

The Spillover Effects of European Central Bank Non-Standard
Monetary Policy on Non-Euro Economies

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Abstract

This paper is the first to comprehensively assess the impact of the European Central Bank's non-standard monetary policy, in the form of the asset purchase programme (APP) utilising statistical analysis in the form of linear regression, coefficient and correlation models. The overall impacts across the research period are estimated through the results of this analysis and also identify through which channels the spillovers occurred. The results suggest that spillover effects from the European Central Bank asset purchase programme resulted in a decrease in the yields of both Swedish and Danish 10 year-government bonds. Furthermore, it also suggests that the spillover effects occurred on the exchange rates. The results also suggest that spillovers occurred through the asset price channel and through the foreign exchange channel. Unexpectedly the results also infer that no significant spillovers occur through the trade channel, which is not in line with the conclusions of other related literature.

Keywords: ECB non-standard monetary policy, Spillover Effects, Asset purchase programme, Channels, Denmark, and Sweden.

Thesis Declaration Page

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Chapter 1 - Introduction

The decline and subsequent bankruptcy of Lehman Brothers bank in September 2008, due to mass exposure to US sub-prime quality mortgages, was one of the main catalysts of the global financial crisis of 2008 (The Economist, 2013). With over \$600 billion in assets upon filing for bankruptcy, the bank was a significant entity on Wall Street and global financial markets at the time. Its bankruptcy filing caused the Dow Jones Industrial Average, a price weighted index of the 30 most significant stocks traded on the New York stock exchange, to decline by more than 500 basis points in a single day (Johnson & Mamun, 2011). What followed was a period of severe economic downturn, decline in asset prices and lack of liquidity in interbank funding markets (Abbassi, 2015).

The recession, which followed, had not only an impact in the US but also had a significant impact across the Eurozone. Interbank funding, the process of banks' lending to one another as a source of funding on the wholesale markets, declined in availability. This was due to perceived systemic and credit risks which set in across the financial markets with institutions afraid to lend to one another out of the fear of more bankruptcy's. Banks across the Eurozone soon became insolvent due to their over reliance on this source of funding. Examples of banks that suffered this fate are Northern Rock and HBOS in the UK (Smith and Arnold, 2017).

In times of recession such as 2008 where the economy is contracting, monetary authorities such as Central Banks will seek to stimulate economic growth through the introduction of expansionary monetary policies through various channels (Mishkin, 1996, 2001). These policies seek to grow the economy through increased consumer spending and investment and promote bank lending. This is achieved (expansionary monetary conditions) through a number of channels such as reducing interest rates, thus making loans cheaper and saving less attractive due to lower returns incentivising spending and investment or reducing the reserve requirement for banks so they need to hold less cash against their assets and can lend more to consumers. While the above is not an exhaustive list of monetary policy tools, the overall goal of these expansionary policies is to shift the economy back into an expansionary stage and resume positive economic growth.

The monetary policy measures stated above are known as standard monetary policy measures, primary measures that are turned to first in times of poor economic growth or recessionary periods when attempting to incentivise growth. However, these standard methods failed to push the Eurozone economy into growth following the 2008 recession. The exact reasons for this are disputed, but the lack of consumer trust and business confidence in the economy and financial sector after the recession was cited as having a negative impact on spending and growth sentiment (Neisingh and Stokman, 2013). In addition to consumers not looking to borrow, the decline in house prices and poor liquidity conditions, because of over lending and perceived risk in financial markets as mentioned above, in the 2008 to 2009 period left banks very hesitant to lend further to consumers. The result of these conditions was a lack of growth in consumer spending and investing or bank lending.

Recognising these conditions across the Eurozone, the ECB introduced a range of non-standard monetary policy measures in an effort to lift the Eurozone economy from the global recession due to standard measures proving ineffective. One of these policies was negative interest rates, tasked with incentivising lending by charging banks to hold large deposits with central banks to force them to lend or invest it and to decrease returns on savings to close to zero incentivising consumers to spend their savings in the economy. Another policy was the enhancing of refinancing/lending operations known as targeted longer-term refinancing options (TLTRO), which extended credit facilities to banks and financial institutions for up to four years. This facility was supposed to enhance their liquidity and ability to lend to the real economy,

<https://www.ecb.europa.eu/mopo/implement/omo/tltro/html/index.en.html>).

However, no measure had such an impact as the introduction of the asset purchase programme (APP).

The asset purchase programme, or APP, was a non-standard measure introduced by the ECB in 2015 with the objective of purchasing certain assets issued by countries in the Eurozone to improve funding and liquidity conditions on financial markets and in the real economy while also increasing inflationary pressures

<https://www.ecb.europa.eu/mopo/implement/omt/html/index.en.html>). Under the

programme, the ECB would purchase corporate bonds, covered bonds, public sector and government bonds and asset backed securities issued in the euro area and subject to criteria such as credit quality ratings and currency denomination of the assets. The purchasing of these assets would provide banks with much needed funding and liquidity, through the purchase of their debt securities, and instil overall confidence in financial markets. The programme, which began in 2015, is likely to end in December 2018. Purchases over this period averaged 70bn per month (up to May 2018). This paper focuses on the introduction of the APP as a quantitative easing measure and the impacts of spillover effects (explained below) from its introduction on the yields of Swedish and Danish ten-year government bonds. Swedish and Danish ten-year government bonds were not purchased under the APP due to Denmark and Sweden being outside the euro area and their bonds denominated in non-euro currency, as such, they fell outside the ECB criteria for purchase.

In today's globally and open orientated economy the possibility of spillover effects, defined as unanticipated and unplanned secondary effects from an economic or monetary policy with a sole primary planned purpose (Weyerstrass *et al* (2006)), occurring from the economic policy of developed economies is a real prospect. These could occur in multiple ways through a number of channels such as exchange rates (the valuation of currencies against their peers for the purposes of conversion), trade flows (the values of imports and exports between two countries) and capital flows (the movement of cash in the economy between various markets) (Mishkin, 2001). As evidenced by Linn, Mohapatra and Stocker (2013), their study suggested that of the 62% overall increase in capital inflows to developing economies in the 2009-2013 period, 13% was directly attributable to quantitative easing. Merler (2017) also notes an increase in the purchase of non-euro area securities by euro area investors, up from 1% growth end 2013 to 4% growth in 2015. The reasons cited for this are lower euro-area bond yields and asset price movements because of the APP.

This focus of this paper is the examination of the spillover effects of ECB non-standard monetary policy on two developed non-euro developed economies.

Specifically, this study suggests that upon the introduction of the APP, spillover effects did occur into the economies of Denmark and Sweden between January 2015 to May 2018. This study was based on previous identification of spillover effects, Ciarlone and Colabella (2016) previously identified spillover effects on non-euro economies, concluding that cross-border and banking capital flows in central and southeast Europe were affected because of the announcement and implementation of the APP by the ECB. Fratzscher, Lo Duca and Straub (2016) also concluded that spillover effects from ECB unconventional monetary policy between 2007 and 2012 on developing economies and emerging markets boosted equity markets but had little to no impact on non-euro-area bond markets.

Denmark and Sweden have an array of economic linkages to the euro area, which is important in emphasising the importance of this research, one of the main linkages is the trade of goods and services through exports to and imports from euro area countries. The ECB notes that intra-EU trade makes up for 59% of Sweden's exports. Their main trading partner in the euro area is Germany (11% of exports). 71% of Sweden's imports come from EU member states, Germany again being the main trade partner accounting for 19% of imports, followed by the Netherlands accounting for 8% of imports. (Source ECB: https://europa.eu/european-union/about-eu/countries/member-countries/sweden_en)

Intra-EU trade accounts for 62% of Denmark's exports. With Germany again being the largest importer of goods accounting for 16% and United Kingdom accounting for 6%. In addition, 71% of Danish imports come from EU Member States. Germany accounting 21% and the Netherlands accounting for 8%. Financial services are also a key point of interaction between the euro area and Denmark and Sweden.

Swedbank (market cap of €29.5bn) and Danske Bank (market cap of €23.3bn) for example are large players in the capital markets and provide financial services in EU area countries through investment and retail products. (Source ECB: https://europa.eu/european-union/about-eu/countries/member-countries/denmark_en)

There is an inherent gap in the literature, with a lack of studies focusing on the spillover effects onto developed non-euro economies such as Denmark and Sweden.

The current literature focuses on developing non-euro area nations such as the Czech Republic, Hungary and Romania ((Tirpak, McQuade & Falagiarda (2015) and Moder (2017)). These studies follow an event-backed perspective, the process of using single or multiple event(s) to assess the impact on a particular study variable, when approaching the research. An event-backed perspective is arguably less comprehensive as it examines the deviations only when these events occur rather than across the entire length of the research period. This is in comparison to a purely quantitative statistical analysis undertaken in this paper, which is a more comprehensive method. This is the process of taking data from a period and using it to assess the impact on a chosen study variable using statistical analysis throughout the entire research period rather than at certain points.

In addition, a large portion of the current material covering the effects of monetary policy spillovers are undertaking the research from a federal reserve and US perspective rather than from an ECB orientated perspective, (De Los Rios and Shamloo (2017) and Lim, Mohapatra and Stocker (2014)) . This is critical due to the difference in the relationship between the US and Denmark and Sweden versus the Euro Area. It is likely that the economies of Denmark and Sweden will be more sheltered from US orientated monetary policy due to its effect being dollar originated and focused, and also due to less developed trade relationship between the US and Denmark and Sweden in comparison to the EU as we observed previously.

In the undertaking of this research, we are addressing a gap in the current literature by focusing on the effects of spillovers on developed non-euro economies from ECB non-standard monetary policy. The perspective of this research will complement the current literature and contribute to the current economic knowledge and understanding of the effect of monetary policy spillovers. The importance of this research, and the identification and understanding of the channels through which it occurs is paramount for current and future policy makers. It will allow them to not only identify and manage risks of future spillovers, but to be able to plan for the future, to recognise and manage the potential risks for when expansionary policy measures such as the asset purchase programme are reversed.

Chapter 2 - Research Question

In this section, we will outline the research question and the objectives of this research.

The research question examines “The Impact of European Central Bank Non-Standard Monetary Policy on Non-Euro Economies”. The study will conduct an analysis on the economic spillover effects that the non-standard monetary policy measures implemented by the ECB, specifically the asset purchase programme, have had on the economies of Denmark and Sweden between January of 2015 and May of 2018. The variables that will be used in this research will be monthly European Central Bank Asset Purchase Programme purchase amounts, ten-year government bond yields, foreign exchange rates, exports, imports, inflation, Gross Domestic Product, capital flows and the Volatility index, or VIX index, as a control variable. We will also be factoring in for deposit facility interest rates going negative by adding an event variable into our statistical analysis.

- The first primary objective of this research is to ascertain whether ECB non-standard monetary policy, specifically the asset purchase programme, had any impact on our chosen economic variables for the economies of Denmark and Sweden in the January 2015 to May 2018 period. This will be achieved through the completion of a number of sub-objectives, which are as follows.
 - Determine whether there was an impact from European Central Bank Asset Purchase Programme purchases, for each economy through the undertaking of a statistical analysis, analysing the output for statistical significance to determine the extent of any spillover effects which may have occurred on any of our observed variables which include ten-year government bond yields, foreign exchange rates, exports, imports, inflation, Gross Domestic Product, capital flows, the Volatility index and our dummy variable.

- The secondary objective is to contribute to the base of academic literature that examines the spillover effects of non-standard monetary policy, growing the current knowledge base by addressing a gap in the literature and enhancing the levels at which spillover effects are understood in order to aid policy decision-making and contribute to current economic knowledge. This will also be completed through a number of sub objectives, which are as follows.
 - Through undertaking a study in a recent observation period on two developed non-euro economies. The current literature is sparse in terms of research on developed non-euro economies; as such, this research will examine the economies of Denmark and Sweden, which are both developed, and non-euro economies.
 - Using a research period that encompasses almost the entire ECB extended asset purchase programme, with asset purchase increases and decreases occurring over the timeline, which will capture a broader range of potential spillovers. This not only, increases the potential for findings in this research while complimenting the current academic pool of research, but will also potentially increase the understanding of spillover effects of ECB non-standard monetary policy by examining how our observed economies react to a both an increase and decrease in monthly purchases.
- The third objective of this research is to attempt to relate the theories of the spillover effects of monetary policy, such as the transmission mechanisms or “channels” (Mishkin, 1996, 2001) to real-world macroeconomic policy. We will complete this by examining our statistical variables, the policies implemented, and relating any observations back to the literature in an attempt identify where the mechanisms discussed in the literature may appear in our analysis.

It should be noted that it is not the research objective of this study to ascertain whether the spillover effects that occurred had a negative or positive impact but rather to statistically verify if they actually occurred.

The importance of this research and completion of these research objectives is paramount in the contribution to the development and implementation of sound economic policies. Furthermore, with Denmark and Sweden having such close ties to the EU in terms of trade, tourism and financial services, it is vital that ECB policies contribute positively to these economies.

Chapter 3 - Literature Review

3.1 Introduction

In this section, the literature review will be undertaken. The objective of this section is to engage in the critical application and critique of the concepts and theories relevant to this piece of research. In doing this, the current range of the literature regarding spillover effects and the respective conclusions will firstly be examined, followed by an examination and explanation of the theoretical concepts. Following this, a critical analysis of a number of topical issues in the literature regarding spillover effects, which are critical to this study, will be undertaken. These topical issues will consist of the significance of the exchange rate channel in the literature, the different methods undertaken across the literature and why it is significant, and the study of developing economies in comparison to developed economies and how most of the relevant literature focuses on developing economies. Furthermore, using the most up to date and relevant literature, we also seek to illustrate the importance of this research and its role in addressing the gaps and shortcomings in the current literature.

3.2 The Current Literature

The current literature covering the spillover effects of non-standard monetary policy discuss the implications from multiple orientations, Eichengreen and Gupta (2014) from a Federal Reserve perspective and Tirpak, McQuade and Falagiarda (2015) from an ECB perspective for example. However, studies on the spillovers of non-standard monetary policy from an ECB perspective have only really begun to emerge in the broader literature in the last number of years. This is likely due to the topic gaining further public attention and more information becoming publicly available, such as the ECB APP monthly purchases data. The current range of literature consists of academic studies, working papers from monetary authorities and institutions and journal papers published by economists and other financial publications. The majority of the literature is in the form of working papers undertaken by institutions such as the ECB, IMF or World Bank with a smaller portion from an academic source or other sources such as newspaper publications. This is an important point to note due to the generally different objectives and methodologies of these different types

of literature. Working papers focus on exploring a hypothesis, examining the primary results with the objective of sharing results as a work in progress or as a gateway to further research. Meanwhile, an academic research paper is published with all empirical findings, research and results finalised. While working papers are still reliable and recognised sources of information, it is important to address the lack of academic literature on this specific topic as a shortcoming, which has led to a large number of working papers used in this research, thus emphasising the importance of this research. However, in line with our research objectives of contributing to the base of academic literature that examines the spillover effects of ECB non-standard monetary policy, this literature seeks to contribute to the remedy of this issue, growing the base of relevant academic literature.

3.3 Theoretical Framework

In this section, the theoretical framework will be discussed. The theoretical framework identifies the underlying theoretical concepts utilised for the purposes of this research, their importance, and how they relate to our research.

One of the key underlying concepts of the study is the presence of economic “spillover effects” Mishkin (1996, 2001), described as unanticipated secondary economic or monetary effects from economic policy, from standard and non-standard monetary policy occurring through various “channels”. The channels, described as the methods of transmission through which economic or monetary policy effects travel to affect the real economy, range from more straightforward channels such as the interest rate channel to the more complex and theoretical channels such as the balance-sheet channel.

Mishkin (1996, 2001) discusses these channels, and how spillover effects occur through them. While all the channels discussed in the literature can potentially carry spillover effects, the channels that fall into the scope of this research are the interest rate channel, exchange rate channel, the bank-lending channel and the asset-price channel. The interest rate channel states that when interest rates fall, the cost of capital decreases thus increasing investment and spending in the economy leading to a rise in output. The exchange rate channel states that the effects of monetary

policies can also affect the real economy through their impact on the value of currencies relative to one another. The bank-lending channel states that upon expansionary monetary policy, bank deposits will increase and thus the number of loans available will increase, increasing investment and spending in the economy. The asset-price channel states that upon a monetary policy decision by a central bank or monetary authority, this will affect asset prices in the real economy based on the monetary decision undertaken.

These channels are the most relevant to this research due to the nature of non-standard monetary policy, how it affects the banking system and liquidity by increasing money supply and decreases interest rates, how it affects imports and exports through changes in foreign exchange rates and how it affects the price of assets such as government bonds. For the purposes of this research, the asset price channel is especially important for government bonds as changes the price will affect the yield of these assets, which is an observed variable.

As previously discussed, this paper focuses on the spillover effects of non-standard monetary policy, which travel through these channels and produce spillover effects on certain variables. These channels outline the basic mechanisms through which these spillover effects will be observed which is paramount to this research and its conclusions.

3.4 General Spillover Analysis

A majority of the research literature, which examines the presence of spillover effects from non-standard monetary policy, concluded that spillover effects did occur from the implementation and in some cases the announcement of non-standard monetary policy.

Tirpak, McQuade and Falgardia (2015) concluded that they observed evidence of strong spillovers on a number of countries in Central and Eastern Europe from the non-standard monetary policy especially on the sovereign bond yields of the countries in the research. Furthermore, De Santis (2016) concluded that, in reference to the asset purchase programme that up to October of 2015 GDP weighted ten-year euro area yields reduced by 63 basis points because of ECB policy.

Fratzscher, Do Luca and Straub (2016) also concluded that while ECB policies mainly affected European financial markets, positive spillovers did occur on global markets through increases in equity prices and decreased credit risks of banks and sovereign bonds.

Spillovers were also identified when examining the spillover effects of Federal Reserve non-standard monetary policy. Lim, Mohapatra and Stocker (2014) concluded, “Of the 62 percent increase in inflows during 2009–13 related to changing global monetary conditions, at least 13 percent of this was attributable to quantitative easing”. Furthermore, Canova (2005) concluded that with regards to monetary policy spillovers “Transmission, when it occurs, is almost instantaneous with Latin American variables peaking within a couple of quarters of the shocks”. While the types of economies observed, and research periods differ in these research papers, it is clear that spillover effects can be observed from a US perspective. The deviation in the countries that are researched demonstrates spillovers can occur on multiple types of economies.

While all of these studies are event studies using different variables, examined in further detail later on, the theme among the literature is that the research identifies evidence of spillover effects occurring from non-standard monetary policy. However, we must account for some considerations. Firstly, in the 2013 to 2016 period, which encompasses to a certain degree all of the above papers research periods, the ECB was lowering interest rates past the negative bound and they currently stand at minus 40 basis points for the deposit facility. Furthermore, the main refinancing operations has also been reduced gradually over the 2013 to 2016 period, and was reduced to zero in early 2016. These aggressive expansionary standard policies, coupled with the large scale events announcing their introduction are likely to have had spillover effects in the same period, thus potentially affecting the results of studies undertaken in that period.

Furthermore, considering that a large portion of the literature undertake event study methodologies, it is important to note that not all of the announcements considered are directly related to the asset purchase programme with some focusing on interest rate announcements such as Briciu and Lisi (2015). As such, there is a

possibility that these announcements may have had an effect as well as the announcements regarding the implementation of the asset purchase programme (APP) which could skew the results of these pieces of research. These factors have been taken into account for the methodology of this paper, which will use both statistical analysis and control event variables in an attempt to counter spillovers from exterior variables that fall outside the research. However, there is an apparent lacking in the evidence base. A large portion of the Federal Reserve orientated literature focuses on developing economies in south America and a large portion of the ECB orientated literature focuses on developing economies in Europe, however, there is no literature which focuses on ECB effects on South America or Federal Reserve Policy on developing economies in Europe? This is a gap in the literature and lends to the possibilities for future research.

3.5 Exchange Rate Channel

The exchange rate channel is an important component of this study due to the countries chosen for the research. Denmark and Sweden both have their own domestic currency, the Danish Krone and Swedish Krone respectively. The exchange rate can weigh on a number of factors such as exports, imports and asset purchases. For example, if these currencies were to grow stronger or get weaker in comparison to the euro, then imports would become more expensive or cheaper for euro area citizens, which could affect the amount purchased. Furthermore, fluctuations in foreign exchange rates could affect international investment in Swedish and Danish assets by international investors. If Swedish and Danish assets, specifically government bonds, became too expensive for international investors due to unfavourable foreign exchange rates, it is likely they will invest in assets denominated in different currencies, which could affect their yields due to decreased demand.

While this research seeks to establish the presence of spillover effects of non-standard monetary policy from an ECB perspective, it is important in emphasising the importance of this research that the current range of literature surrounding the spillover of non-standard monetary policy is, as previously stated, largely US/Federal Reserve orientated. Examples of literature with a focus positioned on non-standard

monetary policy originated from the Federal Reserve include Canova (2005), De Los Rios and Shamloo (2017) and Lim Mohapatra and Stocker (2014)). This raises multiple implications for research studies, with the spillover effects on, Denmark and Sweden for example, from these policies arguably muted through the exchange rate channel (Mishkin, F. 1996 & 2001) with the Nordic countries having weaker trade and service relationships with the US. However in opposition to this hypothesis, Moder (2017) states that “With regard to the exchange rate channel, they conclude that it does not seem to shape the response of macroeconomic variables in the case of unconventional monetary policy shocks, as opposed to the case for conventional monetary policy”.

However, this conclusion is limited in its application as it concluded spillovers occurred via mainly the export channel for almost all of the economies studied. The export data used in the study includes only merchandise and not service exports, which could display a different historical export pattern if included. Furthermore, the export channel is not deemed significant for all non-euro area countries studied in the paper and the possibility of FX pressure effects on exports is not considered in the economies where it is not deemed significant. Finally, the exchange rates are described as “very stable” in the conclusion to the study, which would beg the question as to how the exchange rate channel significance would have been concluded upon in a more volatile environment and whether further analysis was needed? The exchange rates in the research period for this paper are slightly more volatile, with the Swedish Krona gaining 9% on the Euro over the period observed which could potentially lead to significant spillovers occurring through the exchange rate channel (Mishkin 1996, 2001). In addition, Chinn (2013) states in her conclusion that “Neely (2012) examined the impact of the LSAP1 (Large Scale Asset Purchase) events. He found that the dollar depreciated against foreign currencies upon announcement” and goes on to state that “Fratzscher et al conclude that QE1 spurred a portfolio rebalancing, with capital flows moving out of the emerging market economies, and into the advanced economies”. This shows that spillover effects from non-standard monetary policy can occur through the exchange rate channel, which means spillover effects could have affected the economies of Denmark and Sweden through the FX channel.

This is significant for this research, and while the literature conflicts as to the significance of the exchange rate channel, it is a factor which if not considered would likely alter or skew the results of this particular research. As such, it will be considered in this research paper.

3.6 Alternative Methods in the Literature

The methods undertaken can be critical in determining the significance and relevance of a piece of literature when conducting research. The type of study conducted (event study, statistical analysis), the length of time over which the variables were examined, the variables themselves which were considered, the data used, the model constructed and the boundaries or limitations of the research are just some of the factors which must be considered when examining a piece of research.

The current literature presents a broad range of characteristics with studies taking multiple approaches and using multiple variables in their research. One of the key differences being that the research undertaken uses both ECB and US (Federal Reserve) orientated monetary policy. These different methodical approaches, as demonstrated below, can lead to both similarities and differences in conclusions. However, differences in methods add to the overall diversity of the literature considered in this research paper. Furthermore, by acknowledging multiple approaches and methods, a broader knowledge of the research topic can be incorporated and considered into the methodology for this research, and the potential for bias is reduced.

The current literature examines the effects of the result of spillovers of non-standard monetary policy from multiple angles. For example, Eichengreen and Gupta (2014) use exchange rates, foreign reserves and equity prices as the variables in their study on the impacts expectations of reduced Federal Reserve security purchases on emerging markets. They concluded that discussions of the Federal Reserve tapering purchases through their purchase programme inflicted currency depreciation and stock market declines on the observed emerging market economies (Brazil, Russia, India, Indonesia, China & Turkey). However, Fratzscher, Lo Duca & Straub (2014)

concluded that the spillover effects of ECB non-standard monetary policy positively affected equity prices in both core and periphery euro area economies. We observe different conclusions about the effects of non-standard monetary policy on equity prices; this is an example of how using different study variables can produce different results. However, Fratzscher, Lo Duca & Straub (2014) have a research period of five years and four months Eichengreen and Gupta (2014) utilise just a five-month research period. Furthermore, the economies that are analysed are different. It is difficult to determine would the conclusions differ if both research papers examined economies that are more similar and had the same observation period, if these variables were more aligned then perhaps the results would be more similar.

Similarities can also occur when different methods and variables are used, Neely (2010) concluded through the undertaking of an event study, (a methodology whereby independent variables are solely analysed for their reactions to events), that the large scale asset purchase announcements by the Federal Reserve decreased long-term U.S bond yields and long term foreign bond yields. Meanwhile, De Santis (2016) concluded that the ECB asset purchase programme reduced the GDP-weighted 10-year euro area yields. While the papers were published at different times and use different variables, both are event studies and examine the same conclusion on the effects of asset purchase programmes on bond yields in their respective jurisdictions.

These findings are relevant to our research from a methods perspective, the spillover effects that occur on Denmark and Sweden due to ECB non-standard monetary policy may differ to those if this research was undertaken from a US Federal Reserve perspective. Furthermore, differences may have been observed if different variables were utilised, or if an extended research period was used which leads to the potential for further research on this topic.

In conclusion, the methods undertaken deviate in multiple ways such as spillover source (ECB or Federal Reserve), variables used, analysis method (event study or statistical analysis for example) length of the research and the type of economy

used. In constructing our approach, we noted that there was little to no analysis of the spillovers of ECB orientated policy on the economies of developed non-euro countries. Furthermore, it is also clear that there is a higher number of event studies in comparison to statistical analysis methods. As such, in line with our research objectives of contributing to the current literature base chose to analyse the spillovers of ECB orientated policy on the economies of two developed countries utilising a statistical analysis.

3.7 Developed Economies vs Developing Economies

The underlying economies used for research purposes also vary in the literature. Geographical location, currency, orientation and size of the economy are just a number of the variables that differentiate the economies used. However, the majority of literature which focuses on the spillover effects of purchase programmes, including both the APP from and ECB and Federal Reserve perspective, is based on developing economies with a minority of the literature focused on developed economies.

We can observe the following for reference. Tirpak, McQuade and Falagiarda (2015) and Moder (2017) focus on the spillover effects of non-standard monetary policy but both focus on the area of South-Eastern Europe, countries such as Romania and Hungary and concluded that spillover effects did occur as a result of purchase programme announcements. Furthermore, Benkovskis, Bessonovs, FeldKircher and Worz (2011) examine the economies of the Czech Republic, Poland and Hungary for potential spillovers of euro area monetary policy shocks using a VAR model analysis and concluded that ECB monetary policy spillovers did occur impacting GDP, imports and exports. As previously stated, these countries are developing non-euro area countries and as such, this leaves a gap in the literature as to the spillover effects of ECB non-standard monetary policy on developed non-euro economies. While there is a large amount of literature surrounding the spillover effects ECB non-standard monetary policy on other developing euro area countries, there is very limited literature on the impact of the spillover effects on developed non-euro economies. One of the few pieces of literature was a working paper undertaken by the National

Bank of Denmark (DNB). Jensen, Spange and Mikkelsen (2017) concluded that Danish bond yields have declined in anticipation of ECB purchase programmes and that Denmark has “continued to import the monetary policy stance of the euro area”. Furthermore, the paper goes on to conclude that countries such as Sweden have also seen their yields decline in anticipation of purchase programmes. However, the economies of Denmark and Sweden are likely to react differently than developing economies in some manner due to their stronger trade relationship with the EU and their stronger presence in the financial markets. In support of this hypothesis, Eichengreen and Gupta (2014) concluded that the size of countries financial was a key factor and those countries with larger markets saw higher pressures on exchange rates, equity prices and foreign reserves.

A large portion of the Federal Reserve orientated paper also focus on developing economies, Canova (2005) for example examines the transmission of US monetary shocks to Latin America, specifically Mexico, Panama, Brazil, Chile, Ecuador, Argentina, Uruguay and Peru, and concluded that spillover effects from Federal Reserve policy did occur through the interest rate channel. Furthermore Lim Mohapatra and Stocker M. (2014) examine the effects of quantitative easing on financial flows to 60 developing economies, concluding that federal reserve quantitative easing was responsible for at least a 13% increase in capital inflows over the research period. While the Federal Reserve orientated literature is likely to have less relevance to spillover effects on Denmark and Sweden, it is clear that developing economies are also focused on from a US policy perspective.

The importance of whether the economies observed are developing or developed can also be emphasised through the function of economic dependency theory (Prebisch, R. 1980). While the theory outlines the concept of dependency theory from a number of perspectives, the theoretical references most relevant to this research is the assumption that while there is currently a large amount of interaction between core countries, and between core and periphery countries, there is very little interaction between the periphery countries themselves. This results in a strong and developed set of core countries while the periphery countries remain isolated with weak growth. Evidence of this was demonstrated in the trade introduction with

the observation that exports make up approximately 90% of Hungary's GDP, and its biggest trade partners were euro area countries. Further evidence of this can be found by examining Romania, with its biggest trading partners being developed euro area countries, specifically Germany, Italy and France. (Source ECB: https://europa.eu/european-union/about-eu/countries/member-countries/romania_en). In summary, these countries are dependent on the core economies for resources, and as such any economic policies instilled by developed economies, which affect the developed economies, will naturally spillover to these dependent economies through the trade channel and the foreign exchange channel with trade of goods becoming either more expensive or cheaper. As such, by examining two non-euro developed economies, this dependency factor is reduced, which could produce different reactions to spillovers from euro area monetary policy.

In conclusion, in constructing our approach, we noted that there was little to no analysis of the spillovers of ECB orientated policy on the economies of developed non-euro countries. Furthermore, it is also clear that there is a larger amount of literature focusing on developing economies rather than developed economies further emphasising the importance of this research. As such, in line with our research objectives of contributing to the current literature base chose to analyse the spillovers of ECB orientated policy on the economies of two developed countries.

3.8 Related Literature for Sweden & Denmark

There is very limited literature that examines the spillover effects of ECB purchase programmes on Denmark and Sweden, which has been one of the primary limitations to this study. Furthermore, on a more general observation, there is also very limited literature that examines non-euro developed economies.

One of the few pieces of literature which examines the spillover effects of ECB purchase programmes on Denmark, and also mentions its effects on Sweden was a working paper undertaken by the National Bank of Denmark (DNB). Jensen, Spange and Mikkelsen (2017) concluded that in reference to Denmark “yields have tended to decline in anticipation of the PSPP (APP)” and that Denmark has “continued to import the monetary policy stance of the euro area”. While Denmark did not conduct its own purchase programme, their government bond yields have tracked those of the core European countries quite closely (see Item No.3 in the appendices). Concerning Sweden, Jensen, Spange and Mikkelsen (2017) also concluded “Countries with a floating exchange rate, such as Sweden and the United Kingdom, have also seen their sovereign yields decline in anticipation of the PSPP (APP)”.

This literature concludes that spillover effects from the ECB APP did occur onto the economies of Denmark and Sweden. However, once again, this is an event study, with a VAR analysis, so it important to note different methods were undertaken. Furthermore, the research period was 2010-2016, the ECB asset purchase programme was only fully engaged in 2015, and due to the slim research period where the APP was actually having an impact it is likely that this research has missed some key conclusions given the timeframe. As such, in line with research objectives, this research seeks to fill the void in the literature, examining the effects on the economies of Denmark and Sweden in a more recent research period, throughout which the asset purchase programme was in full operation.

3.9 Literature Review Conclusion

In conclusion, most of the literature examining spillover effects conclude that they did occur and were observed on the research variables, however, a number of gaps in the literature remain. Firstly, the majority of the literature consists of working papers rather than academic literature, which has left an imbalance in the current range of literature. Secondly, in relation to the variables considered in the current literature, the majority of studies regarding the spillover effects of ECB monetary policy are conducted on developing economies rather than developed economies, which is a key gap in the literature. Furthermore, the studies which do consider developed economies, examine euro area developed economies rather than non-euro developed economies, this is another key gap in the literature. Thirdly, in regards to the methodologies of the current literature, the vast majority of the studies undertaken utilise event study analysis or VAR model analysis, which each have their own limitations, rather than just a pure statistical analysis methodology utilising standard measures such as correlation, coefficient and regression statistics to determine the presence and significance of spillovers. Finally, we note a clear gap in the literature with very little research focusing on the impact spillover effects of ECB non-standard monetary policy, further emphasising the importance of this work. As such, we have considered these limitations, in conjunction with our research objectives, in our approach to the research design and our research questions.

Chapter 4: Methodology

This section will outline the methodology of this research paper. It will outline, critique and justify the methodology undertaken and variables chosen for this research, identifying any issues and limitations where appropriate. Alternative methodologies from previous studies will also be considered and acknowledged, with a critical analysis performed where appropriate, justifying why these methods were not chosen. The importance of a clear and effective methodology is paramount in the completion of the objectives of the research, and must be undertaken in a manner that allows

4.1 Sample Selection Criteria

Denmark and Sweden were selected as the country chosen needed to have its own inflation objectives, not be a euro area country, not be subject to ECB quantitative easing (not in euro-area and not use the euro) and have its own monetary objectives with full sovereign autonomy over said objectives. In addition, countries chosen needed to be developed economy and not a developing economy. Independent inflation objectives also are necessary as if the countries chosen had shared inflation objectives, with the EU for example, this could skew our results and conclusions due to exterior variables interfering. The same reasoning is applied for monetary objectives. The countries not being subject to the ECB APP is paramount to this research due to the research focus being on spillover effects, if these countries were subject to the APP then the effects, if any, would not be spillovers. It should be noted that the strong trade relationship between Denmark and Sweden and the EU was not a determining factor in the choice of these economies but rather an observation made upon the choice of these economies.

Other countries for this study considered for analysis fell outside strict inclusion criteria of the research. In addition, a large portion of the economies considered had undertaken their own large scale quantitative easing measures, which would have made it very difficult, statistically and numerically speaking, to determine if the ECB purchases were attributable to statistical observations rather than internal monetary actions occurring in the same period. The other economies considered for this study

were Australia, England and Japan; however, while they fit the criteria for the research, they were excluded as all of these countries had large-scale internal quantitative easing purchase programmes that would have been likely to affect our results when attempting an analysis from an ECB perspective. As such, these economies were excluded from consideration for the research.

4.2 Consideration of Alternative Methodologies

There are multiple methods that could have been undertaken in conducting an analysis on the spillover effects of ECB non-standard monetary policy, specifically the asset purchase programme, on the economies of Denmark and Sweden. However, considering our research question, for the purposes of this research a statistical analysis using sample time series data from a number of chosen variables from the period of January 2015 to May 2018 will be undertaken. This contributes to our mandate of full completion of our research objectives by adding to the current knowledge base of spillovers of non-standard monetary policy, as this period has not been researched. Prior to considering alternative methodologies, an outline and critical analysis of the chosen methodology for this research will first be undertaken for consideration.

The methodology chosen for this research is to use a quantitative approach and conduct a statistical analysis on samples of our chosen variables over the research period with the objective of using our statistical analysis to identify and quantify any numerical findings in relation to spillover effects from ECB non-standard monetary policy on the economies of Denmark and Sweden. A quantitative approach was chosen for this research because we would be attempting to quantify spillover effects from ECB non-standard monetary policy and performing a statistical analysis on our variables, rather than looking for any qualitative or non-numerical qualities, in our data. Quantitative approaches are also the method chosen by many similar studies on this research topic such as Moder (2017), Gupta & Eichengreen (2014) and De Santis (2016).

While the original research paper anticipated for this research was January 2010 to December 2017, the period chosen for this research, January 2015 to May 2016, was

decided upon for a number of reasons. Firstly, January 2015 saw the introduction of what is the asset-purchase programme in its most current format, which enables us to produce the most up to date findings and conclusions; we observed an increase in monthly ECB asset purchases in 2016, followed by two decreases in monthly ECB asset purchases in 2017. This gives us much more favourable conditions due to the fact we can examine as to whether the spillovers occurred from increases or decreases, or both, in purchases, which move provoked a stronger response if any, and how both upward and downward movements in purchase amounts affected our individual variables. Furthermore, we had a significant event occur in our research period, the deposit facility moved further negative from -0.30% to -0.40% and the main refinancing option went to 0% from 0.05% in March of 2016 (ECB https://www.ecb.europa.eu/stats/policy_and_exchange_rates/key_ecb_interest_rates/html/index.en.html). While this research does not undertake an event case study and a control variable will be inserted from the interest rate movements in the Deposit Facility and main refinancing option mentioned above for this event in SPSS. The addition of the event dummy variable adds a further variable to our research which contributes to our research objectives by allowing the production of the most accurate results when performing a statistical analysis on our variables, enhancing the quality of our input to the pool of existing literature researching the spillover effects of non-standard monetary policy.

4.3 Research Variables

In this section, we will define and justify the variables used in this research. Our variables for this research are 10-year Government bond yields, monthly ECB APP purchase amounts, export values, import values, gross domestic product, inflation, foreign exchange for the domestic currency of each economy, capital flows, and euro and the Volatility Index (all values refer to data for both Sweden and Denmark except monthly ECB APP purchase amounts and VIX index values). Specifically, for our model, our independent variable will be 10-year government bond yields and the remainder will be independent variables. All variable data is sourced from a Bloomberg terminal and downloaded and stored in excel file format, while this is not a necessary facility and this data is available on other public sources, this was done

due to the ease of accessibility and to ensure the utmost data accuracy. In addition, the excel format of the files made it easier to paste into SPSS for further analysis. The criteria for these variables was that we needed to account for which variables would be most likely to suffer spillover effects as a result of ECB non-standard monetary policy and in turn which variables would allow us to best complete our research objectives to the fullest manner.

Specifically, our independent variable for this analysis is the 10-year government bond yield; the remaining variables are dependent variables. The reason for our independent variable being 10-year Government bond yields is due to the manner of the APP. Under the APP a large percentage of the securities purchased are government bonds (Source ECB: <https://www.ecb.europa.eu/mopo/implement/omt/html/index.en.html>). As such, given the volume, it is highly likely ECB bond purchases will greatly affect international bond markets, inflicting downward yield pressures from highly increased liquidity in the Eurozone bond market versus outside the EU. Musso and Gambetti (2017) state that the credit channel was likely to be relevant in relation to their analysis on the macroeconomic impact of the APP, going on to state “it is likely to operate at least in part via the increased asset prices and decreased yields induced by the asset purchases”. To reiterate, all securities purchased under the ECB APP must be issued by an entity in the EU and denominated in Euro (i.e. investors purchase the bond with euros and all principal and interest payments are in euros) (Source ECB: <https://www.ecb.europa.eu/mopo/implement/omt/html/cspp-qa.en.html>) as such Danish and Swedish Government Bonds do not meet this criteria. From a methods comparative perspective, Bond yields have also been used for the purposes of analysis by Fratzscher, Lo Duca and Straub (2014) and Beirne *et al* (2015).

Our other variables included export values, import values, gross domestic product, inflation, foreign exchange for the domestic currency of each economy and euro, Swedish and Danish capital flows, and the VIX index. We chose to include exports

and imports due to the close trade relationship that Denmark and Sweden have with the European Union. This allows us to examine whether the increased money supply because of the ECB APP leads to any spillovers, through the trade channel, onto export and import volumes, perhaps due to increased economic activity in the EU because of cheaper loans due to the interest/bank lending channel (Mishkin 1996, 2001). We chose to include GDP, or Gross Domestic Product defined as the value of goods and services produced in a year, for its propensity as an economic indicator and the ability to link it to other possible spillover channels such as imports and exports. A hypothesis may be that spillovers of ECB non-standard monetary policy, through the trade channel, onto export and import volumes should affect GDP due to the impact onto the balance of payments for the economy in question.

We chose to include inflation, defined as a general increase in prices and a fall in the purchasing value of money, as it is largely affected through investments and increases or decreases in economic activity. If the ECB were to increase or decrease purchases, the yields of Danish 10 year government bonds may deviate due to increased or decreased investor demand, this would result in changes in capital flows from euro to Danish krona or vice versa. We know that capital flows will affect the exchange rate and any large exchange rate fluctuation is likely to impact inflation. A further hypothesis is due to investors demand for Danish bonds changing, investment activity in Denmark increases or decreases and in turn affects government economic activity, which could affect inflation or at least affect inflationary pressures.

We also chose to include foreign exchange rates, defined as the value of currencies against one another, as these have proven to not only be one of the key channels for the spillovers of monetary policy (Mishkin 1996, 2001) but they are also a key factor in regard to export and import volumes, and asset prices with regards to euro area investors. Foreign exchange rates have also been observed in previous research studies including Chen *et al* 2015) and Lim, Mohapatra and Stocker (2014) and Jancokova and Georgios (2017)

We chose to include capital flows as large deviations in capital flows will likely affect FX rates, price pressures on SEK and DKK denominated assets, and thus the yields of the Swedish and Danish government bonds. Capital flows will affect the FX rates through the deviations in the volumes of purchase and sale of these currencies, which will, affects the available quantities and thus the rate at which it can be purchased and sold. An increase in price pressures on the SEK and DKK denominated assets with an increase in capital inflows will be an indication of outside investors purchasing these assets using foreign currency, the upward price pressure will drive down the yields of these assets and thus affect our dependent variable. As such, we must consider it in our research. Other examples of literature, which examine capital flows, are Lim, Mohapatra and Stocker (2014) and Chinn (2013).

We included the VIX index, or volatility index, which is a measure of the expectation of stock market volatility, as more of a control variable in order to account for any external interferences such as international politics or other high-profile events that fall outside the scope of this research. In reference to the research objectives of this study, we felt a control variable would allow us to identify anomalies and deliver the most accurate results and conclusions as possible.

4.4 Justification of the Methodology

In undertaking a statistical analysis for our research period, we chose to use monthly data values for our variables. The main rationale for this was the availability of the data, ECB APP purchase amounts, export values, import values and inflation for the economies of Denmark and Sweden were all published monthly rather than daily. Furthermore, gross domestic product is released quarterly; however, we could format this into monthly data by simply taking the quarterly release for GDP growth, dividing it by three, and placing that value in each of the following three months, which resulted in the same overall growth per quarter. As such, we took monthly values for all of our variables.

Methodologies of other studies have also been considered when constructing the methodology of this research. In terms of considering the methodologies of alternative studies, the vast majority use an event study analysis, (a methodology

whereby independent variables are solely analysed for their reactions to events) when attempting to quantify the spillover effects of either Federal Reserve or ECB nonstandard monetary policy. This is likely in the cases of some research papers due to the lack of availability of securities purchase data for the programmes that were in place during the research period.

As previously stated, the majority of studies which undertaken an analysis on the spillover effects of non-standard monetary policy use an event study analysis. Examples of pieces of research, which undertake this method, are Tirpaq, McQuade and Falagiardia (2015), Nelly (2010) and Jensen, Spange & Mikkelsen (2017). An event study is a methodology whereby independent variables are solely analysed for their reactions to events over the research period. The basic objective is to identify any abnormal statistical anomalies on the research variables, which are attributable to the occurrence of the event(s).

One of the main limitations to this methodology is that findings are based on either one, or multiple, points in time over the research period versus a constant statistical analysis over the entire research period. If an ECB non-standard monetary policy announcement is made in the beginning of the year and bond yields fall as a result, but by the middle of the year the euro has depreciated, and inflation imports have decreased, not all the policy implications are considered. Furthermore, the event study methodology assumes that observed impacts are permanent; it also does not consider the economic conditions of the observed economy at the time. An events impact could deviate from a negative impact to a positive impact based on the economic conditions of the economy it affects at the times. This research seeks to complete a constant statistical analysis over the entire research period, considering the correlation between our variables and how ECB non-standard monetary policy measures have an impact over an extended period of time rather than from an event point of view.

The second main issue with using an event case study analysis is due to market over reaction to significant news or policy announcements. Thaler and De Bondt (1985) discuss how the stock market overreacted to news and policy announcements and concluded "Research in experimental psychology has suggested that, in violation of

Bayes' rule, most people "overreact" to unexpected and dramatic news events". Furthermore, Yilmaz (2016) was quoted in the International Journal of Economics, Commerce and Management, concluding, "The findings in literature present a challenge to market efficiency since investors who apply contrarian and relative strength strategies may take advantage of documented overreaction and under-reaction without bearing extra risk". This over reaction policy is likely to affect the results of announcement and event based methodologies whereby the conclusions are generated based on event reactions from the research variables. If the variables are subject to market over reactions, then the research results are potentially inaccurate in depicting the real effects of spillovers from non-standard monetary policy.

Another common methodology in examining the spillover effects of non-standard monetary policy is to use a VAR analysis. Examples of pieces of research that undertake this method are Moder (2017), Lusso & Gambetti (2017) and Brockmeijer & Bayoumi (2013). A VAR model, or value at risk model, represents the theoretical maximum loss, which can occur given the model inputs at a specific point in time. It is based purely on the inputs the model and does not take into account external non-numerical variables which may occur, such as political or social events, in the calculations. VAR models can be highly useful for risk metrics and forecasting but present a number of limitations, which must be considered.

The limitations, as discussed by Bjornland (2002) on the use of VAR in macroeconomic analysis, were that due to the limited number of variables and the nature of the shocks in macroeconomic analysis that a VAR model should be used as an estimate measure to a larger structural system. In conclusion, the large number of impacts, which could occur on the variables inputted into the VAR model, make it difficult to interpret the significance of the findings of such a macro-sighted model when the results are trying to be specific in their conclusions. Further limitations of the VAR model are also discussed by Krause (2003) in which he concluded "that under certain circumstances VAR does not give an appropriate risk measure, its

estimation is subject to large estimation errors, and a downward bias in the estimation can easily be exploited”.

4.5 Research Limitations

It is acknowledged that a potential limitation to this study is the fact that these two economies are closely linked to the EU through a number of channels, which may lead to excessive spillovers being observed because of the closer relationship rather than if the relationship was less developed. Another limitation in this study is the timeline of the quantitative easing measures implemented in the form of interest rate actions by Denmark and Sweden. Denmark moved its deposit interest rate twice within our research period, 0.05 % to -0.2% in January of 2015 and then 0.2% to -0.75% in February of 2015. While Sweden moved its rates into negative territory outside of the research period in 2014, they made three interest rate adjustments within our research period, from -0.85% to -1.00% in March of 2015, -1.00% to -1.10% in July of 2015 and -1.10% to -1.25% in February 2016. While these events fall outside of the scope of this research, we acknowledge them as a limitation and their potential to affect the results and conclusions of this research. However, we also acknowledge the potential for future research in this limitation and how these interest rate changes affected EU area, Danish and Swedish Government bond yields.

Another reason for the research period was also due to a limitation, due to data publications and the access to the monthly purchases of prior purchase programmes, some of which were not publicly available. These included programmes such as the SMP, the securities market programme which ran from 2010 to 2012, or other smaller programmes such as the first and second covered bond purchase programme (CBPP1 (2009-2010) and CBPP2 (2011-2012)). As such, this can be identified as one of the shortcomings and the limitations to this methodology, and research, in that the research period is limited by the publication of the monthly APP purchases. These data limitations do hinder the potential for further research in the period before January 2015.

Further limitations and shortcomings included the different periods that data was released, such as the inflation data that was released monthly while the GDP was released quarterly; meanwhile some of our variables were in daily values. In order to ensure data accuracy and to produce the most accurate results possible, all data was converted into monthly format due to the fact most came in monthly format and due to availability issues.

4.6 Statistical Methodology

In this section, we will outline the statistical methodology that will be undertaken in the research.

A linear regression analysis will firstly be undertaken, defined as a statistical process to determine if statistically significant relationships exist amongst variables (Statistics How To, 2018), to determine the significance of the relationship between our dependent variable, 10 year government bond yields, and our independent variables: monthly ECB APP purchase amounts, export values, import values, gross domestic product, inflation, foreign exchange for the domestic currency of each economy, capital flows, and euro and the Volatility Index. This will allow a greater understanding of which among the independent variables are most related to the dependent variable, furthermore and in conjunction with other statistical results; our regression analysis will allow for to infer causal relationships between the independent and dependent variables where applicable.

In addition to our standard regression analysis, a stepwise regression analysis will also be undertaken giving further insight into the relationship between our dependent variable and our independent variables. A stepwise regression will analyse the significance of the relationship between our dependent variable and our independent variables over the research period and will remove any independent variables it deems insignificant under certain criteria and will return an r-squared value based solely on the variables deemed significant. This will allow for further analysis and information and will allow for to infer causal relationships between the independent and dependent variables where applicable.

A correlation matrix analysing the correlation, a statistical measure used to determine the strength and direction of the relationship between two variables, will also be undertaken. In addition, with other statistical results, correlation values will assist in determining whether a significant relationship exists between our dependent variable, 10-year government bond yields, and our independent variables monthly ECB APP purchase amounts, export values, import values, gross domestic product, inflation, foreign exchange for the domestic currency of each economy, capital flows, and euro and the Volatility Index. However, it is important to note that these correlation values are not direct impacts of one variable on another but rather just statistical measures of the strength and direction of the relationship and do not imply cause and effect. To examine the direct effects of each statistically significant independent variable, i.e. the p-value or significance value falls within the bounds of normality under a t-test, on our dependent variable; we will use beta-coefficients, which show the degree of change in our dependent variable for every one-unit change in the respective independent variable. We can then determine the level of effect that each specific independent variable has had on our dependent variable. For clarity, the unstandardised coefficient will be utilised in the results rather than the standardised coefficient due to the fact that the unstandardised coefficient value looks at our variables in their original format while standardised coefficient examines the variables in a normalised format which leads to a different result value.

A Durbin-Watson value will also be considered in our statistical analysis of our time series data. A Durbin Watson value is used to determine whether autocorrelation or serial correlation, defined as a mathematical representation of the degree of similarity between a given time series and a lagged version of itself over successive time intervals, exists in our time series sample data. A positive indicator for autocorrelation implies that the correlation between the values of our variables is based on related objects and infers that our variables are not independent of one another. However, for the purposes of this research, whilst we will be acknowledging the Durbin Watson value in our analysis, no attempts will be made in the event of a positive indication to rectify signs of autocorrelation. This is due the fact that the Durbin Watson measure does not consider the matrixes, the explanatory variables for our values, of the regression variables in our time-series data. Therefore, whilst

we acknowledge this statistic, due to this flaw we will be solely considering it and not attempting to change its output value.

The function for our analysis is as follows. The model assumes that changes in the dependent variables are functions of changes in the independent variables. Therefore, this model assumes that changes in the yields of Danish and Swedish government bonds are a function of changes in ECB originated non-standard monetary policy which include monthly asset purchases, FX rates, exports, imports, inflation, capital flows, VIX Index, GDP growth and the control variable, which takes place over time t . We are hypothesising that the increases in ECB purchases did in fact effect, through spillovers, the yields of Danish and Swedish 10-year government bond yields.

4.7 Formula Model

$$\Delta Y(d) \text{ and } \Delta Y(s) = Fn(\Delta NSMP_{ ECB} + \Delta FX + \Delta Exports + \Delta Imports + \Delta Inf + \Delta CapFlows + \Delta VIX + \Delta GDP + \lambda Newst).$$

4.8 Model Key

$\Delta Y(d)$	Changes in Danish 10-Year Government Bond Yields
$\Delta Y(s)$	Changes in Swedish 10-Year Government Bond Yields
Fn	Function
$\Delta NSMP_{ ECB}$	Changes in the Non-standard Monetary Policy of the ECB
ΔFX	Changes in Foreign Exchange Rates
$\Delta Exports$	Changes in Exports
$\Delta Imports$	Changes in Imports
ΔInf	Changes in Inflation
$\Delta CapFlows$	Changes in Capital Flows
ΔVIX	Changes in the Volatility Index
ΔGDP	Changes in Gross Domestic Product
$\lambda Newst$	Dummy Control Variable

Chapter 5: Results

In this section, we will analyse the results of the research, in doing so we seek to give an in depth analysis of our findings and to synthesise the data collected. We will first examine correlation values between Government Bond Yields and the respective independent variables for both Denmark and Sweden, followed by analysis of the regression and coefficient values. We will also acknowledge any relevant limitations and implications of the study. While we will interpret our descriptive statistics, graphs will also be inputted to demonstrate the trends over the period. The graphs also serve as an alternative perspective when analysing the descriptive statistics.

Further to the downward yield pressures, the results also displayed both a positive correlation and beta between yields and exchange rates and a negative correlation and beta between ECB Purchases and exchange rates. This is also in line with expectations as bond yields and FX rates tend to move in the same direction.

Furthermore, whilst we acknowledge the Durbin-Watson correlation in these results, we note that the Durbin-Watson calculation does not take into account the matrixes of the regression variables in our time-series data. As such, whilst we acknowledge the Durbin-Watson value, and in some cases the positive indication of autocorrelation in the time-series data, due to the nature of our data we will not be attempting to address this measure.

5.1 Section One: Correlations and Observations

5.11 Denmark

Beginning with Denmark, we will examine our correlation matrix with relevant graphs, identifying all significant points in relation to this research.

Table 1.0: Denmark Correlation Coefficient

		Correlations									
		DanishYields	EURDKK	Exports	Imports	Inflation	GDP	CapitalFlows	VIX	Purchases	Dummy
Pearson Correlation	DanishYields	1.000	-0.119	-0.138	0.085	0.277	0.245	0.119	0.085	-0.229	-0.384
	EURDKK	-0.119	1.000	-0.158	-0.105	-0.265	0.079	-0.618	0.627	-0.402	-0.220
Sig. (1-tailed)	DanishYields		0.229	0.195	0.299	0.040	0.061	0.229	0.299	0.075	0.007
	EURDKK	0.229		0.162	0.256	0.047	0.311	0.000	0.000	0.005	0.083

Fig 1.1: Denmark 10-Year Govt. Bond Yields vs ECB Purchases Jan 2015 to May 2018

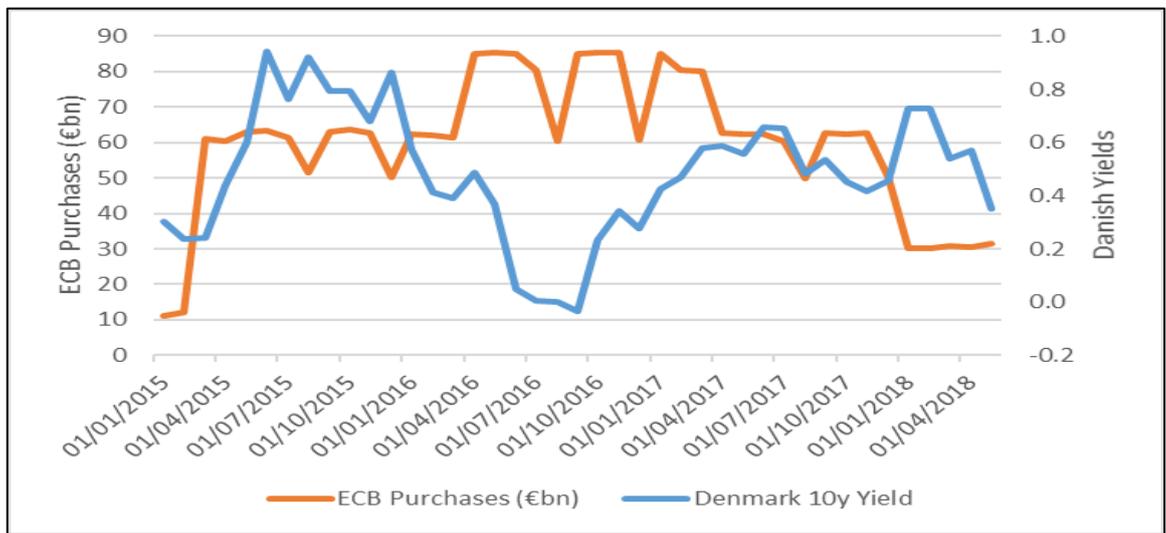
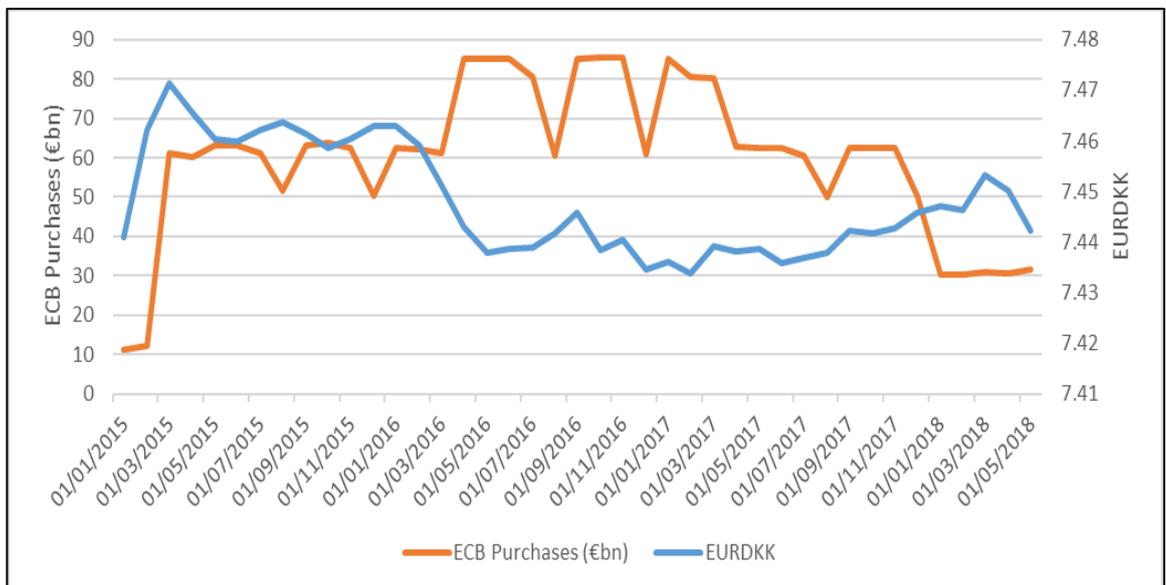


Fig 1.2: ECB Purchases vs EURDKK Exchange Rate January 2015 to May 2018



We note a weak to moderate Pearson correlation between ECB Purchases and Danish 10 Year government bond yields of -0.229 (P-value = 0.075) which was slightly weaker than expected, there is further evidence of this negative correlation in our graph titled “Yields vs ECB Purchases”, where we can observe a severe negative movement in the November 2015 to late 2017 period. From this graphical depiction, the degree of the negative correlation appears stronger than is produced in the descriptive table especially the November 2015 to September 2016 period where the variables move in contrast to one another. We also note a moderate to strong negative Pearson correlation between ECB Purchases and the EURDKK exchange rate of -0.402 (P-value = 0.005) which was also as expected. This was expected as when ECB purchases increase, the value of the euro will decrease, thus decreasing the value of EURDKK.

There is further evidence of this correlation in our graph titled “ECB Purchases vs EURDKK”. Purchases and EURDKK track away from one another in the early 2016 to early 2017 period, following this EURDKK then begins to appreciate around March 2017 as ECB purchases reduce. This is interesting as the values for both the Danish 10 year Government Bond Yields and EURDKK seem to bottom out and begin to track upwards in and around the same period of late 2016/early 2017, however we note that the bond yields depreciated in a much greater manner.

5.12 Sweden

We will now examine the correlations for Sweden and examine our correlation matrix with relevant graphs, identifying all significant points in relation to this research.

Table 2.0: Sweden Correlation Coefficient

		Correlations									
		SwedishYields	EURSEK	Inflation	VIX	ECBPurchases	Dummy	GDP	Flows	Imports	Exports
Pearson Correlation	SwedishYields	1.000	-0.004	0.027	0.082	-0.434	-0.201	0.044	0.038	0.252	0.317
	EURSEK	-0.004	1.000	-0.233	0.628	-0.399	-0.206	0.014	0.026	-0.291	-0.237
Sig. (1-tailed)	SwedishYields		0.491	0.435	0.304	0.002	0.104	0.391	0.407	0.056	0.022
	EURSEK	0.491		0.071	0.000	0.005	0.098	0.465	0.436	0.033	0.068

Fig 2.1: Sweden 10-Year Govt. Bond Yields vs ECB Purchases Jan 2015 to May 2018

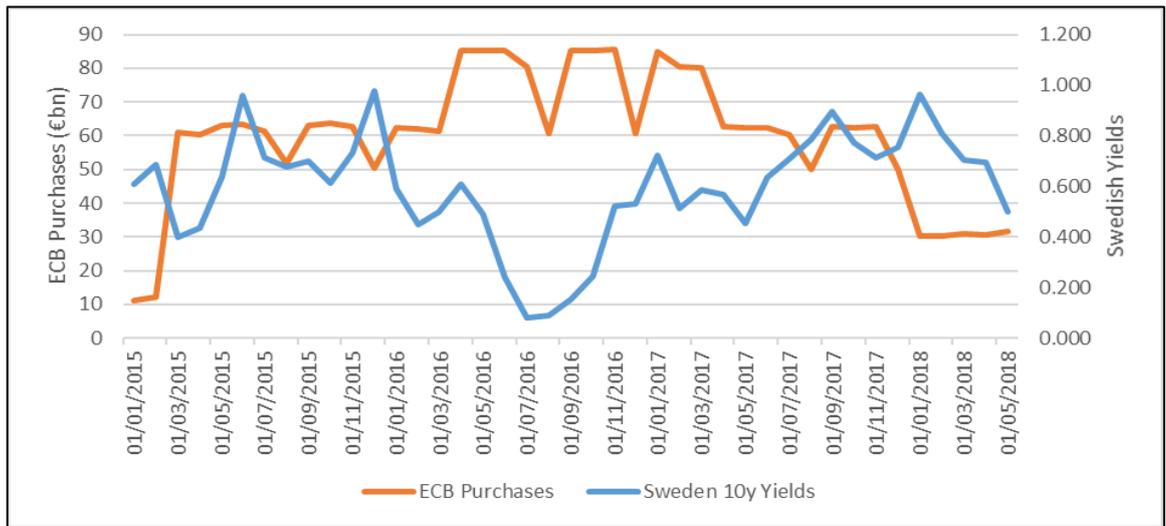
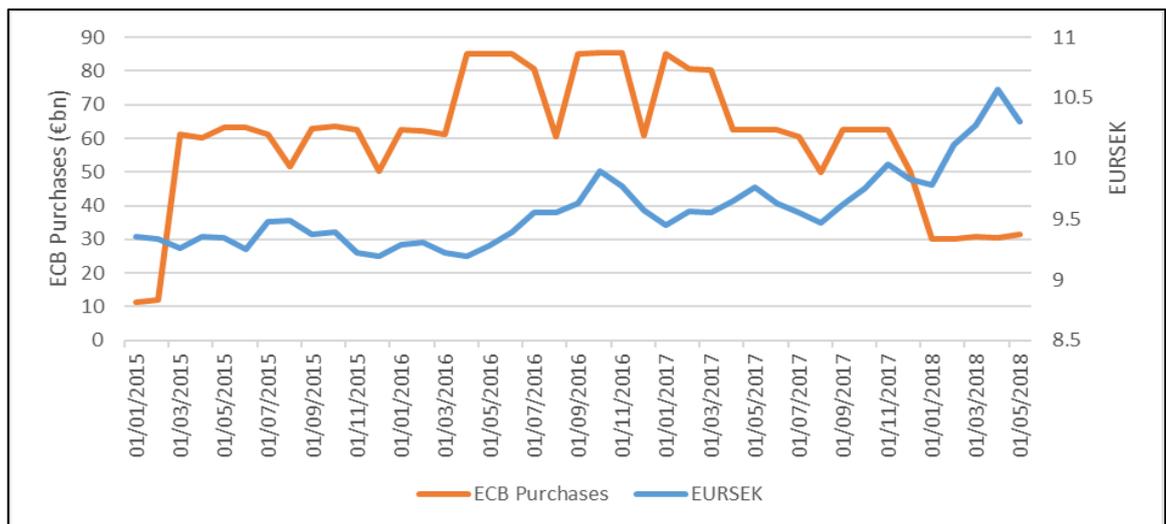


Fig 2.2: ECB Purchases vs EURSEK Exchange Rate January 2015 to May 2018



We note a moderate to strong Pearson correlation between ECB Purchases and Swedish 10 Year government bond yields of -0.434 (P-value = 0.002) which was as expected, there is further evidence of this negative correlation in our graph titled “Swedish Yields vs ECB Purchases”, where we can observe a severe negative movement in the November 2015 to late 2016 period. We note that this is the same period which Danish yields behaved in a similar manner. From this graphical depiction, the degree of the negative correlation appears in line with what is depicted in the descriptive table with a moderate to strong negative correlation. We

also note a moderate correlation between ECB Purchases and the EURSEK exchange rate of -0.399 (P-value = 0.005), which was in line with expectation. This was expected as ECB purchases increase will decrease the value of the Euro, this decreasing the value of EURSEK. There is further evidence of this negative correlation in our graph titled “EURSEK vs ECB Purchases”.

Interestingly, the yields for both Denmark and Sweden seem to behave in a very similar manner in the research period, tracking downwards until late 2016 and then beginning an upward trajectory until early 2017 in line with the future decrease in ECB Purchases. At this point, Danish yields seem to flatten out to a greater degree than Swedish yields, however, from January 2018 until the end of the research period they seem to behave once again in a similar manner.

5.2 Section Two: Regression, Coefficient and Significance Analysis.

5.21 Denmark

It was observed that our (Danish) independent variables, Imports, Exports, GDP and Capital Flows data, were not deemed statistically significant in relation to their effect on the dependent variable. While a full regression and co-efficient matrix detailing all results will be available in the appendices (see “Item No. 1” in appendices) for the purposes of the results section we will examine the results using our ECB Purchases, Inflation, EURDKK, VIX Index and our dummy variable as our independent variables. This was not in line with our original hypothesis or previous literature; previous literature had found significance using capital flows data and the trade channel. Due to the open nature of Denmark’s economy, it was hypothesised that spillovers would occur through the trade channel. However, no significance was observed

Our standard regression analysis displays the dependence of our dependent variable on our independent variables. The r-square value 0.381 indicates a weak regression model and was not in line with expectations. This value, as with our correlation values for Denmark, are lower than hypothesised.

Table 3.0: Denmark Regression Model Summary

Model Summary ^b										
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
1	.617 ^a	0.381	0.292	0.204262	0.381	4.302	5	35	0.004	0.839

a. Predictors: (Constant), Dummy, VIX, Inflation, Purchases, EURDKK
b. Dependent Variable: DanishYields

Table 3.1: Denmark Regression Model Coefficient Matrix

Coefficients ^a								
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
	(Constant)	0.660	0.137		4.837	0.000	0.383	0.938
	EURDKK	-0.071	0.039	-0.338	-1.791	0.082	-0.151	0.009
	Inflation	0.191	0.081	0.347	2.347	0.025	0.026	0.356
	VIX	0.010	0.008	0.217	1.269	0.213	-0.006	0.026
	Purchases	-0.002	0.002	-0.166	-1.090	0.283	-0.006	0.002
	Dummy	-0.247	0.074	-0.489	-3.364	0.002	-0.396	-0.098

a. Dependent Variable: DanishYields

EURDKK coefficient values are in line with expectations, a negative unstandardised beta of -0.071 (p-value = 0.082) states that on average across the research period, a one percent increase in EURDKK results in a decrease in the Danish 10-year government bond yield of 7.1bp. This is in line with expectation as the bond yields and currency of a country are positively correlated, as such when Danish 10-year government bond yields fall, the value of the Danish Krona against other currencies also decreases. Therefore, this will cause a rise in the value of EURDKK as the amount of Danish Krona received per euro increases. Due to the very flat nature of Danish Krona over the research period, there has been a negligible impact on Danish 10-year government bond yields with an implied decrease of only 3.6 basis points over the research period because of the changes in the value of Danish Krona.

The impact of purchases, in line with previous correlation values is small with a negative unstandardised beta of -0.002 (p-value = 0.283) however, we note that the beta value is negative which is in line with expectations. This beta value indicates that on average across the research period an increase of one billion in purchases results in a decrease of 0.2 basis points in Danish 10-year government bonds. This would imply that Danish 10-year government bond yields decreased by 17 basis points over the research period because of ECB asset-purchases.

Our dummy variable beta value of -0.247 (p-value = 0.002) is also in line with expectations having a large impact on Danish 10-year government bond yields implying a decrease of 247 basis points over the research period. As previously stated this dummy variable accounts for the lowering of interest rates in the euro area, the main refinancing option from 0.05% to 0% and the Deposit Facility from -0.30 to -0.40 basis points. The negative value is in line with expectations as we anticipate these rates changes to increase upward price pressure on DKK denominated securities, thus decreasing yields.

Examining the stepwise regression, the results display similar findings. The r-square value of 0.125 regressing against just the dummy variable and 0.316 regressing against the dummy variable and inflation again indicates a weak regression model. We also note that the stepwise regression has dropped both ECB Purchases, EURDKK and VIX as independent variables due to the fact they are not deemed significant. This would imply that from a regression perspective, these variables have little impact on Danish 10-year government bond yields.

Table 3.2: Denmark Stepwise Regression Model Summary

Model Summary ^c										
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
1	.384 ^a	0.147	0.125	0.227062	0.147	6.731	1	39	0.013	
2	.562 ^b	0.316	0.280	0.205963	0.169	9.400	1	38	0.004	0.715

a. Predictors: (Constant), Dummy
b. Predictors: (Constant), Dummy, Inflation
c. Dependent Variable: DanishYields

Table 3.3: Denmark Stepwise Regression Model Coefficient

Coefficients ^a										
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B		Collinearity Statistics	
		B	Std. Error	Beta			Lower Bound	Upper Bound	Tolerance	VIF
1	(Constant)	0.613	0.061		10.098	0.000	0.490	0.736		
	Dummy	-0.194	0.075	-0.384	-2.594	0.013	-0.345	-0.043	1.000	1.000
2	(Constant)	0.506	0.065		7.770	0.000	0.374	0.638		
	Dummy	-0.259	0.071	-0.513	-3.649	0.001	-0.403	-0.115	0.910	1.099
	Inflation	0.237	0.077	0.431	3.066	0.004	0.081	0.394	0.910	1.099

a. Dependent Variable: DanishYields

The Dummy Variable are deemed as statistically significant which was in line with our original hypothesis. We observe unstandardised beta values of -0.194 (p-value = 0.013) or -0.259 (p-value = 0.001) for our dummy variable depending on the model;

this would infer that this variable is having a large impact on Danish 10-year government bond yields implying a decrease of 194 or 259 basis points over the research period based on a stepwise regression model.

Inflation being deemed as statistically significant which was not in line with our original hypothesis. We observe unstandardised beta values of +0.237 (p-value = 0.004); this would infer that this variable is having a large impact on Danish 10-year government bond yields implying an increase of 237 basis points over the research period based on a stepwise regression model.

5.22 Sweden

It was also observed that our (Swedish) independent variables, Imports, Exports, GDP and Capital Flows data, were not deemed statistically significant in relation to their effect on the dependent variable. As such, while a full regression and coefficient matrix detailing all results will be available in the appendices (see “Item No. 2” in appendices, for the purposes of the results section, we will examine the results using our ECB Purchases, Inflation, EURSEK, VIX Index and our dummy variable as our independent variables. This was not in line with our original hypothesis, as previous literature had found significance using capital flows data and the trade channel. Again, similar to Denmark, due to the open nature of Sweden’s economy, it was hypothesised that spillovers would occur through the trade channel. However, no significance was observed.

Our standard regression analysis displays the dependence of our dependent variable on our independent variables. The r-square value 0.303 indicates a weak regression model, which is lower than original hypothesised.

Table 4.0: Sweden Regression Model Summary

Model Summary ^a										
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
1	.550 ^a	0.303	0.203	0.19411	0.303	3.040	5	35	0.022	1.083
a. Predictors: (Constant), Dummy, VIX, ECBPurchases, EURSEK, Inflation										
b. Dependent Variable: SwedishYields										

Table 4.1: Sweden Regression Model Coefficient Matrix

Model		Coefficients ^a								
		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B		Collinearity Statistics	
		B	Std. Error	Beta			Lower Bound	Upper Bound	Tolerance	VIF
1	(Constant)	0.878	0.127		6.938	0.000	0.621	1.135		
	EURSEK	-0.034	0.029	-0.230	-1.166	0.252	-0.094	0.025	0.513	1.948
	Inflation	0.143	0.088	0.525	1.627	0.113	-0.035	0.321	0.191	5.229
	VIX	0.005	0.008	0.128	0.705	0.486	-0.010	0.021	0.605	1.653
	ECBPurchases	-0.004	0.002	-0.364	-2.074	0.046	-0.008	0.000	0.648	1.543
	Dummy	-0.270	0.147	-0.597	-1.834	0.075	-0.569	0.029	0.188	5.313

a. Dependent Variable: SwedishYields

EURSEK coefficient values are in line with expectations, a negative unstandardised beta indicating that a fall in the yields of Swedish 10 year government bonds will result in an increase in EURSEK. Our unstandardised beta of -0.034 states that on average across the research period, a one percent increase in EURSEK results in the Swedish 10-year government bond yield decreasing by 3.4 basis points. However, we also note the lack of statistical significance of this observation. Our beta value is in line with expectation as the bond yields and currency of a country are generally positively correlated, as such when Swedish 10-year government bond yields fall, the value of the Swedish Krona also falls. Therefore, this will cause a rise in the value of EURSEK as the amount of Swedish Krona received per euro increases. As such, because EURSEK appreciated 10.1% over the research period, this would infer that Swedish 10-year government bond yields fell 34.3 basis points over the research period because of FX rates.

The impact of purchases, in line with previous correlation values is small with a negative unstandardised beta of -0.004 (p-value = 0.046), we note that the beta value is negative which is in line with expectations. This beta value indicates that on average across the research period an increase of one billion in purchases results in a decrease of 0.4 basis points in Swedish 10-year government bonds. This would imply that Swedish 10-year government bond yields decreased by 29 basis points over the research period because of ECB asset-purchases.

Our dummy variable negative unstandardised beta value of -0.270 (p-value = 0.075) is also in line with expectations, implying a decrease of 270 basis points over the

research period. As previously stated this dummy variable accounts for the lowering of interest rates in the euro area, the main refinancing option from 0.05% to 0% and the Deposit Facility from -0.30 to -0.40 basis points. The negative value is in line with expectations as we anticipate these rates changes to increase upward price pressure on SEK denominated securities, thus decreasing yields.

Examining the stepwise regression, the results display similar findings. The r-square value of 0.188 regressing against just ECB purchases indicates a weak regression model. We also note that the stepwise regression has dropped EURSEK, VIX, Inflation and our Dummy variable as independent variables due to the fact they are not deemed significant. This would imply that from a regression perspective, these variables have little impact on Swedish 10-year government bond yields. However, in comparison to Denmark, this implies that ECB Purchases did in fact have a significant impact on Swedish 10-year government bond yields with a negative unstandardised beta value of -0.005 (p-value = 0.005

Table 4.2: Sweden Stepwise Regression Model Summary

Model Summary ^b										
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
1	.434 ^a	0.188	0.168	0.19840	0.188	9.055	1	39	0.005	0.699

a. Predictors: (Constant), ECBPurchases
b. Dependent Variable: SwedishYields

Table 4.3: Sweden Stepwise Regression Model Coefficient Matrix

Coefficients ^a								
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	0.886	0.102		8.731	0.000		
	ECBPurchases	-0.005	0.002	-0.434	-3.009	0.005	1.000	1.000

a. Dependent Variable: SwedishYields

Chapter 6: Discussion Section

6.1 Introduction

In this section, the discussion will be undertaken. The purpose of this section is to discuss and analyse the findings of this research considering the conclusions of previous research, highlighting any similarities and differences. The practical implications for stakeholders will also be discussed in reference to any new and interesting findings and the potential for future research in light of the limitations and findings of this research will be discussed.

6.2 The Results & the Current Literature

The results of this research were very interesting, with our two sample countries different reactions to the spillover effects from the ECB asset purchase programme. While spillover effects were observed on both countries, the ways in which they occurred differed which would mean that the internal situation and economic characteristics of the individual countries do have a role to play in whether spillover effects will occur.

One of the interesting results was the lack of significance of the trade channel with regards to spillovers, which was not in line with our hypothesis of spillover effects being observed through this channel, the strong trade relationship between the EU and Denmark and Sweden would have led to the assumption that spillover would be observed through this channel. However, there was no evidence statistically of spillovers occurring for either Denmark or Sweden, which is in contrast to other literature such as Moder (2017). A difficult phenomenon to explain, as it would infer that in contrast to the conclusions in Moder (2017) that the economies of Denmark and Sweden are less vulnerable to shocks through the trade channel and that certain economies trade will not be impacted by monetary policy shocks while others will be impacted? While a potential limitation regarding an explanation, considering this limitation presents a possible motive for future research concerning the vulnerability of certain countries trade infrastructure from by monetary policy shocks.

Secondly, another interesting finding was the lack of statistical significance with regards to capital flows on Swedish and Danish Bond yields with our results showing a weak correlation and beta coefficient value. While it was hypothesised that capital flows would affect the results, the findings were also deemed not statistically significant. This is in contrast to previous literature including Lim Mohapatra and Stocker M. (2014) who concluded that the quantitative easing was responsible for a large portion of the change in flows to developing economies. It was hypothesised that deviations in Swedish and Danish capital flows would affect the level of purchases of Danish assets, thus potentially affecting the demand and thus yields and pricing, of the 10-year government bonds of each country.

Furthermore, we consider that in regards to the hypothesis previously considered regarding the reactions of developing vs developed countries that the economies of Denmark and Sweden reacted in both similar and different manners. Our results were in contrast to Moder (2017) who acknowledged significant spillover effects through the trade channel while our results deemed the trade channel not statistically significant; inferring that developed economies may be less vulnerable to monetary shocks through this channel. However, Tirpak, McQuade and Falagiarda (2015) concluded that, for a number of developing economies considered in the research, yields declined in anticipation of ECP purchase programmes. This would infer that the bond yields of both developed and developing countries are equally vulnerable to non-standard monetary policy spillovers. This is also a potential topic for future research.

In line with previous literature, and expectations, spillover effects from the ECB asset purchase programme were observed on both the economies of Denmark and Sweden. There was downward pressure placed on the 10-year Government Bond Yields of both Denmark and Sweden with a reduction across the research period due to ECB purchases of 17 basis points and 29 basis points respectively. The downward pressure on yields because of ECB purchases is in line with our original hypothesis and previous literature including Tirpak, McQuade and Falgardia (2015), De Santis (2016) and the one piece of literature which also focuses on Denmark and Sweden Jensen, Spange and Mikkelsen (2017). An interesting observation however is that

Swedish 10-year Government Bond Yields declined further than Danish 10-year Government Bond Yields as a result of ECB purchases. This could be due to the fact that Sweden's financial services infrastructure is larger than Denmark's which was described as a key factor when discussed by Eichengreen and Gupta (2014). Furthermore, it may also be as a result of Denmark's much more stable exchange rate due to the fact it is pegged to the euro while the Swedish Krona is not pegged. This would infer that the yields of a country with a floating exchange rate are more vulnerable to spillovers than those with a pegged exchange rate, however, one limitation is that there is no literature to suggest that floating exchange rates leave countries more vulnerable to monetary policy shocks than those with a pegged currency. In light of this limitation lies a possible direction for future research. Furthermore, to the above, we note that the spillover effects on 10-year Government Bond Yields are deemed statistically significant on Sweden, but statistically not significant on Denmark.

Other significant spillover effects were observed on the 10-year Government Bond Yields of Denmark and Sweden through the FX channel. Deemed statistically significant, while small, Danish 10-year government bond yields decreased by 3.6 basis points over the research period because of the changes in the value of exchange rates between the Euro and Danish Krona. This was in line with our original hypothesis as due to the peg to the euro the deviations in the value of the Krona against the euro are minimised over the research period. However, what was also interesting in conjunction with this observation was the effect of ECB purchases on the value of EURDKK, and it was concluded that, if it were not for the peg, for every 1 billion increase in purchases by the ECB, EURDKK declines by 2.4 basis points. This was also deemed statistically significant at 95% confidence level. This was also in line with our original hypothesis and in agreement with previous literature including Nelly (2012) who concluded that the dollar depreciated upon the large-scale asset purchase programme undertaken by the Federal Reserve. This infers that while the impact from yields was from the deviations in the values of the exchange rates, the deviations in value in the exchange rates were caused by ECB purchases.

6.3 Sweden

In regard to Sweden, spillovers onto 10-year Government Bond Yields were also observed with the results inferring that Danish 10-year government bond yields decreased by 34.3 basis points over the research period because of the changes in the value of Swedish Krona against the euro. However, we should note that this observation was deemed not statistically significant. The larger impact of exchange rates in comparison to Denmark was in line with expectations due to the peg of Danish Krona to the euro. In comparison the deviations in the exchange rate between the euro and Swedish krona are larger. However, in conjunction with Denmark, the effect of ECB purchases on the value of EURSEK was also deemed significant. The impact of ECB purchases on the value of EURSEK was also deemed significant with the results inferring that for every one billion euro increase in monthly ECB purchases, that the value of EURSEK would decline by 3.0 basis points. Again, in line with the literature, this shows that the effects were much the same as observed on Denmark, inferring that while the impact from yields was from the deviations in the values of the exchange rates, the deviations in value in the exchange rates were caused by ECB purchases.

6.4 Denmark

In summary, with regards to Denmark, spillovers from ECB purchases were observed on the yields of their 10-year government bonds. However, while the graphical depictions, beta and correlation values were in line with expectations these were not statistically significant. Spillovers were also observed through on yields, indirectly, through the FX channel. The results demonstrated that the changes in ECB purchases had an impact on EURDKK, and that the changes in values of EURDKK had an impact on the yields of Danish 10-year government bonds. Both of these results were deemed statistically significant. In regard to Sweden, spillovers from ECB purchases were also observed on the yields of their 10-year government bonds, with the observation being deemed statistically significant. However, in regard to the indirect spillovers of the FX channel, the impact of the changes in EURSEK on the 10-year Swedish government bond yields was not deemed statistically significant. However, the impact of ECB purchases on EURSEK was deemed significant. These

results are in line with the current limited literature, Jensen, Spange and Mikkelsen (2017), who observed decreases in the yields of both Denmark and Sweden as a result of ECB purchase programmes.

6.5 Implications for Stakeholders and the Potential for Future Research

While the specifics of the spillover effects for both Denmark and Sweden differ, the implications must still be acknowledged. ECB purchases had direct impacts on both the currencies and the bond yields of Denmark and Sweden whether through directly or indirectly through the FX channel. These unintended consequences must be considered by policymakers when invoking monetary actions, and how unintended effects could potentially in extreme circumstances cause economic stability issues. The differences in the results between the two countries also raises the potential for future research, the spillovers on the yields of Danish 10-year government bonds are deemed not statistically significant, while the spillovers on the yields of Swedish 10-year government bonds are deemed significant. Furthermore, the effects of exchange rates on yield is deemed significant for Denmark but not significant for Sweden. This anomaly infers that Danish bonds are less vulnerable to exchange rate fluctuations than Swedish Bonds. Both of these observations are a potential route for future research.

One observation that was deemed significant for both Denmark and Sweden was the effects of ECB purchases on the exchange rates of their domestic currencies with the euro. Both EURDKK and EURSEK were deemed to have a negative relationship with increases in ECB purchases and both were deemed to be statistically significant. As such, the impact of ECB purchases on the exchange rates with other countries is also another case for potential future research. See “Item No. 4” in appendices.

6.6 Discussion Conclusion

In conclusion, the results we observed were both in line with our original hypothesis and also not in line with our original hypothesis, while spillover effects were observed, spillover effects through the trade channel which were expected were not observed. Furthermore, while spillover effects were observed on both countries, the potential for future research was highlighted through the limitations of this research

with an explanation of some of the anomalies of the results being outside the scope of this research paper. Spillovers from ECB purchases were observed both directly, through their impact on yields and also through their impact on the exchange rates of both Denmark and Sweden, which was in line with expectations and previous research.

Chapter 7: Conclusion

This paper examines the spillover effects of European Central Bank non-standard monetary policy, in the form of the asset purchase programme, on the economies of Sweden between January 2015 and May 2018. This paper is one of the first to examine the spillover effects of these measures on the economies of Denmark and Sweden, and to use a pure statistical analysis methodology rather than an event study or a VAR analysis study.

Spillovers were identified and the channels of transmission were also identified through the statistical analysis undertaken. The research objectives of this paper were firstly to determine whether any spillovers occurred on our variables from the European Central Bank Asset Purchase Programme, secondly, to relate the “channels” of transmission discussed in the literature to real world economics through identifying which channels spillovers occurred through and finally, to contribute to the base of academic literature that examines the spillover effects of non-standard monetary policy, growing the current knowledge base.

Our results showed that the bond yields of both Denmark and Sweden were impacted in a similar manner by the asset purchase programme undertaken by the ECB. However, we note that the yields of Sweden were impacted to a greater degree than those of Denmark over the research period. Our results also showed that spillover effects occurred on the respective exchange rates. These observations are in line with the expected results; however, the fact that no spillovers were detected through the trade channel was not in line with expectations or previous literature. We observed that spillovers from the European Central Bank asset purchase programme occurred both directly on Danish and Swedish yields, but also indirectly through the spillover effects of the European Central Bank asset purchase programme on exchange rates, which in turn then applied further downward pressure on yields.

Regarding the channels of transmission, the channels, we observed statistically significant spillovers through the asset-price channel; upward price pressure leading to decreases in yields, for Sweden, however, this channel was not statistically

significant for Denmark. Meanwhile, while it was concluded that the exchange rate of both Denmark and Sweden were impacted by the ECB asset purchase programme, statistically significant spillover effects, which affected yields, were observed occurring through the foreign exchange channel for Denmark, however, this channel was not deemed significant for Sweden. The differences in the channels through which the spillovers occur was not expected or in line with expectations.

The conclusions we can draw from this research is that not all countries will react in a similar manner from exterior non-standard monetary policy and the spillovers that can occur will vary between countries. It also demonstrates that while these economies are developed with developed trade and financial industries, that they are still vulnerable to spillover effects of economic policy. This research is important as it infers that the internal economic conditions and attributes of individual economies will affect how vulnerable they are to external spillovers, while our economies that are chosen are indeed different in certain mannerisms, it is also likely that some form of qualitative economic factors, not considered in the model, affected the results. Furthermore, this research is important, as it will allow policy makers to predict and model the spillover effects of European Central Bank non-standard monetary policy, in the form of the asset purchase programme when the measures are reversed.

The potential for future research is therefore clear, a comparative of these results with the results of other developed economies, perhaps on euro economies that are equally economically developed, would be paramount in determining why the results differ for Denmark and Sweden. Furthermore, future research may include other variables, which may be able to capture more micro aspects, such as consumer confidence indexes or business confidence indexes, in order to gather data on the internal economic conditions in the research economy at the time of the research, which may give further insight into the results and conclusions. A further avenue for potential research would be to examine the effects of the ECB asset purchase programme on other developed non-euro economies, such as Norway or Switzerland, in order to determine if they had any similarities to the spillover effects observed on Denmark and Sweden.

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Appendices.

Item No.1

Denmark Regression

Model Summary ^b										
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
1	.669 ^a	0.447	0.286	0.205079	0.447	2.784	9	31	0.016	0.928
a. Predictors: (Constant), Dummy, CapFlows, gdp, VIX, Purchases, Imports, Inflation, Exports, EURDKK										
b. Dependent Variable: DanishYields										

Coefficients ^a										
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B		Collinearity Statistics	
		B	Std. Error	Beta			Lower Bound	Upper Bound	Tolerance	VIF
		1	(Constant)	0.439			0.625		0.702	0.488
	EURDKK	-0.072	0.048	-0.345	-1.498	0.144	-0.170	0.026	0.337	2.971
	Exports	0.000	0.000	-0.292	-1.436	0.161	0.000	0.000	0.431	2.320
	Imports	0.000	0.000	0.352	1.669	0.105	0.000	0.000	0.402	2.488
	Inflation	0.084	0.113	0.153	0.746	0.461	-0.146	0.314	0.426	2.350
	GDP	0.045	0.035	0.253	1.270	0.213	-0.027	0.116	0.450	2.220
	CapFlows	3.072E-05	0.000	0.017	0.090	0.929	-0.001	0.001	0.504	1.986
	VIX	0.008	0.008	0.181	1.028	0.312	-0.008	0.025	0.576	1.735
	ECBPurchases	-0.001	0.002	-0.041	-0.241	0.811	-0.005	0.004	0.607	1.649
	Dummy	-0.270	0.082	-0.534	-3.298	0.002	-0.437	-0.103	0.681	1.468

a. Dependent Variable: DanishYields

Item No.2

Sweden Regression

Model Summary ^b										
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
1	.675 ^a	0.456	0.298	0.18223	0.456	2.885	9	31	0.013	1.238
a. Predictors: (Constant), Exports, ECBPurchases, Flows, VIX, GDP, EURSEK, Inflation, Dummy, Imports										
b. Dependent Variable: SwedishYields										

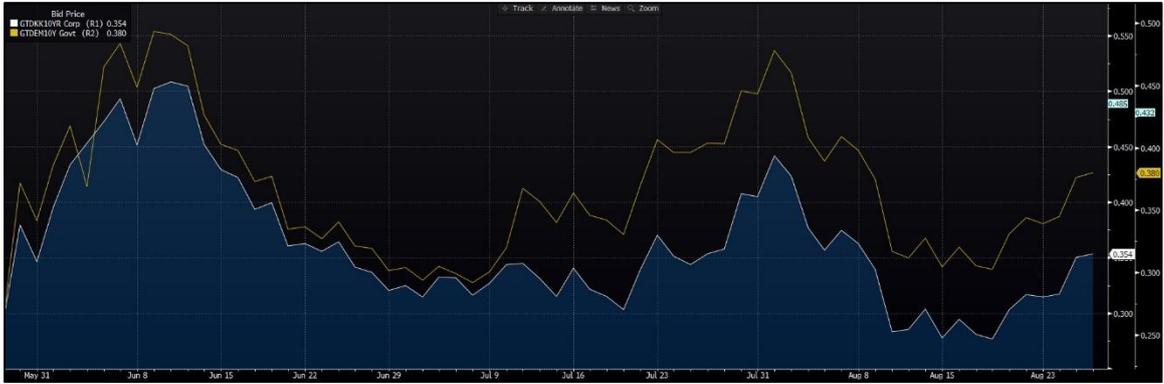
Coefficients ^a										
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics			
		B	Std. Error	Beta			Tolerance	VIF		
		1	(Constant)	0.037			0.503		0.074	0.941
	EURSEK	-0.029	0.029	-0.198	-1.010	0.320	0.457	2.188		
	Inflation	0.132	0.086	0.486	1.533	0.135	0.175	5.720		
	VIX	0.006	0.007	0.141	0.806	0.426	0.574	1.744		
	ECBPurchases	-0.004	0.002	-0.386	-2.233	0.033	0.589	1.698		
	Dummy	-0.320	0.148	-0.706	-2.165	0.038	0.165	6.050		
	GDP	-0.012	0.048	-0.053	-0.258	0.798	0.417	2.397		
	Flows	-0.001	0.000	-0.193	-1.336	0.191	0.837	1.194		
	Imports	-5.650E-05	0.000	-0.230	-0.562	0.578	0.105	9.515		
	Exports	0.000	0.000	0.596	1.583	0.124	0.124	8.080		

a. Dependent Variable: SwedishYields

Item No.3

Danish vs German Yields

(Yellow Line is German 10y Government Bond and Blue Line is Danish 10y Government Bond)



Item No. 4

EURSEK & Purchases Spillovers from ECB Purchases.

Coefficients ^a						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	2.048	0.695		2.946	0.005
	ECBPurchases	-0.030	0.011	-0.399	-2.714	-0.052

a. Dependent Variable: EURSEK

EURDKK & Purchases Spillovers from ECB Purchases.

Coefficients ^a						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.622	0.551		2.944	0.005
	ECBPurchases	-0.024	0.009	-0.402	-2.745	0.009

a. Dependent Variable: EURDKK