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The ECB's unconventional monetary policy announcements: Cross-border spillover effects on the Scandinavian markets

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Abstract

Domestic monetary policies have always had domestic spillover effects. With a global market that experienced trends of instability and distress following the 2008 financial crisis, the European Central Bank introduced several unconventional monetary policy (UMP) measures as a counter-acting force. Through recent times until 2019, over 136 cases of UMPs have been announced through press conferences, press releases, and speeches given by the ECB. Despite these measures being supportive elements during challenging economic events specific to the euro area, several studies document spillover effects on foreign asset prices and output effects on non-euro European markets. In this dissertation, through conducting an event study approach, we examine the impacts, and through which channels the ECB UMP announcements spill over to the Scandinavian markets (of Norway, Sweden, and Denmark). Using a range of domestic financial variables, it is found to have significantly strong impacts on equity prices and longer-term bond yields. Further, by extracting monetary policy surprises from a factor analysis of the euro yield curve, we find broad evidence of spillovers through the signaling channel before the ECB key interest rates hit the zero lower bound. As the euro area enters the ZLB, the spillovers to Scandinavian countries are mitigated.

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Resumo

As políticas monetárias domésticas sempre tiveram efeitos sobre a economia doméstica. Com um mercado global que conheceu tendências de instabilidade e dificuldades após a crise financeira de 2008, o Banco Central Europeu introduziu várias medidas de política monetária não convencionais (UMP) como uma força contrária. Nos últimos tempos, até 2019, foram anunciados mais de 136 medidas de UMP através de conferências de imprensa, comunicados de imprensa e discursos proferidos pelo BCE. Apesar destas medidas providenciarem apoio durante circunstâncias económicas desafiantes específicas da área do euro, vários estudos documentam efeitos colaterais nos preços de ativos estrangeiros e e sobre a atividade económica nos mercados europeus não-área do euro.

Nesta dissertação, através de uma análise de tipo estudo de eventos, examinamos os impactos dos anúncios de UMP e os canais através dos quais se transmitem aos mercados escandinavos (Noruega, Suécia e Dinamarca). Utilizando um conjunto de variáveis financeiras domésticas, constata-se que há impactos significativamente fortes nos preços das ações e nos rendimentos das obrigações a longo prazo. Além disso, ao extrair os choques de política monetária de uma análise de fatores sobre a curva de rendimento do euro, encontramos amplas evidência de contágio através do canal de sinalização antes de as taxas de juro diretoras do BCE atingirem o limiar inferior zero. À medida que a área do euro atingiu o limiar inferior, o contágio aos países escandinavos foi mitigado.

Título: Os anúncios de política monetária não convencionais do BCE: Efeitos colaterais transfronteiriços no mercado escandinavo

Autor: Markus Nysæter

Palavras-chave: Banco Central Europeu; repercussões da política monetária não convencional; estudo de eventos; limite inferior zero; Escandinávia

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III. List of Abbreviations

ABSPP – Asset-Backed Securities Purchase Program

APP – Asset Purchase Program

CBPP – Covered Bond Purchase Program

COLL – Collateral Assets for Refinancing Operations

CSPP – Corporate Sector Purchase Program

ECB – European Central Bank

FED – Federal Reserve

FOR – Foreign Currency Funding

FWG – Forward Guidance

LSAP – Large-Scale Asset Purchases

LTRO –Longer-Term Refinancing Operations

OMT – Outright Monetary Transactions

PSPP – Public Sector Purchase Program

QE – Quantitative easing

SMP – Securities Markets Programme

SOE – Small open economy

TLTRO – Targeted Longer-Term Refinancing Operations

UMP – Unconventional monetary policy

ZLB – Zero lower bound

"Extraordinary times require extraordinary action.
There are no limits to our commitment to the euro."
- Christine Lagarde, President of the ECB [1]

1. Introduction

Domestic monetary policies have always had domestic spillover effects. Over the recent years, a large set of empirical evidence has clearly stated that monetary policy measures implemented by the core economies' central banks have significant spillover effects on smaller open economies (SOEs). In the aftermath of the 2008 financial crisis, the global financial markets experienced tendencies toward increased instability and distress. In Europe, several unconventional monetary policy (UMP) measures were introduced by the European Central Bank (ECB), with the objective of resolving potential low inflation- and liquidity disruption risks (Hartmann and Smets, 2018). Notwithstanding that these UMP measures are implemented to support markets and the overall economy during undesirable economic events within the euro area, several studies have documented cross-border spillovers on foreign asset prices and output effects on the non-euro European market (Falagiarda, et al., 2015; Fratzscher et al., 2016; Georgiadis and Gräb, 2015). However, to the best of knowledge, evidence regarding spillover effects resulting from the ECB's UMP to the region of Scandinavia (i.e., the countries of Norway, Sweden, and Denmark) has received little attention in previous literature.

Attempting to fill this gap, this dissertation will empirically examine the spillover effects of the ECB's non-standard monetary policy announcements on a set of asset prices and yields in the Scandinavian markets. These are considered interesting cases due to their high integration with the European (Monetary) Union, yet their variable magnitude of integration relative to each other. By this it is closely considered the fact that both Sweden and Denmark are members of the European Union, however, have not adopted the euro currency. Norway, on the other hand, is not a member of the European Union, though, a part of the European Economic Area (EEA) giving the country full inclusion of EU legalization within the free movement of capital, goods, services, and labor. This means that the three SOEs are considered close trading partners with the euro area countries providing capital through portfolio investments as well as direct foreign investments.

[1] Lagarde, C. [@Lagarde] (2020, March 2018). *Extraordinary times require extraordinary action. There are no limits to our commitment to the euro*. [Tweet]. Twitter. https://twitter.com/lagarde/status/1240414918966480896

Furthermore, the financial assets are highly comparable in light of the country's common economic model, the Nordic model, distinguished by financial openness through cooperative labor markets, stable governmental finances, and growth-enhancing trades. Consequently, these features of the model made the global financial market consider the countries as *safe havens,* especially during the 2009 euro area sovereign debt crisis.

Significant dissimilarities between the countries do exist in terms of exchange rates. Whereas Norway and Sweden have floating exchange rates relative to the euro (and an independent inflation targeting practice), Denmark has a pegged rate to the euro. With the implementation of the euro in 1999, Denmark entered the ERM II which still governs the fixed-exchange-rate regime at a central rate of 746 Danish kroner per 100 euro.[2] This magnitude of Scandinavian economic integration with the euro area thus gives us a fundamental basis for raising and testing a set of key empirical questions that remains unanswered. Firstly, previous studies show that international spillovers mainly occur through the financial variables of bond yields and interest rates (Falagiarda et al., 2015; IMF, 2016). Will similar significant results emerge regarding transmission to the Scandinavian countries? We focus on a group of financial variables including exchange rates, equity prices, and interest rates. These tend to instantly react to monetary policy surprises and are considered typically instruments for the first phases of the monetary policy transmission. Next, will a new set of UMP measures make a different impact on the transmissions? While the initial UMP measures from the ECB were aimed to prevent a collapse of the European economic system, announcements since 2014 have been intended to stimulate the economy and avoid a disinflationary spiral as the key policy rates hit a zero lower bound (ZLB) in 2012. The question split our sample of financial variables to shed light on how different intentions of measures influence the euro market, and thus cross-border spillovers.

Next, through which channels will potentially ECB unconventional monetary policy measures affect financial variables? We attempt to extract the market surprises from a European yield curve and further break them down into a set of factors that denotes a market channel and a signaling channel (Chen et al., 2014). The market channel is in particular driven by the portfolio rebalancing channel and concerns the demand and supply of government security markets. In

[2] The Exchange Rate Mechanism (ERM II) ensures exchange rate fluctuation between the euro and non-euro member countries do not disrupt economic stability within their markets. Participation in ERM II is required to meet the convergence condition for exchange rate stability (European Commission, 2019).

practice, this can be considered as a trade of the ECB's longer-term assets with shorter-term liquid assets (reserves), which lower government bond yields and increases equity returns by creating liquidity confidence in the market. The signaling channel, however, is creating similar market confidence, but through ECB signals of steady expectations regarding short-term policy rates. This dissertation addresses the important impacts of both channels.

To answer these questions raised, we conduct a traditional event study analysis of two different approaches. First, we test the impacts of the ECB's UMP using a series of dummies on each identified day of announcements, both pre- and post-ZLB. The study is using 1-day window of daily data and is controlled for (among other things) any market reaction that rather could stem from news surprises of macroeconomic releases.

Second, whereas the announcement dummy approach is considered limited not capturing the size of actual monetary policy surprises of markets expectations, we introduce a modified approach. Following Chen et al. (2014) we build the abovementioned surprise measures of portfolio rebalancing and signaling factors aimed to capture the unexpected components of UMP announcements. [3] The estimated factor values further replace the dummies to accurately measure the impacts of Scandinavian markets and their channel of transmission. Looking for different impacts through the UMP timeline we interact the surprise factors with a ZLB dummy, taking the value of one when entering the zero lower bound territory, including a new set of policy measures.

In accordance with existing literature, we find that UMPs in general do affect equity returns to increase and long term yields to decrease, while impacts on exchange rates are non-significant. Additionally, we also find certain results show evidence of opposite impacts on the Norwegian variables relative to the Swedish and Danish, indicating the assets are considered with different features to euro area investors. Dividing the samples in pre- and post-ZLB periods we find the impacts to be less dominant when entering the new phase of easing UMPs and negative rates. On channels we find the signaling channel to be the biggest transmitter of announcement shocks to all three countries, however, due to the currency peg of the Danish krone, interest rates impacts are also to a greater extent transferred to the portfolio rebalance channels.

[3] Chen et al. (2014) are extending the work of Gürkaynak, et al. (2005) to conduct factors of Fed's monetary policy surprises from longer-term US bond yields

The remainder of the thesis is organized into six chapters. Chapter 2 presents the literature review. Chapter 3 briefly introduces the ECB's UMP measures and announcement dates. Chapter 4 defines a set of transmission channels for international spillovers. Chapter 5 presents the event study methodology and factor analysis used to extract announcement surprises. Chapter 6 discusses the results of announcement impacts and transmission channels. Lastly, Chapter 7 presents a conclusion, as well as limitations, and further suggestions for future research.

2. Literature Review

Whilst literature is showing broad and extensive analysis of the potential effectiveness of the unconventional monetary policy, a vast majority focus on domestic variables (see for example Beirne et al., 2011; Krishnamurthy and Vissing-Jorgensen, 2011; Glick and Leduc, 2012; Baumeister and Benati, 2013, and Krishnamurthy et al., 2018). Considering the mixed theoretical predictions, the international transmission of monetary policy shocks becomes an important empirical question. The analysis of how economic and financial variables are affected by spillover effects of various policy shifts from advanced economies to small open economies (SOE), has first received broader attention in recent years.

2.1.Spillover impacts – From Fed to Emerging markets

A large strand of the existing spillover literature is dominated by an "If the Fed sneezes, who catches a cold?" approach, primarily limited to spillovers from the US Federal Reserve (Fed) to emerging market economies. A commonly used approach addresses the question by conducting a vector autoregression (VAR) on different sets of interest rates, as well as exchange rates. Chinn (2013) examines the influence of these policies on developing market exchange rates and asset prices, concluding that they support global rebalancing by boosting emerging market currency appreciation. Solely focusing on high-frequency data on bonds, Gilchrist et al. (2019) show results that yields on dollar-denominated sovereign bonds issued by 95 countries, both advanced and emerging, are highly responsive to unanticipated changes in the stance of US unconventional monetary policy. Aizenman (2014) and Berge and Cao (2014) both evaluate the emerging markets' impact after the federal funds rate hit the zero lower bound (ZLB), concluding that countries with stronger fundamentals faced a larger fall in stock prices, depreciation of exchange rate, and increase of CDS spreads than countries with a weaker fundamental.

Ahmed and Zlate (2014), Burns et al. (2014), and Chen et al. (2014) all report evidence of the effects of unconventional US monetary policies on capital inflows into emerging markets. Ahmed and Zlate (2014) and Chen et al. (2014) conclude that the unconventional policy can only be described as one among several explanatory factors of changes in inflows to EMEs. By conducting simulations where rather a normalization of UMPs and activity are assed, Burns et al. (2014) find significant slowdowns in capital inflows, driven by weaker portfolio investments in particular. Takáts and Vela (2014) set to investigate through which channels international monetary transmission works, and whether the responsiveness of emerging market central banks to policy actions in advanced economies varies between exchange rate and inflation targeting countries. Their findings show that under inflation targeting regimes, the link between the US and emerging market policy rates is substantially larger than for all developing markets combined.

Further, US monetary spillover impacts are broadly tested with the measures of *quantitative easing* (QE), the most commonly used type of UMP measure, where, in order to enhance the money supply as well as encourage lending and investment, the central bank purchases longer-term securities on open markets. Fic (2013) examines the market impact of QE on the BRIC economies (i.e., Brazil, Russia, India, and China) stating that the impact long-term yields was significant. Chen et al. (2012) investigate the influence of several central banks (including the Fed's) asset purchase announcements on cross-border financial markets. They discovered that the introduction of QE has a significant impact on global financial markets, affecting the prices of a wide range of developing markets assets, including increased equity prices, falling government and corporate bond yields, and compressing CDS spreads. Fratzscher et al. (2016) relate these flows to news about Fed´s QE and other determinants. They find that QE1 (in an early phase of the 2008 financial crisis) boosted bond and equity prices, especially in the US, and led to US dollar appreciation. Contrarywise, QE2 (in a later phase of the crisis) boosted equity prices worldwide and led to US dollar depreciation.

2.2.Spillover impacts between advanced economies

A second approach that dominates this topic within existing literature is how unconventional policies affect the advanced economies among themselves. Rogers et al. (2016) assess the relationship between monetary policy, foreign exchange risk premia, and term premia at the ZLB. Using a structural VAR including policy shocks of Fed, Bank of England, ECB, and Bank of Japan they find evidence of lower demand for liquidity in (US) treasuries and foreign exchange risk

premium. In an equivalent manner to this dissertation, Bauer and Neely (2014) distinguish the monetary transmission channels between signaling and portfolio rebalancing, by estimating a term structure model on international interest rate dynamics. Considering announcements associated with the Fed´s Large-Scale asset purchases (LSAP) programs during the period from 2008 to 2012 (QE1, QE2, and QE3), they show signaling effects varying from strong in the US and Canada to negligibly small in Japan. Similarly, Neely (2015) examines the QE1 announcements to demonstrate that policy news lowered foreign bond rates and the USD exchange rate vis-à-vis various developed economies. Later, Buch et al. (2019) provided evidence that the same spillover effects from the US, UK, EA, and Japan to 17 developed countries are vastly represented within the banking system. Using micro-banking data, they state that international spillovers occur by lending to private sectors and that the magnitudes of transmission, especially through the bank lending and portfolio channels, are influenced by bank-specific heterogeneity.

2.3.Spillover impacts within the euro area

The empirical evidence on any cross-border effects of an unconventional shift affected by the European Central Bank (ECB) measures is rather scarce, however, the existing studies show heterogeneous impacts inside the euro area. The empirical literature on monetary spillovers from the ECB is reckoned by Fratzscher et al. (2016) and Georgiadis and Gräb (2016), who find positive effects of ECB's unconventional policies of asset purchase programmes (APPs) across asset classes and confidence in advanced economies globally. Moreover, Burriel and Galesi (2018), Georgiadis (2015), and Leombroni et al. (2021) find that ECB's monetary policies, both conventional and unconventional, have a heterogeneous effect on the countries within the euro area. Using a global vector autoregressive (GVAR) model both Burriel and Galesi (2018) and Georgiadis (2015) conclude that most euro area members benefit from the measures. However, countries with banking systems of more fragile character experience weaker spillover effects and hence benefit less.

Papers combining the effect of the ECB unconventional policy on non-euro SOEs, however, are close to non-existent. Falagiarda et al. (2015) conduct a comprehensive event study using high-frequency identification (HFI) to trace spillovers from ECB´s unconventional policy announcements to yields in non-euro countries in Central- and Eastern Europe (CEE). Bernhard and Ebner (2017) analyze cross-border spillovers of UMP on Swiss asset prices using an event study and the change in 10-year government bond futures as an indicator of market anticipation.

They find a more substantial spillover effect on the domestic asset prices from ECB announcements compared to announcements of FED, BoE, and BoJ. Kucharcuková et al. (2016) compare the macroeconomic impact of conventional and unconventional ECB policy actions on the euro area and its spillover to six EU countries outside the euro area using a block-restricted VAR. In addition, Potjagailo (2017) analyzes the spillover effects based on a factor-augmented VAR model with two blocks, which exploits a large data set of fourteen European countries. The findings argue that the size of spillover effects varies with country characteristics, with the strongest impact on countries with fixed exchange rates.

In line with a continuously growing literature on the topics of unconventional monetary spillovers, this dissertation seeks to contribute by filling an alleged gap in research on the impacts of Scandinavian markets.

3. ECB Policy Measures

As a consequence of the economic downturn arising since the global financial crisis, the ECB introduced a significant reduction in key interest rates and a set of unconventional monetary policy measures (UMPs). The cyclical phases throughout ECB's history can be divided into different sub-periods, which are briefly discussed in this section. *The first period* from August 2007 to September 2008 is often referred to as the financial market turmoil (Hartmann and Smets 2018). In this initial phase of the financial crisis, the ECB announced a series of non-standard monetary measures to reinforce the interbank money market functioning within the euro area. *The second period* denotes the escalation from international financial turmoil to the intense systematic financial crisis that prevailed between October 2008 and May 2010. *The third period,* which runs from June 2010 to June 2013, includes the emergence of the sovereign debt crisis specific to the euro area when the Greek fiscal condition deteriorated significantly, and subsequently, several other euro area countries became distressed (Hartmann and Smets 2018). *The fourth period*, from June 2013 to December 2019, is characterized by the ECB's actions to overcome the zero lower bound (ZLB) of key interest rates in its attempt to address deflation risks and bring back inflation levels. *The fifth* and more recent period, from March 2020, address the adverse and sudden impacts due to the COVID-19 pandemic on inflation paths and the considerable declines in GDP. This last period is out of the analysis developed in this dissertation. The following subsections give a brief explanation

of the specific UMP measures announced by the ECB, together with a set of highlighted dates during the abovementioned periods.

3.1. Covered Bond Purchase Programmes (CBPP, CBPP2, and CBPP3)

In May 2009, the ECB introduced a modification of the existing measures through the Enhanced Credit Support (ECS). The ECS comprised fixed-rate full allotment, and longer-term- and foreign currency liquidity provision. An additional part of the support was the first Covered Bond Purchase Program (CBPP1). From July 2009 to June 2010, 60 billion euros in purchases were made in both primary and secondary markets within the euro region, due to investors' recent shift in risk awareness. According to the ECB, the program was announced with the aim of supporting a set of particularly affected financial market segments important to bank funding. Beirne et al. (2011) concluded that the programs i) supported lower money market term rates, ii) eased funding conditions for credit institutions and enterprises, iii) encouraged credit institutions to keep and expand their lending to clients, and iv) improved market liquidity. A second (CBPP2) and third (CBPP3) installment of the program were later decided in October 2011 and September 2014, in response to a worsening of the sovereign debt crisis, which impacted bank funding conditions once more, and as part of the comprehensive easing package to fight deflationary risks, respectively.

Table 1. Covered Bond Purchase Programme (CBPP) announcements

Announcement date	Description of announcement
07/05/2009	The ECB announcement to purchase euro-dominated covered bonds within the euro area (CBPP1)
02/07/2009	The initial phase of covered bonds purchases (CBPP1)
30/06/2010	The end of CPP1 (total purchase amount of EUR 60 bn)
06/10/2011	The ECB announcement of a second round of euro-dominated covered bonds purchase (CBPP2)
03/11/2011	The beginning of a second round of covered bonds purchases (CBPP2)
31/10/2012	The end of CPP2 (total purchase amount of EUR 40 bn)
04/09/2014	The ECB announcement of a third round of euro-dominated covered bonds purchase (CBPP3)
20/10/2014	The beginning of a third round of covered bonds purchases (CBPP3)

3.2. Securities Markets Programme (SMP)

In May 2010 the ECB's first government bond purchase program, the Securities Markets Programme (SMP) was introduced, with the intention of repairing the monetary transmission channel within the euro area. The liquidity was injected through secondary market purchases in order to resolve the securities market dysfunction arising during the 2008 financial crisis. In August 2012, the ECB launched an Outright Monetary Transactions (OMT). The program included transactions in the secondary sovereign bond market with no quantitative restrictions.[4] The main intention of the OMT introduction was to eliminate the euro area's monetary and financial fragmentations and it was announced in the aftermath of the ECB president Mario Draghi's "whatever it takes to preserve the euro" speech. However, the OMT has never applied. Though, its disclosure calmed the financial markets, particularly sovereign bond markets (Altavilla et al. 2014).

Table 2. Securities Market Programme (SMP) announcements

Announcement date	Description of the announcement
09/05/2010	The ECB announcement of the SMP
07/08/2011	The ECB GovC announcement of SMP reactivation – due to negatively affections of the sovereign debt crisis in Spain and Italy
06/09/2012	The final phase of SMP taken over by OMT

3.3. Asset Purchase Programme (APP)

In January 2015, the ECB Governing Council (GovC) announced an enlarged Asset Purchase Programme (APP), which included the already implemented private sector's programmes of CBPP3, an Asset-Backed Securities Purchase Program (ABSPP), as well as a Public Sector Purchase Programme (PSPP). Launched in March 2015, the latter was an utterly new ECB programme comprising bond purchases from euro area governments, agencies, and European institutions. With the main intention of opposing the risk of an excessively lengthy period of low inflation and providing stimulus in an environment with restricted interest rates cuts, the APP contributed with average monthly purchases of both public and private sector securities of 60

[4] The purchases were restricted to bonds of member countries subject to the European Stability Mechanism (ESM), an intergovernmental organization that serves as a permanent firewall for the eurozone, protecting and facilitating access to financial aid programs for eurozone member states in financial distress (Pereira 2016)

billion euros.[5] As key interest rates once again were lowered in March 2016, the ECB set to add the Corporate Sector Purchase Programme (CSPP) as a new element to the existing APP. The programme, aimed to buy investment-grade euro-denominated bonds within the non-bank corporation sector, was launched in April 2016, increasing the average monthly APP target to 80 billion euros (see Appendix A, Figure A.2). Later, the ECB Government Council announced an extension of the program three additional times but revising downwards the purchases amounts, with average monthly purchase paces of EUR 60 billion (2017), EUR 30 billion (2018), and EUR 15 billion (2018) respectively. In January 2019 an announcement to fully reinvest the principal payments from all maturing securities in the APP portfolio was made together with the end of net purchases. In November 2019 purchases were restarted at a monthly pace of EUR 20 billion and were expected to last as long as required to maintain the accommodating influence of the ECB's policy rates, and to cease just before the central bank starts raising key interest rates (ECB, 2019).

Table 3. Asset Purchase Programme (APP) announcements

Announcement date	Description of the announcement
21/11/2014	The ECB implemented the ABSPP
22/01/2015	The ECB announcement of an expanded asset purchase programme (APP)
09/03/2015	The ECB started with purchases of public sector securities (PSPP)
10/03/2016	The ECB announcement of a considerably expansion of the APP (monthly purchases increased to EUR 80 bn)
21/04/2016	The ECB detailed announcement of the CSPP
08/06/2016	The ECB startup of CSPP
08/12/2016	The ECB GovC announcement of an extension of APP (reduced to a monthly pace of EUR 60 bn)
26/10/2017	The ECB GovC announcement of a second extension of APP (reduced to a monthly pace of EUR 30 bn)
14/06/2018	The ECB GovC announcement of a third extension of APP (reduced to a monthly pace of EUR 15 bn)
24/01/2019	The ECB GovC announcement to reinvest the principal payments from maturing securities the APP portfolio
01/11/2019	The ECB GovC announcement of a third extension of APP (reduced to a monthly pace of EUR 20 bn)

[5] Figure A.2 in Appendix A shows average monthly APP targets from the implementation in 2015 (including CBPP3) to March 2022

3.4. Longer-term refinancing operations (LTRO)

During the third period, the ECB GovC announced a liquidity-providing policy measure in terms of long-term refinancing operations (LTROs), with maturities ranging from three months to three years (very long-term refinancing operations; VLTROs). The first operation was assigned in December 2011 with the main objective to supply euro are banks with longer-term liquidity and further lessen tension in the interbank money market. A second VLTRO was later assigned in February 2012. These VLTROs provided banks with financing certainty, made maturing bonds easier to redeem, and helped them maintain credit lines with private consumers.

As of June 2014, the ECB commenced a series of two-year targeted longer-term refinancing operations (TLTROs) with intention of increasing bank lending, especially to private non-financial enterprises. Later, the TLTRO was announced to be expanded in two more series in June 2016 (TLTRO-II) and March 2019 (TLTRO-III) respectively. In March 2020, as an immediate response to the COVID-19 pandemic, the ECB launched the Pandemic Emergency Purchase Programme (PEPP), a restructured and repricing revision of the TLTRO program, acting to reinforce impacts of the already low policy rates of the ECB.

Table 4. Longer-term refinancing operations (LTRO) announcements

Announcement date	Description of the announcement
23/03/2008	The ECB announcement its first supplementary LTRO offered with a 6-month term
07/05/2009	The ECB announcement of lengthening to its first 12-month LTRO
08/12/2011	The ECB GovC announcement of the first LTROs with a 3-year term
21/12/2011	The ECB conduction of the first VLTRO
29/02/2012	The ECB conduction of the second VLTRO
05/06/2014	The ECB GovC decision of conducting a series of TLTROs.
16/09/2014	The ECB announcement of a first TLTRO (I)
10/03/2016	The ECB announcement of a second TLTRO (II)
29/06/2016	The first conductions of TLTRO-II
07/03/2019	The ECB announcement of a third TLTRO (III)
12/09/2019	The first conductions of TLRO-III
18/03/2020	The ECB announcements of PEPP

4. Transmission channels

The ECB's unconventional monetary policies have a potential set of major transmission channels that could affect a range of financial asset prices in the countries of interest. This dissertation will solely focus on any changes in the variables of (i) nominal exchange rates (NEER) relative to the euro, (ii) equity index returns, (iii) interbank interest rates, and (iv) interest swap rates. The selection of financial variables is extensively comparable with Falagiarda et al. (2015), who are adopting a similar approach to Takáts and Vela (2014), examining transmissions of the Fed's policy effect on a sample of emerging markets. This section presents, with a theoretical perspective, the major transmission channels of any potential international monetary policy spillovers.

4.1.The Portfolio Rebalancing channel

This channel could be especially important for non-standard monetary policies as they are designed to work through changes in domestic assets' yields and prices (Chinn, 2013). Changes in the long-term bond supply do not affect bond prices under the classic frictionless asset price model. Bond premia are defined by risk characteristics in accordance with investors' level of risk aversion and are not affected by the number of bonds issued (Bauer and Rudebusch, 2013). However, when there are preferred habitats to investors, different bonds are not perfect substitutes, and changing the availability of each type of bond alters their prices. By introducing asset purchases for monetary policy purposes, a central bank can lower the quantity of securities owned by the private sector by acquiring it, shifting some investors, and reducing the holdings of others. This could have an international aspect, considering potential substitute assets may include similar assets from other countries. In a standard portfolio balance model, the ECB purchases of euro area short- and long-term government bonds would lower their yields relative to comparable Scandinavian (or non-euro) bonds.

Consequently, the Scandinavian assets might become more appealing, as optimizing investors turn to them for better risk-adjusted returns. Higher demand for non-euro area bonds induces higher bond prices and thus lowers the bond yields. It is expected that the portfolio rebalancing channel could indeed be a prominent channel of transmission for the ECB announcements of non-standard monetary policies, especially those involving direct purchases of assets (Falagiarda, 2015).

4.2.The Signaling Channel

Whereas the portfolio rebalance channel emphasizes the factor of *quantities* of securities, the signaling channel refers to the idea that monetary policy statements transmit new *information* about a central bank's commitment to a certain policy path, as well as its evaluation of the economy (Bauer and Rudebusch, 2014; Bauer and Neely, 2014). That is, in the case of a central bank's public announcement of maintaining a lower short-term interest rate over longer periods (future guidance), the expectations for future short-term policy rate changes. A central bank announcement of a large-scale asset purchase (LSAP) would be incorporated by market participants when forming the prices of the assets ahead of actual purchases, besides signaling effects of a changed view on economic (short-term) conditions. Hence, according to the signaling channel, the announcements may also lower any expectation elements of the longer-term yields, causing variations in interest rate differentials between international economies across all bond maturities. As a result, the spillover effects might occur in a related manner to the portfolio rebalancing channel.

4.3.Other Market channels

Further, we examine a set of other channels announced through different *market interferences* by the central bank. First, the *exchange rates channel*, through which both standard- as well as non-standard announcements of monetary policy, may impact our financial variables of interest. Standard monetary models assume that a decrease in the policy rate, or an equivalent increase in the money supply, in one country's flexible exchange rate regime results in a decrease in the nominal spot currency exchange rate (Mundell-Fleming trilemma model, 1962). Assuming the domestic monetary authority does not respond to the foreign monetary innovation, potential foreign policy shocks can cause an adjustment in the exchange rate of an economy with open capital accounts. Quantitative easing (QE) and other unconventional monetary policies are intended to have a greater impact on long-term rates, which in theory associate foreign QE with lower long-term foreign interest rates. As a result, investors are more likely to favor domestic investments. This adjustment of capital flows will result in an appreciation of the domestic currency. However, the theory tends to be more complex as a potential decrease in foreign long-term interest rates may lead to lower domestic rates even without domestic adjustments (Bernhard and Ebner, 2017).

The announcement of the ECB's unconventional monetary policy tools might contribute to enhanced confidence and economic responses in the euro region. This might lead to a recurrence

of risks and capital outflow from Norway, Sweden, and Denmark. *The confidence channel* may have an impact on safe havens in particular. During the financial crisis, the Scandinavian countries were to be considered safe havens (IMF, 2013). Unconventional monetary policy measures announced by the ECB could lead to boosted confidence in the eurozone. This might lead to increased demand for euro-area assets and consequently to capital outflows from the countries of interest. Capital outflows should lead to lower asset values and consequently higher yields. Looking at the ECB measures, it is reasonable to believe that OMT announcements could be used via the confidence channel as OMT reduced the perceived risk associated with euro-area government bonds (Saka et al., 2015).

Unconventional policy measures may also transfer through an *international bank lending channel*. Global financial integration could potentially lead to disruption in transmission mechanisms for conventional monetary policy (Hume & Sentence, 2009). The increased cross-border financial flows could have an impact on domestic financial conditions. Effectively, this means that a rise in liquidity in the euro area, caused by ECB's policy actions, could influence credit conditions within our countries of interest, due to the high presence of foreign (euro area) owned bank branches within the local banking systems. A decrease in the interbank rates available to the parent bank will result in lower funding costs for the subsidiary. It is important to note that costs for funding the parent banks and the subsidiaries do not always correlate.

4.4.Hypotheses

Considering the international transmission channels elaborated in the sections above, it can be formulated a set of specific expectations regarding the impacts of the ECB's unconventional policies on the financial assets.

H1: The net effect of ECB's announcements of unconventional monetary policy easing measures on the non-euro yields is negative. As previously mentioned, government bonds (swaps) of Norway, Sweden, and Denmark are set to be close substitutes to euro area sovereign bonds. Hence, announcements by the ECB of non-standard policies may have an impact on government bond yields through the portfolio rebalancing channel and are expected to be negative. Likewise, through the signaling channel, expectations of lower long-term yields on euro area bonds in the future may attract investors to the Scandinavian countries' assets, which again will lower the rates.

In addition, the UMP announcements will influence market participants' expectations of future short-term key policy rates. In a potential case where there are enough foreign-owned banks within the local banking system, a reduction in the interbank interest rate in the eurozone may cause a drop in demand for the local money market (Falagiarda et al., 2015). Low demand in domestic money markets will result in declining interbank rates for Norway, Sweden, and Denmark, through the international bank lending channel. If investors expect the rates to be held low for a longer period, the announcement will also influence longer-term rates, however, not tested for in this dissertation.

H2: The net effect of the ECB's announcements of unconventional monetary policy easing measures on exchange rates relative to the euro is positive. The individual exchange rates relative to the euro may have an impact via the exchange rate or confidence channel. Due to the flexible exchange rate regimes of Sweden and Norway and their high degree of financial integration with the eurozone, the exchange rate channel is particularly important for further empirical testing. As stated previously, the exchange rate channel causes an appreciation of the Scandinavian *krone (krona)* impacted by higher demand of investments in krona due to a decrease in European yields. Hence, related to the testing, potential ECB announcements of unconventional policies are associated with an increase in the Norwegian and Swedish krone (krona). Given the exchange rate peg of the Danish krone with the euro, deviations in this exchange rate are expected to be limited.

H3: The net effect of ECB's announcements of unconventional monetary policy easing measures on non-euro countries' equity prices is ambiguous. Non-standard policy measures taken by the ECB through the confidence channel are expected to have negative impacts on equity prices. The channel may lead to improved economic outlook and confidence in the eurozone, affecting the risky assets to become more attractive than risky assets in the countries of interest, ceteris paribus. Additionally, higher expected dividends for euro area equities could be linked to improved economic sentiment and confidence and have a higher investor attraction relative to the non-euro area, ceteris paribus. A potential immediate effect is assumed to come through the signaling effect, whereas surprises in short-term yields expectations are changing investors' preferences in rebalancing to other asset classes. Negative surprises will lead to a shift in positive equity prices.

From a longer-term perspective, the portfolio rebalancing channel is important in the positive impacts of the domestic equity prices, as ECB purchases of euro-denominated bonds increase demands for non-euro bonds. Whilst higher bond prices relate to lower bond yields, less risk-averse investors shift their portfolios to the equity markets. Hence, increased availability of liquidity and decreased discount rate expectations due to the UMP could lead to higher equity prices in the non-euro area countries (Bernhard and Ebner, 2017).

5. Data and Methodology

5.1. Event study description and dependent variables

The empirical framework of our methodology is frequently exploited in the event study literature and aims to capture the market impacts and further specific transmission channels of the UMP announcements. With the primary assumption that financial markets are efficient to all information, the impact of UMP measures should thus appear when they are announced, primarily through market expectation changes. A daily frequency regression is set up to assess the market impact of the ECB's monetary policy announcement using an ordinary least square (OLS) estimation, partially following the approach adopted by Falagiarda et al. (2015). It is considered a day-on-day event widow, with daily data, over the period of January 2007 to December 2019. Hence, the empirical framework is not to address nor capture the persistence of the announcement impacts:

$$\Delta y_t = \alpha + \beta_1 \Delta VIX_t + \beta_2 \Delta IR_t^{DOM} + \beta_3 \Delta IR_t^{ECB} + \beta_4 UMP_t^{ECB} + \beta_5 UMP_t^{DOM} + \lambda News_t + \varepsilon_t , \quad \textbf{(1)}$$

where the dependent variable y_t is our financial variables of interest, including the nominal exchange rates relative to the euro, main equity price indices,[6] and the 3-month interbank rates. In addition, due to the low and poor liquidity of the Norwegian bond market, rather than government bond yields, a set of medium- to long-term swap rates are used. The swap contracts reflect the expected average interest rates over a two-, five- and ten-year horizon. All data are retrieved from Thomson Reuters – Datastream.[7]

[6] Data for the OSEBX (Norwegian) and OMX (Swedish and Danish) equity indices are used.

[7] Appendix A, Figure A.2 plots daily changes in market prices for all financial variable used in Equation 1, including the VIX index and, ECB and domestically key interest rates.

The event study approach is implemented on two different grounds. The traditional approach identifies UMP announcements using a set of dummy variables on identified event days (see Section 5.2). However, the announcement dummies do not capture sizes or real monetary policy shocks in terms of the market's expected components from these decisions. Controlling for these unexpected announcement components is a necessary tool to measure in i) the identification of specific spillover channels and ii) differentiation between easing and tightening decisions. To detect channels of transmission we use a separate modified approach, where the dummies are to be replaced with a set of values reflecting the market's surprise components to monetary policy shocks. Adapting the approach of Chen et al. (2014) values are retrieved by extracting two factors from changes in a euro yield curve. A detailed description of the standard factor analysis is presented in Section 5.3.

5.2.Independent variables

The VIX_t variable measures implied volatility of near-term options on the EuroStoxx50 index and is included so periods of heightened volatility in the Euro markets, which could affect our financial markets of interest, are to be controlled. The variables of IR_t^{DOM} and IR_t^{ECB} are the policy rate in time *t* set by the domestic and European Central Bank, respectively (see Appendix A, Table A.2 for an overview). For our traditional event study approach, the UMP_t^{ECB} consists of event dummies in the context of any ECB announcements of non-standard policy measures. Moreover, introducing the modified approach, the announcement dummies are replaced with estimated values of the signal and market surprises on the event days (see Appendix A, Table A.4 for the full values list). The choosing of days is consistent with the literature on monetary policies and assures the surprise factor to only capture information regarding policy announcements primarily. The record of unconventional policy events is assembled by expanding the series identified in Falagiarda et al. (2015) from January 2015 to December 2019. The sample counts 136 events, including press conferences, press releases, and speeches, related to ECB's non-standard monetary policy measures systematically identified and classified. All events are reported in (and extracted from) the ECB media website. The variable UMP_t^{DOM} represents a country-specific dummy associated with any non-standard monetary policy announcement made by the domestic authorities. With similar procedures as the UMP_t^{ECB} variable, a comprehensive collection and classification of UMP announcements from the central bank of Norway (*Norges Bank)*, Sweden (*Sveriges Riksbank)*, and

Denmark (*Danmarks Nationalbank*), respectively, have been performed based on media website documentations.

Lastly, including the approach adopted by Altavilla and Giannone (2017),[8] the event study is controlled for any news originating from economic releases, $News_t$, which may affect the financial variables tested. More precisely, the control variable is considering all macroeconomic news of the event windows that can influence the dependent variables of interest through that time window. In order to reproduce data flow analysis of information available to market participants at each moment of time, the $News_t$ variable is gathered via a dataset available on Bloomberg, which provides a panel of market participant expectations for each economic release. These expected values are median projections gathered prior to the official release of data. A time series of standardized daily news is calculated by subtracting the released data from the predicted values. Should a release be perfectly forecasted it is not deemed as news for the market participants and will have no impact on our values. On the other hand, if a release is inaccurately predicted it provides *news* and is thus likely to alter the values. In total 63 variables are included to measure the news content of the most important economic releases throughout the study period (see Appendix A, Table A.3).

For the variables expressions in the equation, the exchange rates, equity price indices, spreads, and VIX index rates are all stated in daily percentage changes $(\Delta y_t = y_t - y_{t-1})$. The 3-month interbank and swap rate yields are expressed in daily basis point changes. For the monetary policy variables and event dummies, it is used a one-day event window. More specifically, proximate to the event window, any basis point changes of the key policy rates are computed, while the dummies take a value of one on the announcement day(s) and zero otherwise. The motivation is to investigate international spillovers, which tend to have a longer transmission lag on financial variables compared to domestically implemented policies (Bernhard and Ebner, 2017). Therefore, it is believed that the usage of daily rather than higher frequency data employed in other event studies are justified.

[8] Altavilla et al. (2014) undertook a related event study to assess the impact of the ECB's *Outright Monetary Transactions* announcements on sovereign bond rates in countries within the euro area.

5.3.Monetary policy surprise measurement – Factor analysis

In previous literature, a commonly used definition of monetary policy surprises is described as the difference between expected yields on expiring futures contracts, just before a Central Bank's council meeting, and the actual key interest rates announced after the meeting (Bernanke and Kuttner, 2003; Gürkaynak, 2005). Hence, a relatively simple and straightforward interpretation; the markets can be surprised by a central bank's choice of policy rates. However, announcements can be captured in different dimensions of policy surprises. By extracting two factors from a sample of short-term (1-24 month) yield curves, Gürkaynak, et al. (2005) were able to capture these dimensions by isolating the surprise on the instant policy rate (the *target* or *timing* factor), and surprises on the further interest rate path (a two-year path of policy or *path* factor). Within the *path* factor, they found evidence that up to 90 percent of the variation in asset price responses, including bond yields, is to be explained.

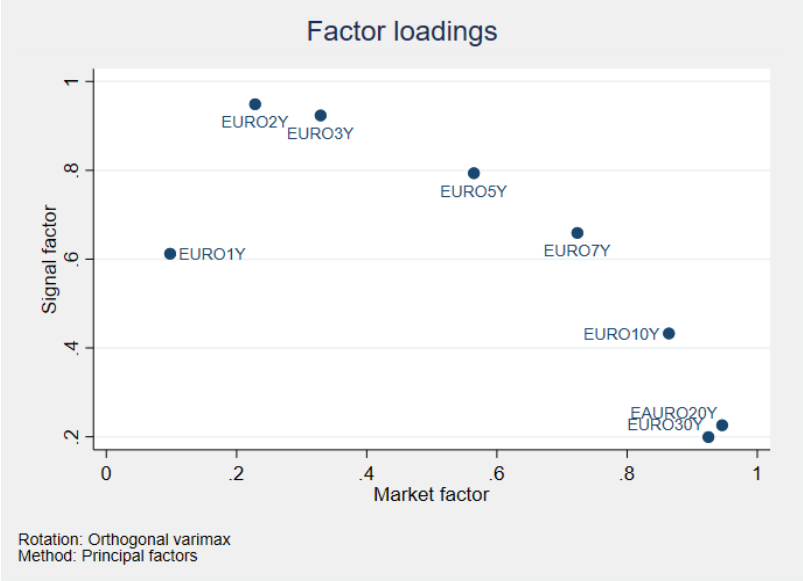
Further, Chen et al. (2014) aim to extend the work of Gürkaynak, et al. (2005) by extracting longer-term US bond yields over a 1-year up to a 30-year yield curve, which is considered more applicable for the unconventional monetary policy announcement. In contrast to Gürkaynak et al. (2005), trying to capture the *timing* factor, Chen et al. (2014) are picking up additional dimensions of announcements; (i) *the market factor*, which can relate to the portfolio rebalancing channel as well as other channels or information the Fed communicates that can impact longer-term interest rates give its high correlation; (ii) *the signal factor*, which much like the path factor of Gürkaynak, et al. (2005) is assumed to correlate with the traditional signaling channel aimed to affect shorter-term rates. Hence, in the case of measuring ECB's UMP announcement surprise effects, the approach of Chen et al. (2014) is considered strongly relevant in this dissertation.

In order to apply the approach consistent with the European market, we follow the method of Varghese and Zhang (2018) to create a data set of changing euro bond yields. *The euro bond yield curve*, consisting of 1-year up to 30-year maturities, is constructed by taking an average of the four big European economies Germany, Italy, France, and Spain bond yields weighted by the outstanding government debt of each country, respectively. On the day of an ECB announcement, if t is considered the close on the announcement day and $t - j$ is the before the announcement, then $\Delta i^{EB}_t = i^{EB}_t - i^{EB}_{t-j}$ is considered the (daily) surprise changes in yields. All bond yield data is retrieved from Thomson Reuters – Datastream. In order to extract the specific announcement factors within

our defined time window, we are considering the yield changes on all days identified in our ECB announcements list (elaborated in section 5.1).[9] In line with the literature, the two factors extracted explain over 97 percent of the euro area bond yields variation. To maximize the sum of the squared loadings variance, a varimax rotation method is used to rotate the factors.[10]

As shown in the loadings plot in Figure 1, the first factor (identified as the *market factor*) has an intuitively high loading of the longer-term bonds of 5- up to 30-years maturities, capturing the transmission channels impacting the demand and supply of bonds. Oppositely, the second factor (identified as the *signal factor*) shows high loading of the shorter-term bonds of 1- to 3-year maturities. In the time before the ECB's implementation of asset purchases, it is most likely that the extracted signal factor rather captures surprises in the forward guidance communication of future policies. Though, it is also anticipated that the factor will include the asset purchase surprise information in the time window when ECB launched its APPs.

Figure 1. The factor loadings of the euro area bond yield curve



Note: *The signal factor shows a high loading of shorter-term bond yields. The market factor plots higher loadings on longer-term bonds. The extracted factors explaining over 97 percent of the bond yield curve.*

[9] 136 announcements in total. To ensure that the surprise factors only capture the ECB UMP announcements information, it is not extracted surprises for every day within the time window.

[10] In short, we estimate the unobserved factor matrix F (Txk with k the number of factors) given by $X = F\Lambda + \eta$, where X is a $T \times n$ matrix of changes in bond yields over n (>k) maturities and T observations, Λ is a $k \times n$ matrix of factor loadings, η represents white noise error terms. (Chen et al. 2014). More computational details of the factor rotation is also given in the appendix of Gürkaynak et al. (2005)

6. Results

The results are divided into two sections, whereas the first section aggregates the impact of announcements of domestic and euro area financial indicators. The second section presents the results of our event study related to specific spillover channel findings.

6.1.Aggregate Impact of ECB's UMP

Table 5 presents the aggregate impact results of our traditional approach regression, more specifically the movement in our financial variables of interest on a UMP announcement day. Columns 2 to 4 show that announcements of ECB measures (β_4) are associated with a movement in the equity, exchange rates, as well as the different short- and long-term interest (swap) rates. In particular, we observe that the ECB announcements are aligned with significant results of higher equity returns in Sweden and Denmark, however negative returns in Norway. One may argue that a large proportion of the Norwegian equity index consists of oil-related companies, thus making it more responsive to shifts in economic condition. UMPs from the ECB convey negative information about the expected future euro area economy. This may lead to negative shifts in demands for oil impacting oil prices, highly correlated with the Norwegian companies' earnings.

In line with Falagiarda et al. (2015), the results on interest rates are somewhat more heterogeneous in terms of statistical significance, with negative impacts on the medium- and long-term rates, especially in the case of Sweden. As a result, this could be interpreted as the ECB announcements of UMP measures might primarily function through the signaling as well as rebalancing channel mentioned previously in Section 4. This is to be expected, whereas the Swedish swap rates tend to be sufficient alternatives for the euro area sovereign rates the market purchases push yields to decrease, averaging on around 0.9 basis points in the longer part of the yield curve. The UMP announcements of the ECB are also associated with increased long-term swap rates in Norway, of 0.8 bp. on the 10-year rate. Contrary to the Swedish rates, Norwegian rates may react stronger to announcements of increased confidence within the euro area. This can lead to capital outflows from safe havens, in accordance with increasing demands on euro area assets. Highly classified as a safe haven (IMF, 2013), Norway is thus prone to capital outflows, which are strictly correlated with increased yields on government bonds (swaps rates).

Table 5. Event study analysis on the impact of ECB's and Domestic UMP measures (all events)

	ECB's UMP			Domestic UMP		
	NO	SE	DK	NO	SE	DK
△NEER	-0.061	-0.012	0.000	0.000	-0.217	-0.002
	(0.043)	(0.038)	(0.000)	(0.140)	(0.217)	(0.001)
△ Equity	0.322**	-0.211*	0.019***	1.065**	0.480	0.175*
	(0.108)	(0.092)	(0.005)	(0.372)	(0.520)	(0.084)
△Interbank3M	0.063	-0.745**	-0.008	-2.697	0.452	0.132
	(0.405)	(0.248)	(0.008)	(1.389)	(1.392)	(0.120)
△Swap Rate (2Y)	-0.023	-0.824**	0.002	-3.229***	-0.878	-0.350
	(0.275)	(0.275)	(0.018)	(0.902)	(1.561)	(0.284)
△Swap Rate (5Y)	0.310	-0.971**	-0.005	-2.417*	-1.502	-0.023
	(0.289)	(0.340)	(0.020)	(0.950)	(1.937)	(0.313)
△Swap Rate (10Y)	0.808**	-0.438	-0.019	-1.577	-1.445	0.334
	(0.310)	(0.332)	(0.021)	(1.014)	(1.889)	(0.333)

Note: The β4 and β5-coefficients from equation (1) are reported in this table. The delta exchange rates, and equity are reported in daily percentage changes. The 3-month interbank and swap rates are reported in basis point changes. The complete regression table is reported in Appendix B, Table B.4. Standard errors in parentheses. $^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$

Further, we find that the announcements have a similar significant impact on the 3-month interbank rate in Sweden. The results correspond to the impacts of the international bank lending channel previously discussed, whereas the global financial integration and increase in cross-border financial flows may affect the domestic financial conditions. In this instance, most regional headquarters of internationally managed companies (banks) are located in Sweden as this is considered to be the most central location for Scandinavian operations.[11] Hence, any (longer-term) liquidity measures by the ECB might lead to a spillover effect via liquidity management at a banking group level; a Swedish operating bank might obtain further liquidity for the parent bank and utilize it to supplement liquidity in the domestic money market. As a result, we will experience a decrease in demand for funds in the domestic money market, which could explain the fall in interest rates as observed in the instance of Sweden. By comparison, the interest rate responses are

[11] Berhling and Andresen (2015) shows that among the Forbes Global 2000 companies with established operations in the Nordic region, 64 percent have located their regional headquarters in Sweden, 20 percent in Denmark and 8 percent in Norway.

in general stronger for Denmark in the size of spillover due to the exchange rates: Denmark's peg to the euro necessitates substantial interest rate reactions, but the differences between the countries are small, particularly at the longer end of the curve. A surprising element when comparing with previous literature is that we do not find that the exchange rate of the Scandinavian countries relative to the euro affected by announcements, as no coefficients are statistically significant.

Looking at the country-specific UMP announcements (β_5) presented in columns 5 to 7, we observe a shift in movements for most of the Norwegian assets, with a stronger effect of impacts. However, the results are characterized by utterly few observations related to domestic UMP announcements - 12 in Norway; 5 in Sweden; 4 in Denmark, respectively. Considering the Norwegian (monetary) policy operates independently, without direct affiliation with the European Union (ECB), we observe that the announcements significantly affect the equity and medium-term rates. The Scandinavian countries are considered small economies, which ensures that measures through the signaling channel can constitute major changes. A large majority of the measures implemented in Norway are in the context of the 2008 financial crisis, in which the Norwegian central bank, like the ECB, introduced a set of refinancing operations. Through the portfolio rebalancing channel, it clearly has effects on long-term interest rates, especially on the Norwegian two- and five-year rate, which shifts in a negative direction compared with non-standard policies announced by the ECB. Consequently, falling yield curves shift inventors' objectives towards alternative assets, creating an upward shift in equity.

In addition, to omit any uncertainty about whether the markets' impact on UMP announcements rather stems from reactions to the news or changes in interest rate variables, a set of new regressions was run without these considered.[12] When excluded, the estimated effects on UMP announcements are not significantly changed. This indicates that the events being examined are containing the most relevant surprise components within the event window and are not influenced by other events or developments.

[12] The regression results are reported in Appendix B, Table B.1.

6.1.1. Pre- and post-ZLB impacts

To further understand the progress of announcement impacts over time, the overall sample is divided into a pre- and post-zero lower bound phase, with the ECB meeting on 5 July 2012 held as the last announcement included in the pre-ZLB sample period. This is considered an intuitive split as further expansionary proceedings requires unconventional responses such as launching asset purchasing programmes or lowering nominal rates to negative territory, potentially affecting the markets in a different direction. Though UMPs in both phases are designed to improve financial health, strengthen the banks' balance sheets, and ease pressure on the bank lending channels, the latest period confronted with low and progressively negative nominal rates, that will narrow interest margins, and weaken banks' profitability, potentially offsetting the positive effects. However small, the new set of UMPs arising in the post-ZLB-period do generate some differences in the market impacts in different aspects. The results of the transmission to the variables of interest are presented in Table 6. Considering the number of UMP observations is considerably reduced in each of the samples, we do not achieve an equally large range with significant results.[13]

For the interest rates, the pre-ZLB results of significant character are in line with our aggregate results for Norway and Sweden, though with greater impacts. As the early phase of UMPs was aimed to relieve financial distress, high volumes of liquidity became available to the euro area market participants (ruling through the SMP and CBPP). Hence, the previous presented hypothesis of possible capital outflows from the Norwegian interest rate market, boosted through the confidence channel, may tend to stem from the longer-term 10-year yields, with strong positive impacts of 1.5 bp. Similar results to the previous section are observed for the Swedish rates, though stronger effects of negative matters. This could indicate that the early asset purchase programs caused positively effects to portfolio inflows of Sweden, both directly, through the (signaling) announcement effects, and more indirectly, through the influence of euro area financial conditions. Followed by the 2008 crisis euro area market participants tended to consider Swedish assets as good substitutes as there was no major role for an exchange rate floor. Depreciating more than one-sixth of the euro value six months after the Lehman fall, the Swedish krona subsequently strengthened by more than one third within mid-2012 (Everaert and Honohan, 2019). The Swedish 2-year swap rates continue to show a negative impact from ECB's UMP when entering the ZLB

[13] UMP^{ECB} announcement dummies reduces to 62 and 74 observations in pre- and post ZLB samples respectively.

Table 6. Event study analysis on the impact of ECB's UMP measures: Differentiated pre-ZLB and ZLB subsamples

Panel A: Pre-ZLB measures

	Norway			Sweden			Denmark		
	UMP^{ECB}	R^2	Obs.	UMP^{ECB}	R^2	Obs.	UMP^{ECB}	R^2	Obs.
△NEER	-0.100	0.107	1438	-0.051	0.106	1438	-0.000	0.007	1438
	(0.068)			(0.063)			(0.002)		
△ Equity	-0.226	0.444	1393	0.142	0.491	1386	-0.110	0.426	1377
	(0.200)			(0.168)			(0.141)		
△Interbank3M	-0.119	0.074	1393	-1.275*	0.007	1386	0.078	0.738	1377
	(0.885)			(0.541)			(0.228)		
△Swap Rate (2Y)	0.413	0.132	1422	-0.896*	0.131	1423	-0.167	0.110	1418
	(0.558)			(0.551)			(0.584)		
△Swap Rate (5Y)	0.869	0.156	1422	-1.415*	0.162	1423	0.587	0.135	1418
	(0.528)			(0.639)			(0.589)		
△Swap Rate (10Y)	1.545**	0.106	1422	-0.507	0.159	1423	1.117	0.124	1418
	(0.558)			(0.585)			(0.582)		

Panel B: Post ZLB measures

	Norway			Sweden			Denmark		
	UMP^{ECB}	R^2	Obs.	UMP^{ECB}	R^2	Obs.	UMP^{ECB}	R^2	Obs.
△NEER	-0.038	0.080	1953	0.002	0.060	1438	-0.004	0.010	1438
	(0.055)			(0.046)			(0.002)		
△ Equity	-0.163	0.299	1877	0.143	0.454	1878	-0.132	0.285	1857
	(0.095)			(0.088)			(0.096)		
△Interbank3M	0.159	0.011	1877	-0.321**	0.009	1878	0.173	0.117	1857
	(0.215)			(0.134)			(0.116)		
△Swap Rate (2Y)	0.029	0.047	1934	-0.485*	0.041	1893	-0.223	0.011	1916
	(0.214)			(0.212)			(0.190)		
△Swap Rate (5Y)	0.247	0.044	1934	-0.247	0.041	1893	-0.236	0.028	1916
	(0.302)			(0.317)			(0.298)		
△Swap Rate (10Y)	0.555	0.047	1934	-0.087	0.045	1893	-0.104	0.046	1916
	(0.345)			(0.366)			(0.373)		

*Note: The β4-coefficient from equation (1) are reported in the tables. The delta exchange rates, and equity are reported in daily percentage changes. The 3-month interbank and swap rates are reported in basis point changes. A sample split has been performed the ECB meeting 05/07/12 is considered the last date of the pre-ZLB sample. The complete regression table is reported in Appendix B, Table B.5. Standard errors in parentheses * p< 0.05, ** p< 0.01, *** p<0.001*

territory, although more moderate. These may not be too surprising considering the sample's exclusion of ECB's UMP with a clear focus on asset purchase programmes and forward guidance, attempting to encourage a decline in long-term interest rates, the signaling channel restore confidence in the euro area market with provided debt support and less rigid monetary conditions. This confidence creates a variation in international spillover effects.

For Sweden, the yields are shifting towards less negative impacts, indicating signs of increased confidence in growth driven by ECB purchase programmes when entering ZLB. Less dominant impacts (relative to the pre-ZLB results) may also stem from the fact that market interest rates are less responsive to news considering the monetary policies are constrained by the ZLB. As the key policy rates will not fall below the ZLB, news that normally persuade the ECB to ease are not able to be reflected in interest rates over relatively shorter maturities (Swanson and Williams, 2014).

In another sense, the lower bond premia for the euro area countries occurring with the ZLB can also indicate a prospect of declining growth. This will lead to weaker external demands as well as financing for the Scandinavian countries. In accordance with the interpretations of Sweden's international bank lending channel impacts in the previous section, this may explain the significant increase of the 3-months interbank rates when entering the ZLB.

We do not find the sample split effective for the financial variable of Denmark, as no results are statistically significant.

6.2. Channels of spillover

In this section, to further analyze the channels of spillover, the dummy of ECB announcements is replaced by the previously stated *signal* and *market* factor surprises on the specific announcement dates. An important note is that the factors, i.e., surprise components, do not have to move in the same direction, and hence, may influence interest in different ways. [14] This inclusion of surprise components thus suggests that results derived only from our announcement dummy in the previous section are not as well defined, causing to introduce error. The newly defined regression results for each country are presented in Table 7. The coefficient interpretation, however, will somewhat differ

[14] Figure A.1 in Appendix A plots the predicted values of the market and signal surprises on each announcement date over the sample period. Table A.4 in Appendix A is listing the respective values – 136 announcements in total

from our previous results. Firstly, the coefficient signs are to be expected opposite of the dummy announcements, as positive values for the factors are stating tightening surprises and negative values are stating easing surprises. Secondly, a normal *per unit* interpretation of the coefficients by itself will not serve any intuitive nor meaningful information. A more precise reading is to multiply the coefficient with the factor surprise for each announcement respectively (see Appendix A table A.4 for the full values list).

Consistent with the literature, when comparing both channels, it is identified that the longer-term interest rate instruments react more strongly to the signal surprises than the market surprises. However, in contrast, the interest rates in Denmark tend to have a significantly stronger impact for both channels. This illustrates the magnitude of spillovers relative to the exchange rates of the countries. Considering the Danish krone's pegged rate relative to the euro, the interest reactions are required to be stronger than Norway and Sweden with floating rates. Although a vast majority of the financial impact is transferred through the signaling channel, the portfolio rebalancing channels, incorporated into the market channel, also play its role in decreasing the yield curves of Denmark.

The immediate (one-day) reactions to the interest rate swap market of all three countries are significant, with averaging signaling surprise coefficients around 0.7 to 1.4. The results point to strong influences on easing surprises to lowering the yields, confirming results in existent literature (Varghese and Zhang, 2018). The ECB's forward guidance (through the signaling channel) affects euro area market participants' expectations of future rates, that, in turn is transmitted to Scandinavian countries. The lower yields in the Scandinavian countries hence reflect the expectations of lower sovereign yields.

Similar to the event study of dummy announcements, the results indicate that the exchange rates do not play any significant role in affecting the magnitude of output and spillovers. Nonetheless, there are minor changes, whereas a tightening policy surprise by the ECB depreciates the euro and thus, leads to an appreciation in the Norwegian krone. The signal surprise is only significantly affecting the Norwegian equities in a negative manner (with tightening surprises). As presented in

Table 7. Event study analysis on the impact of ECB's UMP measures: The effects of ECB's Market and Signal surprises on Scandinavian financial variables

	Norway			Sweden			Denmark		
	Market	Signal	R^2	Market	Signal	R^2	Market	Signal	R^2
△NEER	0.043	0.031*	0.086	0.005	0.015	0.068	-0.002	0.003*	0.008
	(0.042)	(0.042)		(0.038)	(0.038)		(0.001)	(0.001)	
△Equity	0.027	0.286**	0.326	0.077	-0.073	0.428	-0.008	0.069	0.334
	(0.108)	(0.108)		(0.094)	(0.093)		(0.085)	(0.084)	
△Interbank3M	-0.698	3.202***	0.078	-0.493*	1.449***	0.014	-0.033	0.078	0.669
	(0.400)	(0.398)		(0.251)	(0.249)		(0.121)	(0.119)	
△Swap Rate (2Y)	-0.018	1.442***	0.081	0.124	0.758**	0.066	0.941***	0.616*	0.065
	(0.273)	(0.272)		(0.272)	(0.273)		(0.282)	(0.282)	
△Swap Rate (5Y)	0.295	1.359***	0.091	0.367	0.642	0.087	1.266***	1.075***	0.078
	(0.288)	(0.287)		(0.338)	(0.338)		(0.310)	(0.310)	
△Swap Rate (10Y)	0.458	1.297***	0.072	0.364	0.698*	0.089	1.368***	0.765*	0.083
	(0.307)	(0.306)		(0.329)	(0.330)		(0.330)	(0.330)	

*Note: The β4-coefficients from equation (2) are reported in the table. The coefficients reported indicate a multiplier to the predicted factor surprises of ECB signaling channel and market (mainly the portfolio rebalancing) channel. For example, the first announcement in table A.4 (Appendix A) indicates a value of 0.535 for the market factor and 0.575 for the signal factor. The ECB announcement impact on the Danish 5-year swap rate leads to an increase of 0.67 (0.535*1.266) basis points through the market channel(s), and an increase of 0.62 (0.575*1.075) basis points through the signaling channel. The complete regression table is reported in Appendix B, Table B.5. Standard errors in parentheses* $^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$

the announcement dummy study, this is also expected, as interest rates are commonly used tools to discount future cash flows of a company, increasing interest rates (i.e., tightening interest rate surprises) imply increased discount rates. Thus, future cash flows and dividends are expected to be lower, leading equity prices to decrease.

Moreover, equally to the baseline announcement dummy approach, we seek to exclude all surprise variables rather stemming from the macroeconomic news nor key interest rate changes. Table B.2 (Appendix B) reports all regression results for the modified equation. Consistent with expectations, once the variables are not included, the findings remain unchanged. The differences are insignificant with an average of 1-2 basis points compared with the results of table 7.

6.3. Spillover effects in the ZLB

In a similar manner as the impact analysis of announcement dummies, we seek to find whether spillovers of UMP surprises are affected after key policy rates entered zero-lower bound terrain. We estimate the (modified) baseline regression relying on a dummy interaction, ZLB_t, on the values of UMP_t^{ECB}:

$$\Delta y_t = \alpha + \beta_1 \Delta VIX_t + \beta_2 \Delta IR_t^{DOM} + \beta_3 \Delta IR_t^{ECB} + \beta_4 UMP_t^{ECB} + \beta_5 UMP_t^{ECB} * ZLB_t + \lambda News_t + \varepsilon_t \quad \textbf{(2)}$$

The ZLB interaction takes a value of one at any ECB announcements made after 5 July 2012, and zero at any announcement prior to this date.

The results are provided in Table 9 to 11, whereas columns 2 and 3 estimate our market and signal surprises in the pre-ZLB window, and column 4 and 5 presents the estimated changes when moving into the ZLB terrain. Looking at the coefficients in the pre-ZLB period the results are in accordance with our previous finding regarding a stronger reaction to the signaling channel for Norway and Sweden, and a composition of both for Denmark.

The pre-ZLB surprises are very much presenting a similar transmission pattern as shown in the previous section (of aggregated data). Easing surprises tend to decrease yields of Norway and Sweden through the dominating signaling channel, indicating expectations of lowering yields in

the euro area due to increased confidence. However, surprise impacts of the Danish yields are solely transferred through the portfolio rebalancing channel, measured by the market factor. Exchange rates are not significantly impacted by the surprise factors.

When entering the ZLB period, the previous impact on the long-term interest rates is in many cases almost entirely mitigated. With almost symmetric coefficients, the pre-ZLB impacts of the 3-month rates of Norway and Sweden are essentially taken out by ZLB effects. The results of further decreasing longer-term yields (positive change in factor impacts) in Sweden and Denmark are not considered too surprising considering the highly targeted measurements of ECB of asset purchase programmes and explicit forward guidance in the period. Conversely, the Norwegian 2-year swap rates are impacted by negative (easing) shocks, causing pre-ZLB impacts to almost vanish. This could be interpreted by the expectations of less aggressive easing policies in the Norwegian markets already are incorporated in the asset prices. The ECB's announcements of applying relative aggressive measures to fight lengthier periods of low inflation, even at a ZLB stage, tend to be received as a surprise on the shorter end of the yield curve.

Table 8. Event study analysis on the impact of ECB's UMP measures: Effects of ECB's Market and Signal surprises on Norwegian financial variables (ZLB interacted)

	Norway					
	Market	Signal	Market*ZLB	Signal*ZLB	R^2	Obs.
△NEER	0.086	-0.059	-0.061	0.113	0.087	3391
	(0.064)	(0.048)	(0.087)	(0.109)		
△ Equity	-0.093	0.380**	0.161	-0.406	0.327	3270
	(0.162)	(0.122)	(0.221)	(0.277)		
△Interbank3M	-2.540***	4.391***	2.663**	-4.729***	0.088	3270
	(0.597)	(0.449)	(0.815)	(1.019)		
△Swap Rate (2Y)	0.178	1.868***	0.891	-1.739*	0.084	3356
	(0.432)	(0.308)	(0.558)	(0.698)		
△Swap Rate (5Y)	0.178	1.434***	0.172	-0.306	0.091	3356
	(0.289)	(0.325)	(0.589)	(0.737)		
△Swap Rate (10Y)	0.636	1.350***	-0.390	-0.445	0.072	3356
	(0.462)	(0.347)	(0.630)	(0.787)		

Table 9. Event study analysis on the impact of ECB's UMP measures: Effects of ECB's Market and Signal surprises on Swedish financial variables (ZLB interacted)

	Sweden					
	Market	Signal	Market*ZLB	Signal*ZLB	R^2	Obs.
△NEER	0.005	0.004	0.010	0.058	0.068	3391
	(0.056)	(0.043)	(0.077)	(0.098)		
△ Equity	0.376**	-0.129	-0.521**	0.021	0.430	3264
	(0.145)	(0.107)	(0.194)	(0.036)		
△Interbank3M	-2.246***	2.138***	2.778***	-0.103	0.027	3264
	(0.383)	(0.283)	(0.513)	(0.096)		
△Swap Rate (2Y)	-0.137	0.717*	0.552	0.471***	0.067	3262
	(0.406)	(0.309)	(0.557)	(0.110)		
△Swap Rate (5Y)	0.614	0.419	-0.312	0.546***	0.087	3262
	(0.503)	(0.383)	(0.691)	(0.135)		
△Swap Rate (10Y)	0.525	0.535	-0.187	0.408**	0.089	3262
	(0.491)	(0.373)	(0.674)	(0.133)		

Table 10. Event study analysis on the impact of ECB's UMP measures: Effects of ECB's Market and Signal surprises on Danish financial variables (ZLB interacted)

	Denmark					
	Market	Signal	Market*ZLB	Signal*ZLB	R^2	Obs.
△NEER	-0.002	0.002	0.000	0.005	0.008	3391
	(0.002)	(0.001)	(0.003)	(0.003)		
△ Equity	-0.130	0.126	0.204	-0.204	0.335	3234
	(0.125)	(0.095)	(0.175)	(0.218)		
△Interbank3M	0.128	0.037	-0.293	0.064	0.670	3234
	(0.177)	(0.134)	(0.248)	(0.309)		
△Swap Rate (2Y)	1.927***	0.311	-1.704**	0.766	0.069	3334
	(0.419)	(0.318)	(0.575)	(0.724)		
△Swap Rate (5Y)	2.424***	0.564	-1.884**	1.724*	0.083	3334
	(0.461)	(0.350)	(0.633)	(0.798)		
△Swap Rate (10Y)	2.728***	0.153	-2.208**	2.105*	0.088	3334
	(0.490)	(0.372)	(0.673)	(0.848)		

Note: The β4-coefficients from equation (2) for Norway, Sweden and Denmark respectively are reported in table 10-12. The complete regression table is reported in Appendix B, Table B.6. Standard errors in parentheses, $^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$

The portfolio rebalancing channel also leads to so some dominant shifts in the ZLB phase. Easing monetary conditions and access to increased liquidity in the euro area cause investors' portfolios to adjust in the search for higher yields in the Scandinavian markets. In Sweden, the easing surprise post-ZLB is causing a dominant negative change in equity rate, affecting prices to increase. In line with previous statements, increased external liquidity supply and financing from the euro area banks to regional branches would decrease the demand for money market funds, pushing interbank rates down. However, over time, the negative rates could lead to unfavorable effects on the monetary transmissions. In the case where negative interest rates are passed on to private investors within the euro area, considerably and sudden increased demands for cash may occur and reduce monetary transmission impulses in both shorter and longer ends of the yield curve (IMF, 2013).

Further, should banks pass on the burden of negative interest rates to their lenders, by rating borrowing rates, the ZLB measures may act as tightening effects. This could explain the negative changes to market factor surprises we observe for the Danish swap rates, causing the earlier surprise impacts to almost dissolve when entering the new territory.

To solely test that our impact coefficients are deriving from our extracted factor values and not affected by additional news nor any conventional monetary announcements, we continue to run a second regression excluding the control variables in Equation 2.[15] The estimated effects are not significantly changed from the original regression equation.

7. Conclusion

In 2008, when the global financial markets experienced a severe situation of uncertainty and distress, the Central Banks inevitably had to adjust their conventional monetary policy stagiest. This dissertation follows previous research, showing that announcements of unconventional policy measures from the ECB lead to cross-border spillover impacts on non-euro SOEs. The introduction of the measures has had different intentions and persistently changed from the initial phase, aiming to relive the financial crisis distress, into a new phase arising when key interested rates hit the zero lower bound, focusing on euro area growth and low inflation stimulation. As the existing spillover literature mainly focuses on specific measures impacts, the intention of this dissertation aims to

[15] The regression results are reported in Appendix B, Table B.3.

document the spillover impacts of all ECB measures and the transmission channels to the Scandinavian financial markets.

Using a broad event set of daily data, we conduct two different approaches to identify UMP announcements: a baseline approach of announcement dummies, and a factor analysis capturing the markets' surprises through the portfolio rebalancing and signaling channel.

Consistent with previous work we find significant evidence of UMP spillover effects on the Scandinavian countries' longer end of the yield curve. On a country-specific level, the results are showing spillover impacts of opposite character in Norway relative to Sweden and Denmark. Rising bond yields and lowered equity rates in Norway shed light on the hypothesis of safe havens, where the countries experiencing capital outflows due to increased confidence among euro area investors followed by ECB (easing) announcements. Contrary, evidence of declining yields in Sweden and Denmark indicates that the assets are considered close substitutes to euro-area government bonds. With a focus on segmenting the measures' characteristics and desired mechanisms after entering ZLB, we find significant impacts of the financial variables are moving in the same direction for both periods. However, the results on interest rates are showing that announcements made prior to the ZLB generate more dominant impacts.

On channels, the signaling channel is considered the dominant transmitter of announcement surprise within all our countries of interest. In addition, spillovers to Danish interest rates are to a greater extent transferred through the portfolio rebalancing, illustrating the stronger interest rate reactions due to the currency peg. The surprises of ECB's easing monetary policy measures tend to impact most of our financial variables downwards, indicating future expectations of lower yields in the euro area markets. By interacting the market and signal channels with a ZLB dummy variable, results shows that symmetrical coefficients for ZLB are causing the pre-ZLB spillover impacts to almost mitigate entirely. At the ZLB and with forward guidance, expectations may have formed of a long period of time with constant rates at very low levels, thus there are no surprises that can move market sentiment.

7.1.Limitations

Although the financial variables in this analysis are carefully selected due to their tendency to instantly react to monetary policy surprises, it is not to be assumed that all impacts are shown in the changes within a one-day window. An event-study analysis limitation, in general, is the assumption of all financial markets are efficient to information. Considering our long time window, the markets have been exposed to different financial distress periods, and thus reacted differently. This causes a continuous trade-off discussion on whether to keep time windows narrow, exclude any irrelevant information noise, or expand the time window to make sure that delayed reactions are included. Due to this limitation, the analysis does not measure the impact persistency of the announcements. Next, the results do not segregate the different programs' unique roles and features when presented, and thus do not explain the weight of each program's direct impact on the variables nor transmission channels. In particular, our broad definition of the signaling channel does not isolate forward guidance announcements from other QE (asset purchase) programmes. This could lead the factor surprises to be reported as bigger impacts on the market, than if separated.

Lastly, as the data are retrieved on country-specific terms, the observations for each financial variable are inconsistent. This indicates that the country-specific results may vary in significant outcomes due to the lack of observations on announcement dates in our dataset.

7.2.Future research

As previously stated, the study does not capture any persistence of the announcement impacts. Considering a spillover's relevance to economic impacts are depending on its persistence, this would be an interesting follow-up question to this research. In addition, an extension left to further research is to quantify any possible impacts of monetary policies during the COVID-19 pandemic, including the roles of the Pandemic emergency purchase programme (PEPP).

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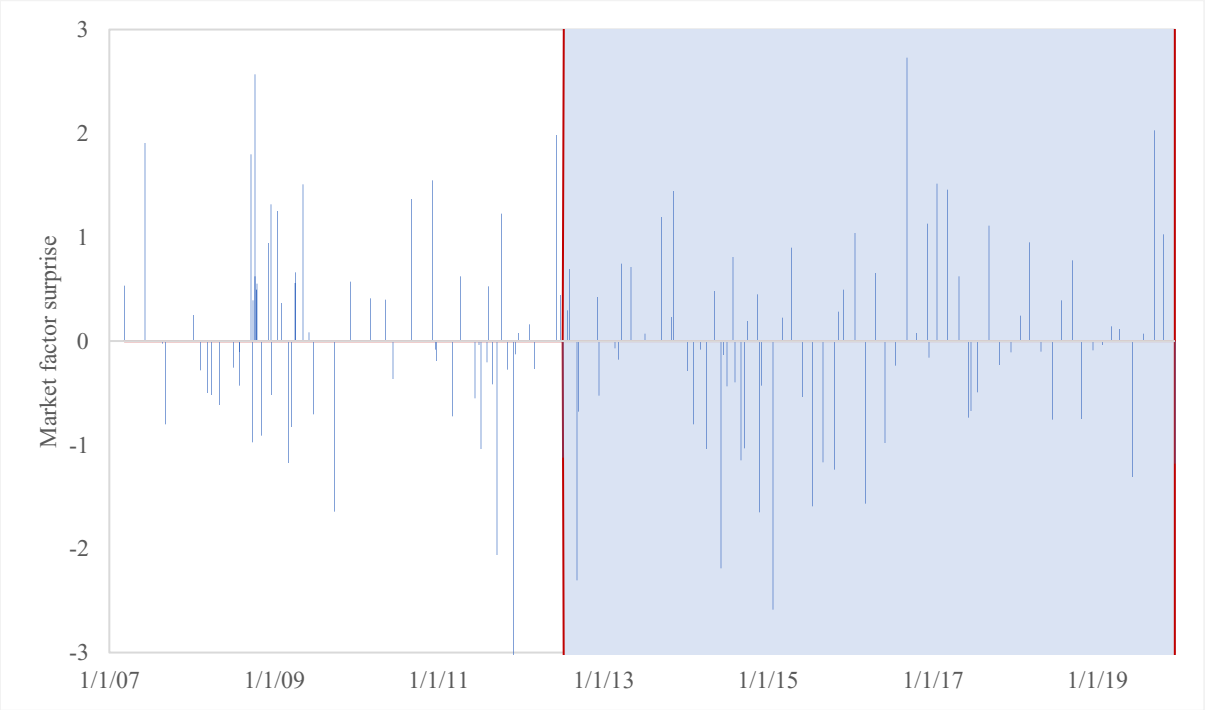
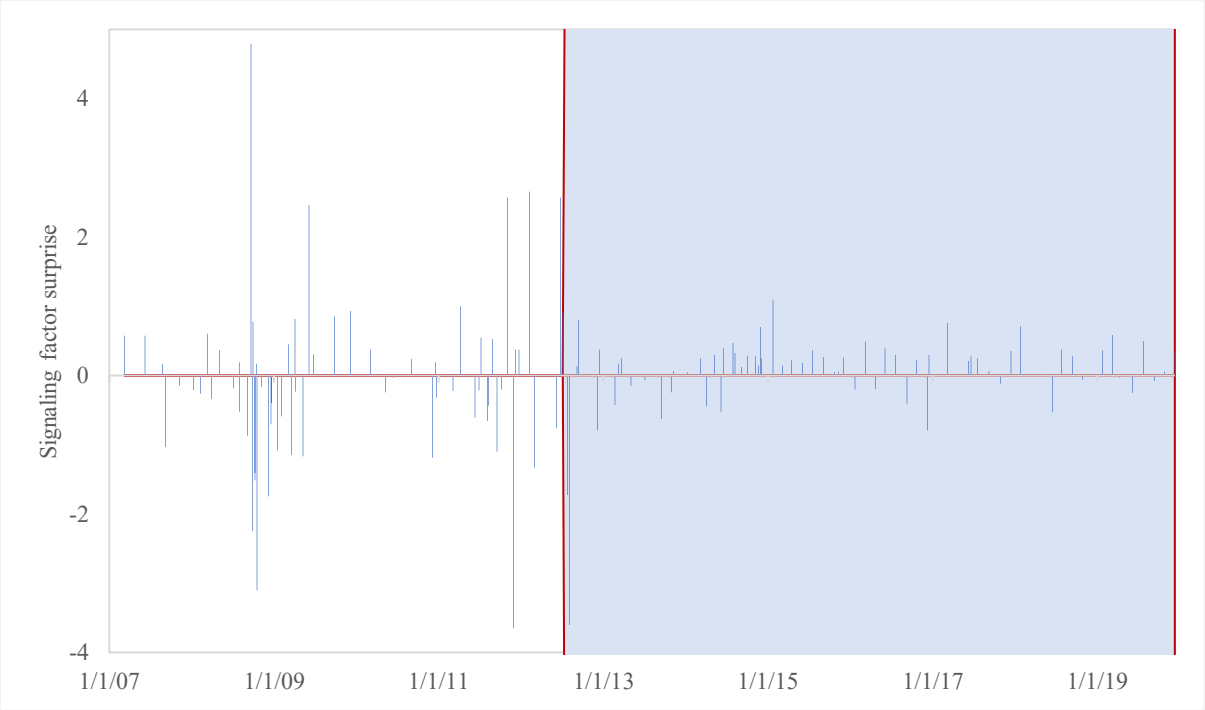
9. Appendix A

Figure A.1. Market and signal factor surprises on the dates of ECB UMP announcements

Panel A: The ECB market surprises

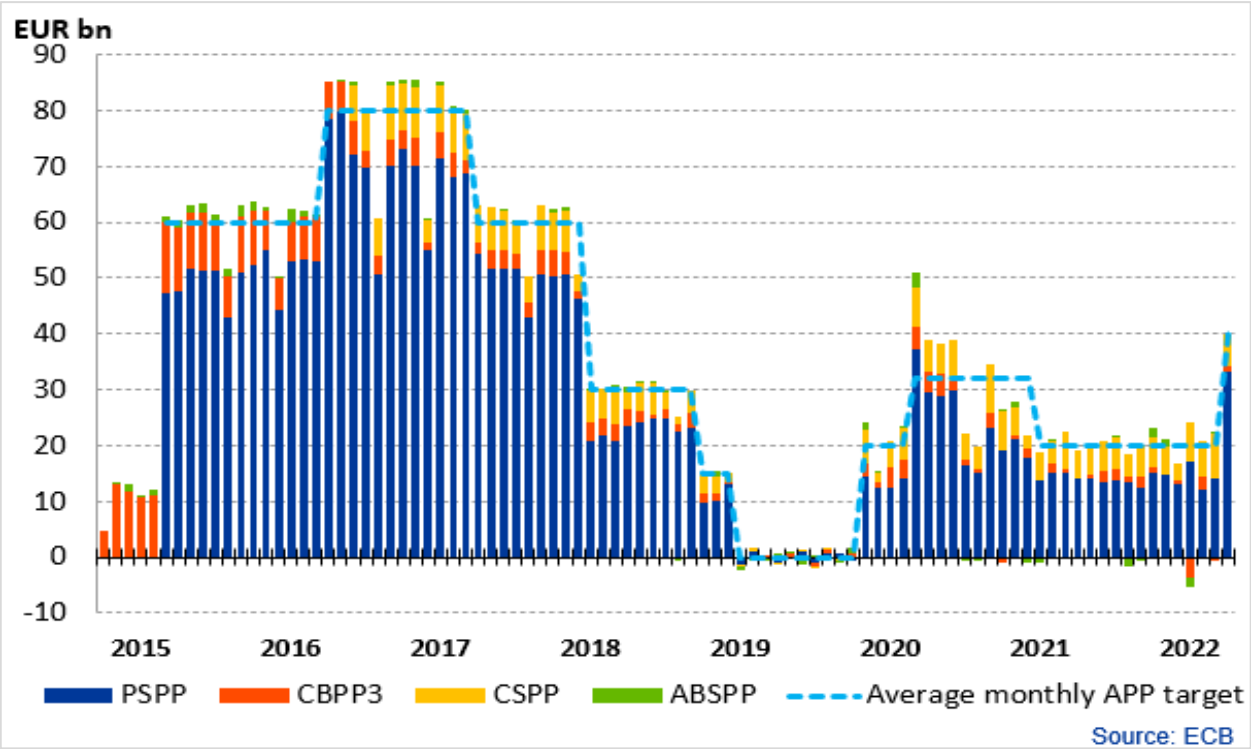


Panel B: The ECB signal surprises



Note: The blue marked area indicates the ZLB period of key interest rates. The market factor surprises are significantly bigger than signal factor surprises when entering the ZLB. However, the factors may influence the interest rates to move in opposite directions on the ECB announcement day.

Figure A.2. The ECB's Asset Purchase programmes (APPs) – Monthly net purchases



Note: Monthly net purchases and average monthly APP target 2015 – March 2022. From Asset purchase programmes, by ECB, 2022, (https://www.ecb.europa.eu/mopo/implement/app/html/index.en.html) Copyright 2022, ECB

Table A.1. Descriptive statistics of dependent variables used in event study analyses – Norway, Sweden, and Denmark (January 2007 – December 2019)

Panel A: Descriptive Statistics NOR

Variable	Obs.	Mean	Median	Std. Dev.	Min	Max
FX EURNOK	3391	.007	-.010	.505	-3.737	3.347
Equity NOR	3270	.012	.083	1.498	-11.046	9.642
Interbank 3M	3270	-.063	0	4.735	-60	57
Swap Rate (2Y)	3356	-.088	0	3.239	-30	19.13
Swap Rate (5Y)	3356	-.09	0	3.432	-25.5	18.5
Swap Rate (10Y)	3356	-.089	0	3.626	-25.13	21.38

Panel B: Descriptive Statistics SWE

Variable	Obs.	Mean	Median	Std. Dev.	Min	Max
FX EURSEK	3391	.005	.005	.449	-2.503	2.518
Equity SWE	3264	-.004	-.058	1.373	-9.394	9.199
Interbank 3M	3264	-.097	0	2.786	-106.7	17.3
Swap Rate (2Y)	3262	-.113	0	3.226	-34.5	21.42
Swap Rate (5Y)	3362	-.112	-150	4.048	-51.5	53.4
Swap Rate (10Y)	3262	-.106	-.100	3.947	-23.7	30.55

Panel C: Descriptive Statistics DEN

Variable	Obs.	Mean	Median	Std. Dev.	Min	Max
FX EURDKK	3391	0	0	.015	-.128	.123
Equity DEN	3244	.018	.018	1.174	-11.163	7.874
Interbank 3M	3244	-.132	0	2.363	-55.33	50.34
Swap Rate 2Y	3334	-.135	-.050	3.333	-21.7	36.25
Swap Rate (5Y)	3334	-.129	-.130	3.699	-19.7	29.75
Swap Rate (10Y)	3334	-.122	.-150	3.945	-21.1	28

Table A.2. Changes in key policy rates of ECB, Norway, Sweden, and Denmark (January 2007 – December 2019)

	Negative Changes	Positive Changes	Tot no. of changes
ECB	14	6	20
NOR	13	17	30
SWE	17	16	33
DEN	22	9	31

Table A.3 Macroeconomic releases included as market reactions to News

Norway	Sweden	Denmark
Consumer Confidence	Consumer Confidence	Consumer Confidence Indicator
CPI MoM	CPI MoM	CPI MoM
CPI Underlying MoM	CPI YoY	CPI YoY
CPI Underlying YoY	CPIF MoM	Current Account Balance
CPI YoY	CPIF YoY	Current Account SA
Credit Indicator Growth YoY	GDP QoQ	Foreign Reserves
Deposit Rates	GDP WDA YoY	GDP (YoY) NSA
GDP Mainland MoM	Household Consumption MoM	GDP SA QoQ
GDP Mainland QoQ	Household Lending YoY	GDP SA YoY
GDP QoQ	Industrial Orders MoM	Industrial Production MoM
Ind Prod Manufacturing MoM	Industrial Orders NSA YoY	Retail Sales MoM
Ind Prod Manufacturing WDA YoY	Industrial Production MoM	Retail Sales YoY
Industrial Confidence	Industrial Production NSA YoY	Unemployment Rate Gross Rate
Industrial Production MoM	Manufacturing Confidence	
Industrial Production WDA YoY	Manufacturing Confidence s.a.	
Norway PMI	Manufacturing Confidence SA	
PPI including Oil MoM	PPI MoM	
PPI including Oil YoY	PPI YoY	
Retail Sales - vol sa (YoY)	Private Sector Production MoM	
Retail Sales SA Volume MoM	Private Sector Production YoY	
Trade Balance	Retail Sales MoM	
Unemployment Rate	Retail Sales WDA YoY	
	Service Production MoM SA	
	Service Production Value YoY	
	Service Production YoY WDA	
	Trade Balance	
	Unemployment Rate	
	Unemployment Rate SA	

Source: Bloomberg

Table A.4. Estimated market and signal factor surprises on the dates of ECB UMP announcements

Ann. date	Market	Signal	Ann. date	Market	Signal	Ann. date	Market	Signal
08/03/2007	0,535	0,575	29/06/2011	-0,035	-0,216	04/12/2014	-0,429	0,249
06/06/2007	1,907	0,577	07/07/2011	-1,039	0,547	22/01/2015	-2,585	1,091
22/08/2007	-0,024	0,175	04/08/2011	-0,202	-0,655	05/03/2015	0,222	0,141
06/09/2007	-0,801	-1,028	08/08/2011	0,529	-0,437	15/04/2015	0,902	0,219
08/11/2007	0,009	-0,145	25/08/2011	-0,420	0,531	03/06/2015	-0,537	0,184
10/01/2008	0,253	-0,218	15/09/2011	-2,061	-1,105	16/07/2015	-1,594	0,364
07/02/2008	-0,280	-0,266	06/10/2011	1,228	-0,208	03/09/2015	-1,168	0,264
11/03/2008	-0,502	0,607	03/11/2011	-0,279	2,567	22/10/2015	0,284	0,055
28/03/2008	-0,518	-0,340	30/11/2011	-3,180	-3,653	09/11/2015	-1,241	0,046
02/05/2008	-0,617	0,366	08/12/2011	-0,128	0,370	03/12/2015	0,495	0,256
03/07/2008	-0,253	-0,181	21/12/2011	0,076	0,370	21/01/2016	1,041	-0,205
30/07/2008	-0,431	-0,518	09/02/2012	0,159	2,654	10/03/2016	-1,567	0,485
31/07/2008	-0,105	0,188	28/02/2012	-0,266	-1,327	21/04/2016	0,652	-0,194
04/09/2008	-0,006	-0,872	06/06/2012	1,987	-0,761	02/06/2016	-0,984	0,396
18/09/2008	1,798	4,791	22/06/2012	0,442	2,571	21/07/2016	-0,236	0,301
26/09/2008	-0,972	-2,249	05/07/2012	-1,122	0,906	08/09/2016	2,728	-0,409
29/09/2008	0,393	0,779	26/07/2012	0,295	-1,729	20/10/2016	0,079	0,216
07/10/2008	2,570	-1,406	02/08/2012	0,691	-3,605	08/12/2016	1,128	-0,789
08/10/2008	0,622	-1,514	06/09/2012	-2,302	0,131	15/12/2016	-0,163	0,297
13/10/2008	0,494	0,170	12/09/2012	-0,680	0,796	19/01/2017	1,512	0,025
15/10/2008	0,553	-3,105	06/12/2012	0,422	-0,796	09/03/2017	1,455	0,754
06/11/2008	-0,914	-0,163	13/12/2012	-0,527	0,374	27/04/2017	0,626	0,026
04/12/2008	0,946	-1,743	21/02/2013	-0,071	-0,426	08/06/2017	-0,735	0,206
18/12/2008	1,317	-0,704	07/03/2013	-0,180	0,174	19/06/2017	-0,676	0,274
19/12/2008	-0,517	-0,399	22/03/2013	0,742	0,244	20/07/2017	-0,495	0,250
15/01/2009	1,253	-1,080	02/05/2013	0,714	-0,147	07/09/2017	1,111	0,064
03/02/2009	0,365	-0,590	04/07/2013	1,193	-0,632	26/10/2017	-0,231	-0,118
05/03/2009	-1,174	0,453	16/09/2013	0,072	-0,065	14/12/2017	-0,111	0,356
19/03/2009	-0,827	-1,146	31/10/2013	0,233	-0,241	25/01/2018	0,246	0,713
02/04/2009	0,559	0,817	07/11/2013	1,446	0,065	08/03/2018	0,951	0,009
06/04/2009	0,661	-0,235	09/01/2014	-0,286	0,051	26/04/2018	-0,103	0,015
07/05/2009	1,509	-1,168	06/02/2014	-0,800	0,018	14/06/2018	-0,754	-0,530
04/06/2009	0,083	2,467	06/03/2014	-0,085	0,245	26/07/2018	0,395	0,372
25/06/2009	-0,708	0,302	03/04/2014	-1,042	-0,445	13/09/2018	0,780	0,278
24/09/2009	-1,643	0,854	08/05/2014	0,481	0,293	25/10/2018	-0,751	-0,064
03/12/2009	0,570	0,929	05/06/2014	-2,188	-0,521	13/12/2018	-0,090	0,023
04/03/2010	0,409	0,376	17/06/2014	-0,136	0,397	24/01/2019	-0,039	0,363
10/05/2010	0,397	-0,241	03/07/2014	-0,438	0,012	07/03/2019	0,139	0,589
10/06/2010	-0,366	-0,030	29/07/2014	0,811	0,473	10/04/2019	0,113	-0,029
02/09/2010	1,371	0,240	07/08/2014	-0,396	0,321	06/06/2019	-1,310	-0,252
02/12/2010	1,547	-1,186	04/09/2014	-1,151	0,124	25/07/2019	0,071	0,495
17/12/2010	-0,084	0,189	18/09/2014	-1,031	0,021	12/09/2019	2,027	-0,077
21/12/2010	-0,194	-0,319	02/10/2014	0,191	0,286	24/10/2019	1,027	0,058
03/03/2011	-0,724	-0,222	06/11/2014	0,001	0,280	12/12/2019	-1,184	0,356
07/04/2011	0,621	0,999	17/11/2014	0,452	0,141			
09/06/2011	-0,552	-0,606	26/11/2014	-1,652	0,705			

Note: Announcement dates are an expanded list identified in Falagiarda et al. (2015) from January 2015 to December 2019. Announcements include press conferences, press releases, and speeches, related to ECB's non-standard monetary policy measures and extracted from the ECB media website.

Figure A.3. Financial variables used in the event study – daily (January 2007- December 2019)

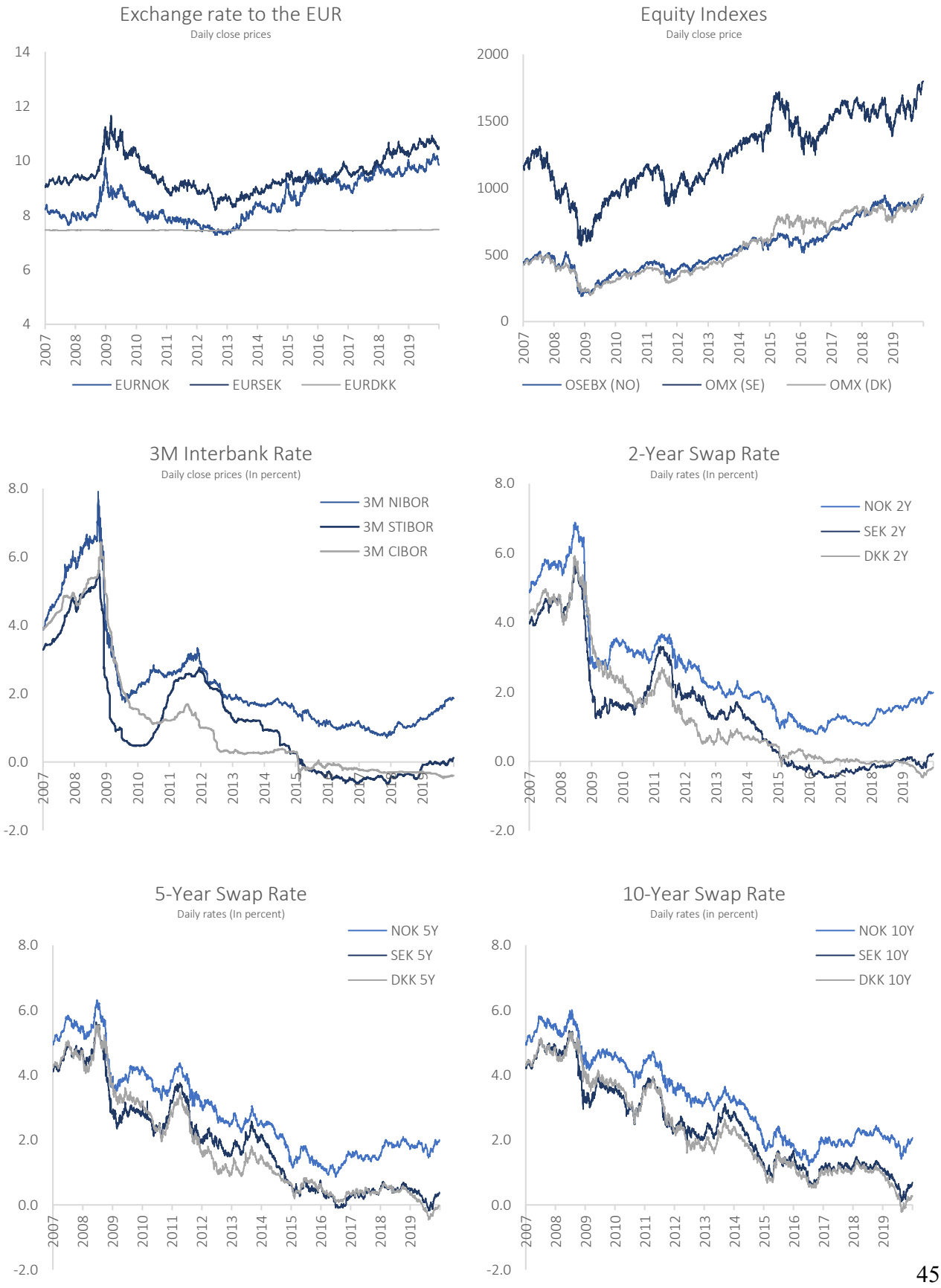
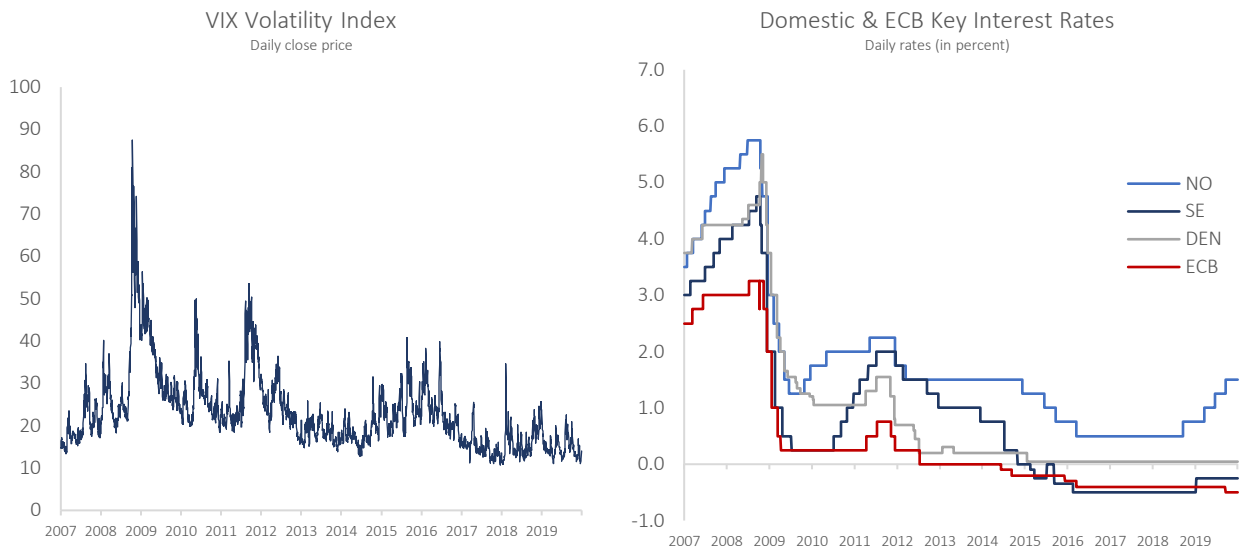


Figure A.2 cont. Financial variables used in the event study – daily (January 2007-December 2019)



Note: The figure plots daily changes of the financial variables used in the event study, 01/01/2007 – 31/12/2019, and are reported as follows: i) Exchange rates; absolute values of domestic currency relative to the euro at close, ii) interbank rates, swap rates & key interest rates; daily percentage points at close, iii) equity indices and VIX index; daily market points at close

Appendix B – Regression Output Results

Table B.1. Event study analysis on impact of ECB's UMP measures: Excluding domestic and ECB interest rate changes and market reaction to macroeconomic surprises (News) – all events

	△NEER NO	△NEER SE	△NEER DEN	△Equity NO	△Equity SE	△Equity DEN	△Interbank3M NO	△Interbank3M SE	△Interbank3M DEN
△VIX	0.020***	0.016***	-0.000***	-0.126***	0.133***	-0.100***	-0.013	0.009	0.011
	(0.001)	(0.001)	(0.000)	(0.003)	(0.003)	(0.003)	(0.012)	(0.007)	(0.006)
UMPECB	-0.041	-0.014	-0.002	-0.321**	0.210*	-0.180*	-0.392	-0.761**	0.185
	(0.043)	(0.038)	(0.001)	(0.108)	(0.092)	(0.085)	(0.416)	(0.248)	(0.208)
UMPNO	0.003			-1.059**			-2.625		
	(0.141)			(0.372)			(1.431)		
UMPSE		-0.252			0.488			0.413	
		(0.218)			(0.519)			(1.392)	
UMPDK			-0.002			0.261			0.143
			(0.007)			(0.430)			(1.058)
_cons	0.004	0.003	0.000	0.056*	-0.042*	0.048**	-0.035	-0.068	-0.142***
	(0.009)	(0.008)	(0.000)	(0.022)	(0.019)	(0.017)	(0.085)	(0.050)	(0.042)
N	3391	3391	3390	3279	3264	3244	3270	3264	3244
R^2	0.071	0.058	0.006	0.324	0.429	0.331	0.002	0.004	0.001

Table B.1 cont.

	△2Y NO	△2Y SE	△2Y DEN	△5Y NO	△5Y SE	△5Y DEN	△10Y NO	△10Y SE	△10Y DEN
△VIX	-0.105***	-0.112***	-0.088***	-0.141***	-0.168***	-0.136***	-0.135***	-0.170***	-0.155***
	(0.008)	(0.008)	(0.009)	(0.009)	(0.010)	(0.009)	(0.009)	(0.010)	(0.010)
UMPECB	-0.207	-0.836**	-0.336	0.209	-0.983**	-0.013	0.756*	-0.449	0.348
	(0.277)	(0.276)	(0.288)	(0.290)	(0.341)	(0.315)	(0.309)	(0.333)	(0.334)
UMPNO	-3.232***			-2.426*			-1.581		
	(0.914)			(0.955)			(1.015)		
UMPSE		-0.687			-1.281			-1.281	
		(1.570)			(1.947)			(1.895)	
UMPDK			-1.580			-2.564			-2.743
			(1.470)			(1.606)			(1.703)
_cons	-0.047	-0.055	-0.100	-0.059	-0.036	-0.098	-0.084	-0.054	-0.100
	(0.056)	(0.056)	(0.058)	(0.058)	(0.069)	(0.064)	(0.063)	(0.067)	(0.068)
N	3356	3362	3334	3356	3362	3334	3356	3362	3334
R^2	0.050	0.055	0.031	0.077	0.077	0.060	0.066	0.081	0.071

Table B.2. The effects of ECB's Market and Signal surprises on Scandinavian financial variables: Excluding domestic and ECB interest rate changes and market reaction to macroeconomic surprises (News)

	△NEER NO	△NEER SE	△NEER DEN	△Equity NO	△Equity SE	△Equity DEN	△Interbank3M NO	△Interbank3M SE	△Interbank3M DEN
△VIX	0.020***	0.016***	-0.000***	-0.125***	0.133***	-0.100***	-0.010	0.011	0.010
	(0.001)	(0.001)	(0.000)	(0.003)	(0.003)	(0.003)	(0.012)	(0.007)	(0.006)
Market	0.068	0.002	-0.002	0.031	0.077	-0.013	-1.261**	-0.499*	0.197
	(0.042)	(0.038)	(0.001)	(0.108)	(0.094)	(0.085)	(0.408)	(0.251)	(0.210)
Signal	-0.040	0.019	0.003*	0.296**	-0.072	0.079	3.613***	1.473***	-0.103
	(0.042)	(0.038)	(0.001)	(0.108)	(0.093)	(0.084)	(0.408)	(0.249)	(0.206)
_cons	0.003	0.002	0.000	0.039	-0.033	0.041*	-0.061	-0.098*	-0.135**
	(0.008)	(0.007)	(0.000)	(0.022)	(0.018)	(0.017)	(0.082)	(0.049)	(0.042)
N	3391	3391	3390	3270	3264	3244	3270	3264	3244
R^2	0.071	0.058	0.007	0.322	0.428	0.330	0.026	0.012	0.001

	△2Y NO	△2Y SE	△2Y DEN	△5Y NO	△5Y SE	△5Y DEN	△10Y NO	△10Y SE	△10Y DEN
△VIX	-0.103***	-0.110***	-0.087***	-0.141***	-0.165***	-0.136***	-0.136***	-0.169***	-0.156***
	(0.008)	(0.008)	(0.008)	(0.008)	(0.010)	(0.009)	(0.009)	(0.010)	(0.010)
Market	-0.220	0.116	0.991***	0.191	0.359	1.292***	0.414	0.359	1.396***
	(0.275)	(0.274)	(0.286)	(0.287)	(0.340)	(0.312)	(0.305)	(0.330)	(0.331)
Signal	1.593***	0.790**	0.565*	1.434***	0.667*	1.039***	1.334***	0.715*	0.727*
	(0.275)	(0.274)	(0.286)	(0.287)	(0.340)	(0.312)	(0.305)	(0.330)	(0.331)
_cons	-0.068	-0.090	-0.116*	-0.060	-0.078	-0.102	-0.058	-0.074	-0.090
	(0.055)	(0.054)	(0.057)	(0.057)	(0.067)	(0.062)	(0.061)	(0.065)	(0.066)
N	3356	3362	3334	3356	3362	3334	3356	3362	3334
R^2	0.055	0.055	0.035	0.083	0.076	0.068	0.069	0.082	0.077

Table B.3. Effects of ECB's Market and Signal surprises on Danish financial variables (ZLB interacted): Excluding domestic and ECB interest rate changes and market reaction to macroeconomic surprises (News)

	△NEER NO	△NEER SE	△NEER DEN	△Equity NO	△Equity SE	△Equity DEN	△Interbank3M NO	△Interbank3M SE	△Interbank3M DEN
△VIX	0.020***	0.016***	-0.000***	-0.125***	0.133***	-0.100***	-0.009	0.011	0.010
	(0.001)	(0.001)	(0.000)	(0.003)	(0.003)	(0.003)	(0.012)	(0.007)	(0.006)
ZLB	0.022	0.013	0.000	0.058	-0.046	0.061	0.071	-0.034	0.194*
	(0.017)	(0.015)	(0.001)	(0.044)	(0.037)	(0.034)	(0.164)	(0.097)	(0.084)
Market	0.137*	0.003	-0.002	-0.083	0.374**	-0.139	-3.771***	-2.261***	0.685*
	(0.063)	(0.057)	(0.002)	(0.160)	(0.144)	(0.125)	(0.602)	(0.383)	(0.306)
Market*ZLB	-0.107	0.007	0.000	0.154	-0.517**	0.208	3.876***	2.789***	-0.868*
	(0.087)	(0.078)	(0.003)	(0.220)	(0.193)	(0.175)	(0.827)	(0.513)	(0.430)
Signal	-0.076	0.009	0.002	0.390**	-0.126	0.137	5.005***	2.167***	-0.255
	(0.048)	(0.043)	(0.001)	(0.122)	(0.106)	(0.095)	(0.457)	(0.282)	(0.233)
Signal*ZLB	0.129	0.052	0.005	-0.416	0.048	-0.214	-5.341***	-2.115***	0.349
	(0.109)	(0.098)	(0.003)	(0.277)	(0.236)	(0.219)	(1.043)	(0.625)	(0.537)
_cons	-0.010	-0.006	-0.000	0.006	-0.007	0.006	-0.090	-0.075	-0.247***
	(0.013)	(0.012)	(0.000)	(0.033)	(0.028)	(0.026)	(0.124)	(0.074)	(0.064)
N	3391	3391	3390	3270	3264	3244	3270	3264	3244
R^2	0.073	0.058	0.008	0.323	0.429	0.331	0.042	0.026	0.004

Table B.3 cont.

	△2Y NO	△2Y SE	△2Y DEN	△5Y NO	△5Y SE	△5Y DEN	△10Y NO	△10Y SE	△10Y DEN
△VIX	-0.103***	-0.110***	-0.087***	-0.140***	-0.166***	-0.135***	-0.136***	-0.169***	-0.156***
	(0.008)	(0.008)	(0.008)	(0.008)	(0.010)	(0.009)	(0.009)	(0.010)	(0.010)
1.ZLB	0.147	0.071	0.219	0.107	0.076	0.173	0.045	0.066	0.098
	(0.111)	(0.110)	(0.115)	(0.115)	(0.136)	(0.125)	(0.124)	(0.133)	(0.133)
Market	-1.054**	-0.193	2.079***	-0.029	0.558	2.519***	0.543	0.486	2.817***
	(0.408)	(0.408)	(0.424)	(0.427)	(0.505)	(0.463)	(0.455)	(0.492)	(0.491)
Market*ZLB	1.269*	0.636	-1.879**	0.355	-0.226	-2.002**	-0.309	-0.125	-2.311***
	(0.561)	(0.560)	(0.583)	(0.587)	(0.694)	(0.636)	(0.625)	(0.675)	(0.675)
Signal	2.086***	0.763*	0.228	1.543***	0.457	0.507	1.406***	0.559	0.096
	(0.310)	(0.310)	(0.322)	(0.324)	(0.384)	(0.352)	(0.345)	(0.373)	(0.373)
Signal*ZLB	-1.952**	0.400	0.853	-0.412	0.951	1.788*	-0.499	0.723	2.166*
	(0.707)	(0.706)	(0.735)	(0.739)	(0.875)	(0.801)	(0.787)	(0.851)	(0.850)
_cons	-0.149	-0.131	-0.245**	-0.121	-0.123	-0.206*	-0.085	-0.113	-0.151
	(0.084)	(0.084)	(0.087)	(0.087)	(0.103)	(0.095)	(0.095)	(0.101)	(0.101)
N	3356	3362	3334	3356	3362	3334	3356	3362	3334
R^2	0.060	0.055	0.040	0.083	0.077	0.073	0.070	0.082	0.082

Table B.4. Event study analysis on impact of ECB's and Domestic UMP measures – All events (Complete regression)

Panel A: Norway

	△VIX	△IR NOK	△IR ECB	UMP ECB	UMP NO	NEWS NO	_cons	N	R^2
△NEER	0.020***	0.007**	-0.010***	-0.061	0.000	-0.106***	0.005	3391	0.086
	(0.001)	(0.003)	(0.002)	(0.043)	(0.140)	(0.020)	(0.008)		
△ Equity	-0.126***	0.027***	-0.004	-0.322**	-1.065**	-0.067	0.058**	3270	0.328
	(0.003)	(0.007)	(0.005)	(0.108)	(0.372)	(0.052)	(0.022)		
△Interbank3M	-0.011	0.192***	0.225***	0.063	-2.697	0.438*	-0.022	3270	0.060
	(0.012)	(0.026)	(0.019)	(0.405)	(1.389)	(0.195)	(0.082)		
△Swap Rate (2Y)	-0.103***	0.109***	0.064***	-0.023	-3.229***	0.771***	-0.041	3356	0.077
	(0.008)	(0.018)	(0.013)	(0.275)	(0.902)	(0.133)	(0.055)		
△Swap Rate (5Y)	-0.139***	0.060**	0.031*	0.310	-2.417*	0.581***	-0.056	3356	0.087
	(0.008)	(0.018)	(0.013)	(0.289)	(0.950)	(0.139)	(0.058)		
△Swap Rate (10Y)	-0.134***	0.044*	0.013	0.808**	-1.577	0.291	-0.082	3356	0.069
	(0.009)	(0.020)	(0.014)	(0.310)	(1.014)	(0.151)	(0.063)		

Panel B: Sweden

	△VIX	△IR SEK	△IR ECB	UMP ECB	UMP SE	NEWS SE	_cons	N	R^2
△NEER	0.016***	0.002	0.000	-0.012	-0.217	-0.089***	0.002	3391	0.068
	(0.001)	(0.002)	(0.003)	(0.038)	(0.217)	(0.015)	(0.008)		
△ Equity	0.133***	0.002	-0.001	0.211*	0.480	0.019	-0.042*	3264	0.429
	(0.003)	(0.004)	(0.006)	(0.092)	(0.520)	(0.036)	(0.019)		
△Interbank3M	0.009	0.021	0.004	-0.745**	0.452	-0.105	-0.067	3264	0.005
	(0.007)	(0.011)	(0.016)	(0.248)	(1.392)	(0.097)	(0.050)		
△Swap Rate (2Y)	-0.112***	-0.012	0.088***	-0.824**	-0.878	0.475***	-0.046	3362	0.067
	(0.008)	(0.013)	(0.018)	(0.275)	(1.561)	(0.109)	(0.055)		
△Swap Rate (5Y)	-0.167***	-0.028	0.111***	-0.971**	-1.502	0.549***	-0.026	3362	0.088
	(0.010)	(0.016)	(0.023)	(0.340)	(1.937)	(0.135)	(0.068)		
△Swap Rate (10Y)	-0.169***	-0.025	0.087***	-0.438	-1.445	0.410**	-0.047	3362	0.088
	(0.010)	(0.015)	(0.022)	(0.332)	(1.889)	(0.133)	(0.067)		

Panel C: Denmark

	△VIX	△IR DKK	△IR ECB	UMP ECB	UMP DEN	NEWS DEN	_cons	N	R^2
△NEER	-0.000***	-0.000	0.000	-0.002	-0.002	-0.000	0.000	3391	0.006
	(0.000)	(0.000)	(0.000)	(0.001)	(0.007)	(0.001)	(0.000)		
△ Equity	-0.100***	0.006	0.019***	-0.175*	0.258	0.065	0.051**	3244	0.334
	(0.003)	(0.005)	(0.005)	(0.084)	(0.429)	(0.040)	(0.017)		
△Interbank3M	-0.002	0.581***	-0.008	0.132	0.025	0.051	-0.071**	3244	0.670
	(0.004)	(0.007)	(0.008)	(0.120)	(0.609)	(0.056)	(0.024)		
△Swap Rate (2Y)	-0.091***	0.171***	0.002	-0.350	-1.618	0.298*	-0.077	3334	0.061
	(0.008)	(0.017)	(0.018)	(0.284)	(1.447)	(0.133)	(0.057)		
△Swap Rate (5Y)	-0.138***	0.106***	-0.005	-0.023	-2.589	0.331*	-0.083	3334	0.071
	(0.009)	(0.019)	(0.020)	(0.313)	(1.598)	(0.147)	(0.063)		
△Swap Rate (10Y)	-0.158***	0.088***	-0.019	0.334	-2.763	0.194	-0.089	3334	0.078
	(0.010)	(0.020)	(0.021)	(0.333)	(1.698)	(0.156)	(0.067)		

Table B.5. Effects of ECB's Market and Signal surprises on Scandinavian financial variables (Complete regression)

Panel A: Norway

	△VIX	△IR NOK	△IR ECB	Market	Signal	NEWS NO	_cons	N	R^2
△NEER	0.020***	0.008**	-0.009***	0.043	-0.031*	-0.104***	0.003	3391	0.086
	(0.001)	(0.003)	(0.002)	(0.042)	(0.042)	(0.020)	(0.008)		
△ Equity	-0.125***	0.026***	-0.003	0.027	0.286**	-0.062	0.041	3270	0.326
	(0.003)	(0.007)	(0.005)	(0.108)	(0.108)	(0.052)	(0.022)		
△Interbank3M	-0.010	0.184***	0.211***	-0.698	3.202***	0.427*	-0.031	3270	0.078
	(0.012)	(0.026)	(0.019)	(0.400)	(0.398)	(0.193)	(0.080)		
△Swap Rate (2Y)	-0.102***	0.105***	0.060***	-0.018	1.442***	0.772***	-0.055	3356	0.081
	(0.008)	(0.017)	(0.013)	(0.273)	(0.272)	(0.132)	(0.054)		
△Swap Rate (5Y)	-0.139***	0.057**	0.027*	0.295	1.359***	0.581***	-0.053	3356	0.091
	(0.008)	(0.018)	(0.013)	(0.288)	(0.287)	(0.139)	(0.057)		
△Swap Rate (10Y)	-0.136***	0.040*	0.009	0.458	1.297***	0.285	-0.055	3356	0.072
	(0.009)	(0.020)	(0.014)	(0.307)	(0.306)	(0.150)	(0.061)		

Panel B: Sweden

	△VIX	△IR SEK	△IR ECB	Market	Signal	NEWS SE	_cons	N	R^2
△NEER	0.016***	0.002	0.000	0.005	0.015	-0.089***	0.002	3391	0.068
	(0.001)	(0.002)	(0.003)	(0.038)	(0.038)	(0.015)	(0.007)		
△ Equity	0.133***	0.002	-0.001	0.077	-0.073	0.020	-0.033	3264	0.428
	(0.003)	(0.004)	(0.006)	(0.094)	(0.093)	(0.036)	(0.018)		
△Interbank3M	0.011	0.020	0.002	-0.493*	1.449***	-0.098	-0.097*	3264	0.014
	(0.007)	(0.011)	(0.016)	(0.251)	(0.249)	(0.097)	(0.049)		
△Swap Rate (2Y)	-0.110***	-0.013	0.088***	0.124	0.758**	0.473***	-0.081	3362	0.066
	(0.008)	(0.013)	(0.018)	(0.272)	(0.273)	(0.109)	(0.054)		
△Swap Rate (5Y)	-0.165***	-0.028	0.111***	0.367	0.642	0.546***	-0.068	3362	0.087
	(0.010)	(0.016)	(0.023)	(0.338)	(0.338)	(0.135)	(0.067)		
△Swap Rate (10Y)	-0.168***	-0.025	0.087***	0.364	0.698*	0.408**	-0.067	3362	0.089
	(0.010)	(0.015)	(0.022)	(0.329)	(0.330)	(0.133)	(0.065)		

Panel C: Denmark

	△VIX	△IR DKK	△IR ECB	Market	Signal	NEWS DEN	_cons	N	R^2
△NEER	-0.000***	-0.000	0.000	-0.002	0.003*	-0.000	0.000	3391	0.008
	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)	(0.000)		
△ Equity	-0.100***	0.006	0.019***	-0.008	0.069	0.065	0.044**	3244	0.334
	(0.002)	(0.005)	(0.005)	(0.085)	(0.084)	(0.040)	(0.017)		
△Interbank3M	-0.002	0.581***	-0.008	-0.033	0.078	0.051	-0.066**	3244	0.669
	(0.004)	(0.007)	(0.008)	(0.121)	(0.119)	(0.056)	(0.024)		
△Swap Rate (2Y)	-0.091***	0.171***	0.002	0.941***	0.616*	0.307*	-0.094	3334	0.065
	(0.008)	(0.017)	(0.018)	(0.282)	(0.282)	(0.133)	(0.056)		
△Swap Rate (5Y)	-0.138***	0.106***	-0.007	1.266***	1.075***	0.343*	-0.088	3334	0.078
	(0.009)	(0.019)	(0.020)	(0.310)	(0.310)	(0.147)	(0.062)		
△Swap Rate (10Y)	-0.158***	0.087***	-0.020	1.368***	0.765*	0.207	-0.080	3334	0.083
	(0.010)	(0.020)	(0.021)	(0.330)	(0.330)	(0.156)	(0.066)		

Table B.6 Effects of ECB's Market and Signal surprises on Scandinavian financial variables -ZLB interacted (Complete regressions)

Table A: Norway

	△NEER	△ Equity	△Interbank3M	△Swap Rate (2Y)	△Swap Rate (5Y)	△Swap Rate (10Y)
△VIX	0.020***	-0.125***	-0.009	-0.102***	-0.139***	-0.135***
	(0.001)	(0.003)	(0.012)	(0.008)	(0.008)	(0.009)
△IR ECB	0.008**	0.026***	0.179***	0.103***	0.056**	0.040*
	(0.003)	(0.007)	(0.025)	(0.017)	(0.018)	(0.020)
△IR NOK	-0.009***	-0.004	0.198***	0.055***	0.026	0.009
	(0.002)	(0.005)	(0.019)	(0.013)	(0.014)	(0.015)
ZLB	0.022	0.055	0.027	0.131	0.099	0.041
	(0.017)	(0.044)	(0.160)	(0.109)	(0.115)	(0.124)
Market	0.086	-0.093	-2.540***	-0.644	0.178	0.636
	(0.064)	(0.162)	(0.597)	(0.409)	(0.432)	(0.462)
Market*ZLB	-0.061	0.161	2.663**	0.891	0.172	-0.390
	(0.087)	(0.221)	(0.815)	(0.558)	(0.589)	(0.630)
Signal	-0.059	0.380**	4.391***	1.868***	1.434***	1.350***
	(0.048)	(0.122)	(0.449)	(0.308)	(0.325)	(0.347)
Signal*ZLB	0.113	-0.406	-4.729***	-1.739*	-0.306	-0.445
	(0.109)	(0.277)	(1.019)	(0.698)	(0.737)	(0.787)
NEWSNO	-0.104***	-0.062	0.422*	0.771***	0.581***	0.286
	(0.020)	(0.052)	(0.192)	(0.132)	(0.139)	(0.150)
_cons	-0.010	0.010	-0.039	-0.128	-0.109	-0.079
	(0.013)	(0.033)	(0.122)	(0.083)	(0.087)	(0.095)
N	3391	3270	3270	3356	3356	3356
R^2	0.087	0.327	0.088	0.084	0.091	0.072

Panel B: Sweden

	(1) △NEER	(2) △ Equity	(3) △Interbank3M	(4) △Swap Rate (2Y)	(5) △Swap Rate (5Y)	(6) △Swap Rate (10Y)
△VIX	0.016***	0.133***	0.011	-0.110***	-0.165***	-0.168***
	(0.001)	(0.003)	(0.007)	(0.008)	(0.010)	(0.010)
△IR ECB	0.000	-0.000	-0.000	0.087***	0.111***	0.087***
	(0.003)	(0.006)	(0.016)	(0.018)	(0.023)	(0.022)
△IR SEK	0.002	0.002	0.017	-0.012	-0.027	-0.025
	(0.002)	(0.004)	(0.011)	(0.013)	(0.016)	(0.015)
ZLB	0.013	-0.046	-0.033	0.058	0.060	0.054
	(0.015)	(0.037)	(0.098)	(0.110)	(0.135)	(0.132)
Market	0.005	0.376**	-2.246***	-0.137	0.614	0.525
	(0.056)	(0.145)	(0.383)	(0.406)	(0.503)	(0.491)
Market*ZLB	0.010	-0.521**	2.778***	0.552	-0.312	-0.187
	(0.077)	(0.194)	(0.513)	(0.557)	(0.691)	(0.674)
Signal	0.004	-0.129	2.138***	0.717*	0.419	0.535
	(0.043)	(0.107)	(0.283)	(0.309)	(0.383)	(0.373)
Signal*ZLB	0.058	0.053	-2.074***	0.439	0.971	0.730
	(0.098)	(0.236)	(0.626)	(0.702)	(0.871)	(0.849)
NEWS SWE	-0.089***	0.021	-0.103	0.471***	0.546***	0.408**
	(0.015)	(0.036)	(0.096)	(0.110)	(0.135)	(0.133)
_cons	-0.006	-0.007	-0.074	-0.114	-0.103	-0.099
	(0.011)	(0.028)	(0.074)	(0.084)	(0.103)	(0.101)
N	3391	3264	3264	3362	3362	3362
R^2	0.068	0.430	0.027	0.067	0.087	0.089

Panel C: Denmark

	(1) △NEER	(2) △ Equity	(3) △Interbank3M	(4) △Swap Rate (2Y)	(5) △Swap Rate (5Y)	(6) △Swap Rate (10Y)
△VIX	-0.000***	-0.100***	-0.002	-0.091***	-0.138***	-0.158***
	(0.000)	(0.002)	(0.004)	(0.008)	(0.009)	(0.010)
△IR ECB	0.000	0.019***	-0.008	0.003	-0.005	-0.018
	(0.000)	(0.005)	(0.008)	(0.018)	(0.020)	(0.021)
△IR DKK	-0.000	0.005	0.580***	0.168***	0.103***	0.084***
	(0.000)	(0.005)	(0.007)	(0.017)	(0.019)	(0.020)
ZLB	0.000	0.057	0.065	0.182	0.151	0.082
	(0.001)	(0.034)	(0.048)	(0.113)	(0.125)	(0.133)
Market	-0.002	-0.130	0.128	1.927***	2.424***	2.728***
	(0.002)	(0.125)	(0.177)	(0.419)	(0.461)	(0.490)
Market*ZLB	0.000	0.204	-0.293	-1.704**	-1.884**	-2.208**
	(0.003)	(0.175)	(0.248)	(0.575)	(0.633)	(0.673)
Signal	0.002	0.126	0.037	0.311	0.564	0.153
	(0.001)	(0.095)	(0.134)	(0.318)	(0.350)	(0.372)
Signal*ZLB	0.005	-0.204	0.064	0.766	1.724*	2.105*
	(0.003)	(0.218)	(0.309)	(0.724)	(0.798)	(0.848)
NEWS DEN	-0.000	0.065	0.050	0.302*	0.336*	0.199
	(0.001)	(0.040)	(0.056)	(0.133)	(0.146)	(0.155)
_cons	-0.000	0.011	-0.104**	-0.202*	-0.180	-0.132
	(0.000)	(0.026)	(0.037)	(0.086)	(0.095)	(0.100)
N	3390	3244	3244	3334	3334	3334
R^2	0.008	0.335	0.670	0.069	0.083	0.088