and liquidity requirements
20/06/2012	Decision on interest rates, key policy rate, overnight lending rate and reserve rate to remain unchanged at 1.5,2.5 and 0.5 respectively.
29/08/2012	Decision on interest rates, key policy rate, overnight lending rate and reserve rate to remain unchanged at 1.5,2.5 and 0.5 respectively.
31/10/2012	Decision on interest rates, key policy rate, overnight lending rate and reserve rate to remain unchanged at 1.5,2.5 and 0.5 respectively.
19/12/2012	Decision on interest rates, key policy rate, overnight lending rate and reserve rate to remain unchanged at 1.5,2.5 and 0.5 respectively.
14/03/2013	Decision on interest rates, key policy rate, overnight lending rate and reserve rate to remain unchanged at 1.5,2.5 and 0.5 respectively.
07/05/2013	Rules pertaining to covered bonds
08/05/2013	Decision on interest rates, key policy rate, overnight lending rate and reserve rate to remain unchanged at 1.5,2.5 and 0.5 respectively.
20/06/2013	Decision on interest rates, key policy rate, overnight lending rate and reserve rate to remain unchanged at 1.5,2.5 and 0.5 respectively.
19/09/2013	Decision on interest rates, key policy rate, overnight lending rate and reserve rate to remain unchanged at 1.5,2.5 and 0.5 respectively.
24/10/2013	Decision on interest rates, key policy rate, overnight lending rate and reserve rate to remain unchanged at 1.5,2.5 and 0.5 respectively.
05/12/2013	Decision on interest rates, key policy rate, overnight lending rate and reserve rate to remain unchanged at 1.5,2.5 and 0.5 respectively.

12/12/2013	The Ministry of Finance decided that the level of the countercyclical buffer should be 1 per cent from the 1st of July 2015.
27/03/2014	Decision on interest rates, key policy rate, overnight lending rate and reserve rate to remain unchanged at 1.5, 2.5 and 0.5 respectively.
04/04/2014	The Ministry of Finance decided to keep the level of the countercyclical capital buffer for banks unchanged.
08/05/2014	Decision on interest rates, key policy rate, overnight lending rate and reserve rate to remain unchanged at 1.5, 2.5 and 0.5 respectively.
12/05/2014	The Norwegian Ministry of Finance has today adopted a regulation on the identification of systemically important financial institutions in Norway.
19/06/2014	Decision on interest rates, key policy rate, overnight lending rate and reserve rate to remain unchanged at 1.5, 2.5 and 0.5 respectively.
27/06/2014	The Ministry of Finance decided to keep the level of the countercyclical capital buffer for banks unchanged.
18/09/2014	Decision on interest rates, key policy rate, overnight lending rate and reserve rate to remain unchanged at 1.5, 2.5 and 0.5 respectively.
26/09/2014	The Ministry of Finance decided to keep the level of the countercyclical capital buffer for banks unchanged.
23/10/2014	Decision on interest rates, key policy rate, overnight lending rate and reserve rate to remain unchanged at 1.5, 2.5 and 0.5 respectively.
28/10/2014	Adjustments to new capital requirements
11/12/2014	Decision on interest rates, key policy rates, overnight lending rate and reserve rate to lower by 0.25 per cent at 1.25, 2.25 and 0.25 respectively.
19/12/2014	The Ministry of Finance decided to keep the level of the countercyclical capital buffer for banks unchanged.
19/03/2015	Decision on interest rates, key policy rates, overnight lending rate and reserve rate to remain by 0.25 per cent at 1.25, 2.25 and 0.25 respectively.
27/03/2015	Speech by Governor Øystein Olsen at a lunch hosted by Danske Bank Markets, New York City
27/03/2015	The Ministry of Finance decided to keep the level of the countercyclical capital buffer for banks unchanged.
16/04/2015	Speech by Governor Øystein Olsen at ACI Norge ("The Financial Markets Association") in Oslo
07/05/2015	Decision on interest rates, key policy rates, overnight lending rate and reserve rate to remain by 0.25 per cent at 1.25, 2.25 and 0.25 respectively.
15/05/2015	Speech by Governor Øystein Olsen at the hearing before the Standing Committee on Finance and Economic Affairs of the Storting (Norwegian parliament)
15/06/2015	The Ministry of Finance adopted a regulation on requirements for residential mortgage loans.
18/06/2015	Decision to lower the interest rates by 0.25, the key policy rate, overnight lending rate and reserve rate reach at 1, 2 and 0 per cent respectively.
18/06/2015	The Ministry of Finance has decided that the level of the countercyclical capital buffer requirement shall be increased to 1.5 per cent from 30 June 2016
23/06/2015	Decision on systemically important financial institutions
25/08/2015	The Ministry of Finance has adopted a regulation to transpose detailed rules in the Solvency II Directive into Norwegian law.
08/09/2015	Changes to the rules on collateral for loans from Norges Bank
24/09/2015	Decision to lower rates by 0.25 per cent, the key policy rate, overnight lending rate and reserve rate reach at 0.75, 1.75 and -0.25
24/09/2015	The Ministry of Finance decided to keep the level of the countercyclical capital buffer for banks unchanged.
05/11/2015	Decision on interest rates to remain unchanged, the key policy rate, overnight lending rate and reserve rate remain at 0.75, 1.75 and -0.25
17/12/2015	Decision on interest rates to remain unchanged, the key policy rate, overnight lending rate and reserve rate remain at 0.75, 1.75 and -0.25
17/12/2015	The Ministry of Finance decided to keep the level of the countercyclical capital buffer for banks unchanged.
08/01/2016	Changes to the rules on collateral for loans.
17/03/2016	Decision to lower rates by 0.25 per cent, the key policy rate, overnight lending rate and reserve rate reach at 0.50, 1.50 and -0.50

17/03/2016	The Ministry of Finance decided to keep the level of the countercyclical capital buffer for banks unchanged.
12/05/2016	Decision to maintain the key policy rate, overnight lending rate and reserve rate at 0.50, 1.50 and -0.50
19/05/2016	Speech by Governon Øystein Olsen at the hearing before the Standing Committee on Finance and Economic Affairs of the Storting (Norwegian parliament)
06/06/2016	Change of settlement date for some F-loans
23/06/2016	Decision to maintain the key policy rate, overnight lending rate and reserve rate at 0.50, 1.50 and -0.50
23/06/2016	The Ministry of Finance decided to keep the level of the countercyclical capital buffer for banks unchanged.
22/09/2016	Decision to maintain the key policy rate, overnight lending rate and reserve rate at 0.50, 1.50 and -0.50
22/09/2016	The Ministry of Finance decided to keep the level of the countercyclical capital buffer for banks unchanged.
27/10/2016	Decision to maintain the key policy rate, overnight lending rate and reserve rate at 0.50, 1.50 and -0.50
07/11/2016	Change to floating interest rate for Norges Bank's market operations from 2017
14/12/2016	The Ministry of Finance adopted a new regulation on requirements for new residential mortgage loans
15/12/2016	Decision to maintain the key policy rate, overnight lending rate and reserve rate at 0.50, 1.50 and -0.50 and to increase the countercyclical buffer for banks from 1.5 percent to 2 percent effective from 31 December 2017.
15/12/2016	The Ministry of Finance has decided that the level of the countercyclical capital buffer requirement shall be increased to 2 per cent from 31 December 2017
19/12/2016	The Finance Minister of Norway and Finland, the Minister for Business of Denmark and the Minister for Financial Markets and Consumer Affairs of Sweden sign Memorandum of Understanding (MoU) in order to facilitate the cooperation regarding cross-border banking groups containing one or more significant branches.
01/03/2017	Quotas for the management of bank reserves
16/03/2017	Decision to maintain the key policy rate, overnight lending rate and reserve rate at 0.50, 1.50 and -0.50 and advice on the countercyclical capital buffer to remain unchanged
16/03/2017	The Ministry of Finance has today decided to keep the level of the countercyclical capital buffer for banks unchanged.
22/03/2017	Speech of Governor Øystein Olsen and Deputy Governor Jon Nicolaisen at Norges Bank's regional network, Sogndal.
04/05/2017	Decision to maintain the key policy rate, overnight lending rate and reserve rate at 0.50, 1.50 and -0.50
10/05/2017	Speech by Deputy Governor Jon Nicolaisen at Norges Bank's regional network, Region South-West, Bryne.
15/05/2017	Speech by Governon Øystein Olsen at the hearing before the Standing Committee on Finance and Economic Affairs of the Storting (Norwegian parliament)
22/05/2017	Speech by Governon Øystein Olsen at a seminar held by the local trade and industry association, Moss.
23/05/2017	Speech by Governon Øystein Olsen at a conference hosted by The Norwegian Association of Local and Regional Authorities (KS)
21/06/2017	The Ministry of Finance has proposed new legislation to implement the deposit guarantee schemes directive and the bank recovery and resolution directive.
22/06/2017	Decision to maintain the key policy rate, overnight lending rate and reserve rate at 0.50, 1.50 and -0.50 and to keep the countercyclical capital buffer unchanged
22/06/2017	The Ministry of Finance decided to keep the level of the countercyclical capital buffer for banks unchanged.
23/06/2017	Law Commission on a new central bank act
21/09/2017	Decision to maintain the key policy rate, overnight lending rate and reserve rate at 0.50, 1.50 and -0.50 and to keep the countercyclical capital buffer unchanged
21/09/2017	The Ministry of Finance decided to keep the level of the countercyclical capital buffer for banks unchanged.
22/09/2017	Speech by Governon Øystein Olsen at the Norwegian University of Science and Technology (NTNU), Trondheim.
27/09/2017	Speech by Governon Øystein Olsen at Norges Bank's regional network in Kristiansand
29/09/2017	Speech by Deputy Governon Nicolaisen at Norges Bank's regional network, Region Inland, Hamar.
11/10/2017	Speech by Deputy Governon Nicolaisen at the 2017 Coastal Business Conference

13/10/2017	Speech by Governon Øystein Olsen at the J. P. Morgan Investor Seminar
26/10/2017	Decision to maintain the key policy rate, overnight lending rate and reserve rate at 0.50, 1.50 and -0.50
14/12/2017	Decision to maintain the key policy rate, overnight lending rate and reserve rate at 0.50, 1.50 and -0.50 and to keep the countercyclical capital buffer unchanged
14/12/2017	The Ministry of Finance decided to keep the level of the countercyclical capital buffer for banks unchanged.
25/01/2018	Decision to maintain the key policy rate, overnight lending rate and reserve rate at 0.50, 1.50 and -0.50
09/02/2018	The heads of relevant ministries, central banks, financial supervisory authorities and resolution authorities in the Nordic and Baltic countries, have signed a Memorandum of Understanding (MoU) on cooperation and coordination on cross-border
12/02/2018	Market operations at quarter-end and year-end in 2018
28/02/2018	New central credit registrar to strengthen the basis for monetary policy
15/03/2018	Decision to maintain the key policy rate, overnight lending rate and reserve rate at 0.50, 1.50 and -0.50 and to keep the countercyclical capital buffer unchanged
15/03/2018	The Ministry of Finance decided to keep the level of the countercyclical capital buffer for banks unchanged.
16/03/2018	Speech by Deputy Governor Jon Nicolaisen at Norges Bank's Regional Network Region North-West in Kristiansund
06/04/2018	Speech by Governor Øystein Olsen at Finance Norway's Capital Markets Day 2018
10/04/2018	Speech by Governor Øystein Olsen at to foreign embassy representatives in Oslo.
12/04/2018	Speech by Governor Øystein Olsen at a lecture at the University of Stavanger.
13/04/2018	Speech by Governor Øystein Olsen at the Regional network, , Region North in Tromsø.
17/04/2018	New requirements on banks' contingency arrangements for cash
19/04/2018	Speech by Governor Øystein Olsen at The Financial Markets Association, Swedbank, Oslo.
03/05/2018	Decision to maintain the key policy rate, overnight lending rate and reserve rate at 0.50, 1.50 and -0.50
14/05/2018	Speech by Governor Øystein Olsen at the hearing before the Standing Committee on Finance and Economic Affairs of the Storting (Norwegian parliament)
19/06/2018	The Ministry of Finance has adopted a new regulation on requirements for new residential mortgage loans.
21/06/2018	Decision to maintain the key policy rate, overnight lending rate and reserve rate at 0.50, 1.50 and -0.50 and to keep the countercyclical capital buffer unchanged
21/06/2018	The Ministry of Finance has decided to keep the countercyclical capital buffer requirement for banks unchanged
16/08/2018	Decision to maintain the key policy rate, overnight lending rate and reserve rate at 0.50, 1.50 and -0.50
20/09/2018	Decision to increase the rates by 0.25 per cent, the key policy rate, overnight lending rate and reserve rate reach at 0.75, 1.75 and -0.25 and advice on the countercyclical capital buffer to remain unchanged
22/09/2018	The Ministry of Finance has decided to keep the countercyclical capital buffer requirement for banks unchanged
28/09/2018	Speech by Deputy Governor Jon Nicolaisen at Norges Bank's regional network in Region Inland, Lillehammer.
25/10/2018	Decision to maintain the key policy rate, overnight lending rate and reserve rate at 0.75, 1.75 and -0.25
04/12/2018	Market operations at quarter-end and year-end in 2018
13/12/2018	Decision to maintain the key policy rate, overnight lending rate and reserve rate at 0.75, 1.75 and -0.25 and to increase the countercyclical buffer for banks to 2.5 percent
13/12/2018	The Ministry of Finance has decided that the countercyclical capital buffer requirement for banks shall be increased to 2.5 percent from 31 December 2019

Source: Central Bank of Norway and Ministry of Finance

Table 1. 6 Macroprudential policies, Sweden

13/02/2008	Executive Board meeting
23/04/2008	Executive Board meeting
16/05/2008	Swap facility with the Central Bank of Iceland

03/07/2008	Executive Board meeting
27/08/2008	Increase of size of monetary policy repo
04/09/2008	Executive Board meeting
18/09/2008	Measures to facilitate market functioning
22/09/2008	Changed collateral requirements for credit
24/09/2008	Swap Facilities with U.S. Federal Reserve
29/09/2008	Swap facilities in US dollars
02/10/2008	Riksbank lends 60 billion SEK
06/10/2008	Increased loans and maturity
08/10/2008	Executive Board meeting
08/10/2008	Changed collateral requirement for credit
10/10/2008	Riksbank issues Riksbank Certificates
13/10/2008	New loans in SEK and USD
20/10/2008	New dollar loans
22/10/2008	The Riksbank offers SEK loans on 27 October
23/10/2008	Executive Board meeting
24/10/2008	The Riksbank to offer USD loans on 28 October
29/10/2008	Assistance for corporate funding
06/11/2008	The Riksbank offers SEK loans on 10 November
10/11/2008	Agreement to take over Carnegie
12/11/2008	On 19 November the Riksbank offers new SEK loans against commercial paper
20/11/2008	The Riksbank offers SEK loans on 24 November
20/11/2008	Swap agreement with Seðlabanki Íslands
24/11/2008	The agreement with the Icelandic central bank means that the Riksbank will lend up to EUR 500 million against Icelandic kronor. The loans granted by the Riksbank provide short-term financing to contribute to stabilising the financial situation in Iceland.
25/11/2008	Riksbank offers new SEK loans against commercial paper
08/12/2008	The Riksbank offers SEK loans on 8 December
10/12/2008	On 17 December the Riksbank offers new SEK loans against commercial paper
16/12/2008	The Riksbank grants loan to Latvia's central bank
19/12/2008	Riksbank will continue to offer USD loans next year
30/12/2008	The Riksbank offers SEK loans on 5 January
09/01/2009	On 21 January the Riksbank offers new SEK loans against commercial paper
14/01/2009	The Riksbank offers SEK loans on 16 January
22/01/2009	The Riksbank offers SEK loans on 26 January
23/01/2009	On 30 January the Riksbank offers new SEK loans against commercial paper
03/02/2009	New dollar auctions and extended swap line with the Federal Reserve
05/02/2009	The Riksbank offers SEK loans on 9 February
10/02/2009	The Riksbank to offer USD loans on 11 February
11/02/2009	Executive Board meeting
13/02/2009	Riksbank offers new SEK loans
16/02/2009	The Riksbank to offer USD loans on 18 February
19/02/2009	The Riksbank will offer SEK loans, with maturity 84 and 168 days, on 23 February
20/02/2009	Riksbank offers new SEK loans

26/02/2009	The Riksbank offers new SEK loans, maturity 84 days and 336, against commercial paper
27/02/2009	Precautionary arrangement with the Estonian central bank
05/03/2009	Riksbank offers new SEK loans
11/03/2009	On 18 March the Riksbank offers new SEK loans against commercial paper (168 days) and 84 days
18/03/2009	Riksbank offers new SEK loans
25/03/2009	Riksbank offers new SEK loans
30/03/2009	The Riksbank to offer USD loans
02/04/2009	Riksbank extends eligible counterparties
06/04/2009	Riksbank offers new SEK loans
06/04/2009	Riksbank offers new SEK loans against commercial paper
16/04/2009	Riksbank offers new SEK loans
20/04/2009	Riksbank offers new SEK loans
21/04/2009	Executive Board meeting
28/04/2009	The Riksbank to offer USD loans
29/04/2009	The Riksbank to offer USD loans
04/05/2009	The Riksbank to offer USD loans
06/05/2009	The Riksbank offers new SEK loans, maturity 84 days and 168, against commercial paper
07/05/2009	Riksbank offers SEK loans with 12-month maturity
12/05/2009	The Riksbank to offer USD loans
14/05/2009	The Riksbank offers new SEK loans
19/05/2009	The Riksbank offers new SEK loans, maturity 84 days and 336, against commercial paper
28/05/2009	The Riksbank offers new SEK loans
03/06/2009	The Riksbank will offer SEK loans, with maturity 84 and 168 days, on 10 June, that will compromise on 25 SEK billion and the minimum interest rate will correspond to the average repo rate during the maturity of the loan with a supplement of 0.20 percentage points.
10/06/2010	Executive Board meeting
11/06/2009	The Riksbank offers new SEK loans
16/06/2009	The Riksbank offers new SEK loans for 84 and 336 days.
22/06/2009	The Riksbank will offer USD loans
25/06/2009	The Riksbank offers new SEK loans
25/06/2009	Swap Facilities with Federal Reserve extended
02/07/2009	Executive Board meeting
06/07/2009	Riksbank offers USD loans
09/07/2009	Riksbank offers new SEK loans
09/07/2009	Riksbank offers new SEK loans
23/07/2009	Riksbank offers new SEK loans
27/07/2009	Riksbank will continue to offer USD loans
29/07/2009	Riksbank offers new SEK loans
05/08/2009	Riksbank will continue to offer USD loans
06/08/2009	Riksbank offers new SEK loans
20/08/2009	Riksbank offers new SEK loans

26/08/2009	Riksbank offers new SEK loans
03/09/2009	Executive Board meeting
03/09/2009	Riksbank offers new SEK loans
10/09/2009	Riksbank offers new SEK loans
11/09/2009	Riksbank offers USD loans
17/09/2009	Riksbank offers new SEK loans
01/10/2009	Riksbank offers new SEK loans
15/10/2009	Riksbank offers new SEK loans
15/10/2009	Riksbank offers USD loans
22/10/2009	Riksbank offers new SEK loans
22/10/2009	Executive Board meeting
29/10/2009	Riksbank offers new SEK loans
29/10/2009	Riksbank offers new SEK loans
05/11/2009	Riksbank offers new SEK loans
12/11/2009	Riksbank offers new SEK loans
26/11/2009	Riksbank offers new SEK loans
10/12/2009	Riksbank offers new SEK loans
16/12/2009	Executive Board meeting
22/12/2009	Riksbank offers new SEK loans
07/01/2010	Riksbank offers new SEK loans
21/01/2010	Riksbank offers new SEK loans
04/02/2010	Riksbank offers new SEK loans
04/02/2010	Riksbank offers new SEK loans
11/02/2010	Executive Board meeting
18/02/2010	Riksbank offers new SEK loans
04/03/2010	Riksbank offers new SEK loans
18/03/2010	Riksbank offers new SEK loans
30/03/2010	Riksbank offers new SEK loans
15/04/2010	Riksbank offers new SEK loans
20/04/2010	Executive Board meeting
20/04/2010	Riksbank offers new SEK loans
29/04/2010	Riksbank offers new SEK loans
26/05/2010	Certificates with right of resale and longer maturity
27/05/2010	Riksbank offers new SEK loans
21/06/2010	Riksbank offers new SEK loans
01/07/2010	Executive Board meeting
16/07/2010	Riksbank offers new SEK loans
19/07/2010	Riksbank offers new SEK loans
16/08/2010	Riksbank offers new SEK loans
02/09/2010	Executive Board meeting
16/09/2010	Riksbank offers new SEK loans
27/09/2010	Riksbank offers new SEK loans
26/10/2010	Executive Board meeting

15/12/2010	Executive Board meeting
15/02/2011	Executive Board Meeting
20/04/2011	Executive Board Meeting
05/07/2011	Executive Board Meeting
07/09/2011	Executive Board Meeting
27/10/2011	Executive Board Meeting
25/11/2011	New capital requirements
20/12/2011	Executive Board Meeting
16/02/2012	Executive Board Meeting
21/02/2012	Top up of foreign currency
18/04/2012	Executive Board Meeting
04/07/2012	Executive Board Meeting
06/09/2012	Executive Board Meeting
25/10/2012	Executive Board Meeting
18/12/2012	Executive Board Meeting
13/02/2013	Executive Board Meeting
18/02/2013	Implementation of the European supervisory authorities' guidelines and recommendations
17/04/2013	Executive Board Meeting
21/05/2013	Decision to implement a risk weight floor for mortgages
03/07/2013	Executive Board Meeting
05/09/2013	Executive Board Meeting
24/10/2013	Executive Board Meeting
17/12/2013	Executive Board Meeting
13/02/2014	Executive Board Meeting
18/03/2014	FI does not grant waivers from the Basel 1-floor
09/04/2014	Executive Board Meeting
08/05/2014	Forthcoming capital requirements for Swedish banks
12/06/2014	Household debt and bank's market funding - risks to stability
03/07/2014	Executive Board Meeting
04/09/2014	Executive Board Meeting
10/09/2014	Capital requirements for Swedish banks
28/10/2014	Executive Board Meeting
11/11/2014	Measures to counteract household indebtedness – amortisation requirement
08/12/2014	Leverage ratio requirement for Swedish banks
10/12/2014	Changed terms and conditions for issues of Riksbank Certificates
10/12/2014	Sound resilience in the financial system
16/12/2014	Executive Board Meeting
12/12/2014	FI's methods for assessing individual types of risk within Pillar 2
29/12/2014	FI intends to implement a partial waiver for covered bonds
12/02/2015	Executive Board Meeting
19/02/2015	Capital needs of Swedish banks
11/03/2015	Amortization requirement for new mortgages
17/03/2015	Decision regarding the countercyclical buffer rate
18/03/2015	Executive Board Meeting

23/04/2015	FI is not progressing with the amortization requirement
29/04/2015	Executive Board Meeting
12/05/2015	FI publishes methods for assessing capital requirements for three important risk types
09/06/2015	Capital needs of Swedish banks
16/06/2015	Temporary changes to conditions for Riksbank certificates
19/06/2015	Resilience continues to be sound but measures required
26/06/2015	Swedish banks' systemic importance (O-SII)
02/07/2015	Executive Board Meeting
06/07/2015	The future structure of banks' capital requirements
09/07/2015	Recognition of other Member States' countercyclical buffer rates
02/09/2015	Capital needs of Swedish banks
03/09/2015	Executive Board Meeting
08/09/2015	Decision regarding the countercyclical buffer rate
16/09/2015	Swap facility with National Bank of Ukraine
21/10/2015	Changes for conditions of collateral
28/10/2015	Executive Board Meeting
25/11/2015	FI increases transparency in capital requirement for Swedish banks
01/12/2015	Growing risks require readiness to introduce further measures
15/12/2015	Executive Board Meeting
16/12/2015	Decision regarding the countercyclical buffer rate
18/12/2015	Changes for conditions of collateral
18/12/2015	New proposal for an amortization requirement
08/01/2016	EBA's MDA Opinion does not change Pillar 2 in Sweden
19/01/2016	FI open to raising the countercyclical buffer rate in March
04/02/2016	FI proposes partial waiver for covered bonds
11/02/2016	Executive Board Meeting
25/02/2016	Capital requirements of Swedish banks
01/03/2016	FI's supervision of banks' calculations of risk weights for exposures to corporates
15/03/2016	FI increases resilience in the financial system
10/04/2016	FI aims for unchanged countercyclical buffer rate in June
20/04/2016	Amortisation requirement for new mortgages
21/04/2016	Executive Board Meeting
09/05/2016	Stress test methodology for assessment of the capital planning buffer
24/05/2016	New methods for banks' risk weights and capital requirements decided
26/05/2016	Capital requirements of Swedish banks
20/06/2016	Decision regarding the countercyclical buffer rate
06/07/2016	Executive Board Meeting
12/07/2016	FI aims for unchanged countercyclical buffer rate in September
11/08/2016	FI decides on stress test methodology for determining the capital planning buffer
25/08/2016	Capital requirements of Swedish banks
07/09/2016	Executive Board Meeting
16/09/2016	Decision regarding the countercyclical buffer rate
03/10/2016	Additional capital requirements for Nordea's PD estimates

27/10/2016	Executive Board Meeting
07/11/2016	New methods for banks' risk weights and capital requirements
25/11/2016	Capital requirements of Swedish banks
01/12/2016	FI's capital assessment method for securitisation within Pillar 2
12/12/2016	Decision regarding the countercyclical buffer rate
15/12/2016	Calibration of stress test for the capital planning buffer
27/12/2016	Biennial Review of the Systemic Risk Buffer
28/12/2016	FI's capital assessment method for securitisation within Pillar 2
21/12/2016	Executive Board Meeting
11/01/2017	Decision regarding reciprocation of macroprudential measures in two EU countries
24/01/2017	FI aims for unchanged countercyclical buffer rate in March
15/02/2017	Executive Board Meeting
24/02/2017	Capital requirements of Swedish banks
30/03/2017	Decision regarding the countercyclical buffer rate
27/04/2017	Executive Board Meeting
27/04/2017	Updated categorisation of Swedish credit institutions
02/05/2017	Decision regarding the countercyclical buffer rate
24/05/2017	Capital requirements of Swedish banks
31/05/2017	Stricter amortisation requirement for households with large debt
29/06/2017	FI's Pillar 2 capital assessment method for systemic risk associated with securitisation
04/07/2017	Executive Board Meeting
14/07/2017	Decision regarding the countercyclical buffer rate
25/08/2017	Capital requirements of Swedish banks
07/09/2017	Executive Board Meeting
26/10/2017	Executive Board Meeting
31/10/2017	Decision regarding the countercyclical
13/11/2017	FI proposes stricter amortisation requirement
13/11/2017	Proposal for a stricter amortisation requirement for households with high loan-to-income ratios
24/11/2017	Capital requirements of Swedish banks
07/12/2017	Basel agreement on banks' capital adequacy
20/12/2017	Executive Board Meeting
22/12/2017	More efficient handling of applications to use the IRB approach for credit risk
27/12/2017	FI recognises the risk weight floor for Finnish mortgage exposures
30/01/2018	Decision regarding the countercyclical buffer rate
09/02/2018	Memorandum of understanding between Nordic and Baltic countries
14/02/2018	Executive Board Meeting
23/02/2018	Capital requirements of Swedish banks
28/03/2018	Proposal to change method for the application of the risk weight floor for Swedish mortgages
26/04/2018	Executive Board Meeting
27/04/2018	Decision regarding the countercyclical buffer rate
22/05/2018	Major upcoming changes to banks' credit risk modelling
25/05/2018	EU notification regarding changed method for the application of the risk weight floor for Swedish mortgages

03/07/2018	Executive Board Meeting
04/07/2018	Opinions from the ESRB and the EBA regarding changed method for application of the risk weight floor for Swedish mortgages
13/07/2018	FI open to raising the countercyclical buffer rate in September
30/07/2018	Proposal to change Finansinspektionen's Regulations regarding the countercyclical buffer rate
14/08/2018	European Commission's decision regarding the risk weight floor for Swedish mortgages
23/08/2018	Changed method for the application of the risk weight floor for Swedish mortgages
24/08/2018	Capital requirements of Swedish banks
06/09/2018	Executive Board Meeting
19/09/2018	FI raises the countercyclical buffer rate
24/10/2018	Executive Board Meeting
01/11/2018	Decision regarding the countercyclical buffer rate
13/11/2018	Biennial Review of the Systemic Risk Buffer
23/11/2018	Capital requirements of Swedish banks
20/12/2018	Executive Board Meeting

Source: Central Bank of Sweden and Swedish Financial Supervisory Authority