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Article

Transmission Channels of Central Bank Asset Purchases in the Irish Economy

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Abstract: The European Central Bank (ECB) engaged in an expanded asset purchase programme (APP) from 2014 to 2018 to help achieve their primary objective of price stability. Total assets purchased over this period was over €2.5 trillion and new net purchases ended in December 2018. This paper identifies whether the ECB's APP in Ireland operated through the portfolio rebalancing channel, the signalling channel or the lending channel. It presents a quantitative descriptive analysis of some key Irish data sets in the 2014–2018 period and uses time-series visualisation and trend analysis to identify trends and correlations. There are a number of preliminary findings. First, much downward pressure on sovereign debt yields and spreads had occurred before the APP began due to previous accommodative monetary policy and the signalling channel. Second, the corporate-sector purchase programme (CSPP) did impact on targeted bonds and may have had spill overs to non-targeted bonds. Third, the APP did not lead to much increased lending to the SME sector. Fourth, while households did engage in traditional portfolio rebalancing, Irish banks did not and were perhaps more motivated to meet their capital requirements and manage their level of reserves. This is a first step towards understanding the transmission channels of ECB policy in Ireland and more work needs to be done to detangle the transmission of the most recent APP from other factors and consider these findings in the context of theoretical models. Such work is important to help inform policy makers on enhancing the transmission mechanism to the Irish economy of the recently launched new ECB asset purchase programme from November 2019.

Keywords: quantitative easing; asset purchase programme; Ireland; transmission channels of QE

JEL Classification: E52; E58

1. Introduction

In 2013 and 2014, Euro-area inflation was falling well below the European Central Bank's (ECB) price stability target of below, but close to, 2 percent over the medium term. In 2014, the ECB decided to engage in an expanded asset purchase programme (APP), a quantitative easing (QE) effort, aimed at returning inflation to levels consistent with this price stability target (ECB 2014a, 2015, 2016)¹. The initial asset purchase programme comprised two separate programmes, which included the third covered bond purchase programme² (CBPP3) launched in October 2014 and an asset-backed securities purchase programme (ABSPP) in November 2014. This programme was expanded to include a secondary markets public-sector asset purchase programme (PSPP) initiated in March 2015 and a

¹ QE and APP will be used interchangeably in this paper as they are taken to mean the same monetary policy.

² The ECB had engaged in covered bond purchases before 2014 with a covered bond purchase programme (CBPP) announced in May 2009.

corporate-sector purchase programme (CSPP) in March 2016. Collectively, these programmes are referred to as the expanded asset purchase programme or quantitative easing.

Between September 2014 and the end of 2018, the ECB purchased over €2.5 trillion worth of securities under these four programmes³ (Larkin et al. 2019, p. 3). Net APP purchases ended in December 2018 with reinvestment of maturing principal amounts occurring from January 2019. This is expected to continue well past the time when the ECB begin to increase key interest rates (ECB 2019b).

The economics literature suggests that central bank asset purchases affect the macroeconomy through three main channels: the portfolio rebalancing channel, the signalling channel and the lending channel (Benford et al. 2009, pp. 93–95; Dunne et al. 2015, p. 65; Gern et al. 2015, p. 207; Brózda 2016, p. 755). In a European context, there is much empirical evidence on the existence of the portfolio channel (Urbschat and Watzka 2017, p. 27; Albertazzi et al. 2018, p. 2); the signalling channel (Altavilla et al. 2015, p. 2; Neugebauer 2018, p. 22; Zaghini 2019, p. 21) and the lending channel (Tischer 2018, p. 35). In Ireland, Larkin et al. (2019, p. 22) found strong evidence that the signalling effect was present in the Irish bond market.

This paper contributes to the literature by expanding this focus to the operation of all three transmission channels in Ireland. The main research question is to identify whether the ECB's APP in Ireland operated through the portfolio rebalancing channel, the signalling channel or the lending channel. It is a first attempt to identify if the channels were operative and if there were any possible barriers to their operation in Ireland. This paper presents a quantitative descriptive analysis of some key data sets in the 2014–2018 period when the ECB was undertaking asset purchases. The aim is to identify initial trends and possible correlations in key variables over this period through time-series visualisation and trend analysis and point to areas for further investigation in the context of theoretical models. This work is important to help inform policy makers on the likely effects of the recently announced new ECB asset purchase programme starting in November 2019.

The remainder of this paper is divided into five sections. Section 2 provides a literature review which provides a theoretical perspective on how the portfolio rebalancing channel, the signalling channel and the lending channel transmit central bank asset purchases to the macro economy. Section 3 documents the data description and analysis. Section 4 presents a summary of the main findings. Section 5 discusses some of the main findings from the data analysis with reference to the literature. Section 6 offers some concluding remarks.

2. Literature Review

From a theoretical perspective, the ECB's expanded asset purchase programme was aimed at further enhancing the transmission of monetary policy, facilitating credit provision to the euro area economy, easing borrowing conditions for households and businesses and ultimately contributing to returning inflation rates to levels below, but close to, 2 percent over the medium-term, consistent with the ECB's primary objective of maintaining price stability (ECB 2015; ECB 2016).

Dunne et al. (2015, p. 65) identify three primary channels in the economic literature through which a central bank's purchases of assets can affect the real economy: the portfolio rebalancing channel, the bank lending channel and the signalling channel. Figure 1 presents these three transmission channels and their macroeconomic outcomes (Dunne et al. 2015, p. 65). The main research question in this paper is to identify whether the ECB's APP in Ireland operated through the portfolio rebalancing channel, the signalling channel or the lending channel. This section presents theoretical perspectives on these three channels. Section 2.1 considers the portfolio rebalancing channel, Section 2.2 the signalling channel and Section 2.3 the bank lending channel.

³ Purchases by the ECB are taken to mean purchases by the Eurosystem, including the ECB and the national central banks of euro-area countries.

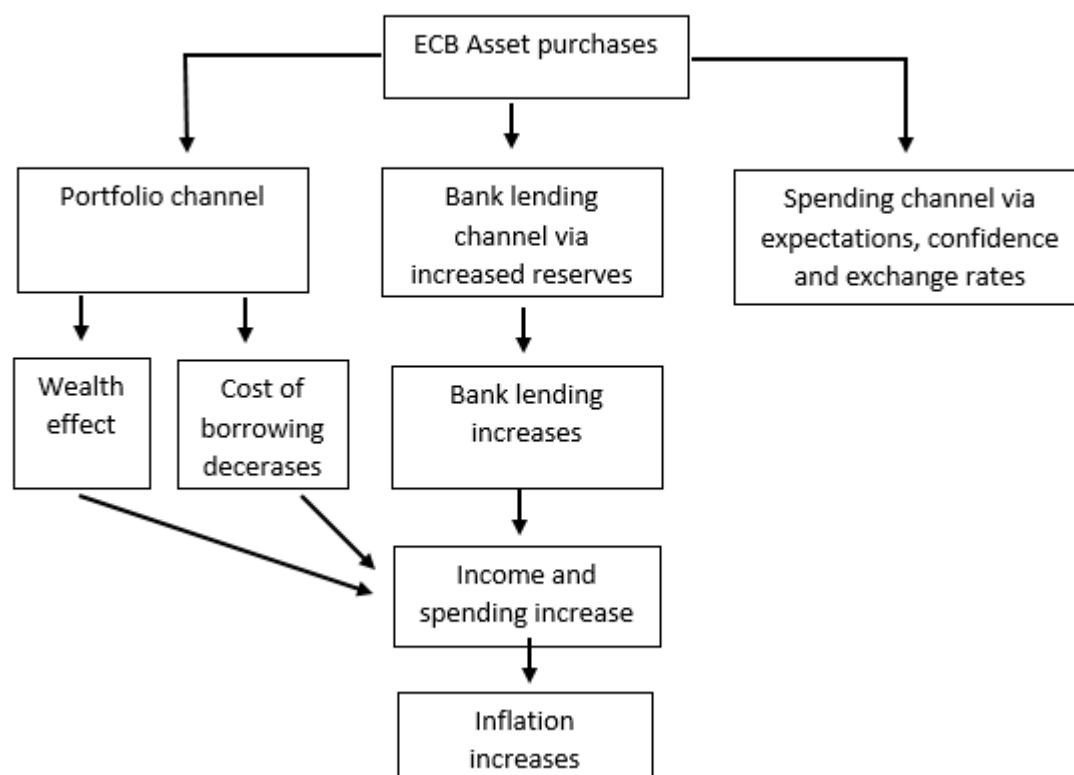


Figure 1. Transmission channels of asset purchases to the macro economy (Dunne et al. 2015, p. 66).

2.1. Portfolio Rebalancing Channel

The portfolio rebalancing channel operates via incentivising institutions to rebalance their portfolio from safe assets, like government bonds, to riskier assets with higher expected returns, like corporate bonds or loans, in their search for higher yield (Albertazzi et al. 2018, p. 1 and Tischer 2018). Theoretically, the central bank buys government bonds and this increased demand increases government bond prices and decreases their yield. This, in turn, indirectly pushes down yields on corporate debt as some investors rebalance their portfolios away from government debt with suppressed yields and towards corporate debt in which the yield is higher (Joyce et al. 2014, p. 3; Gern et al. 2015, p. 207). This, in turn, pushes up corporate bond prices and decreases their yield.

Alternatively, central banks can directly buy private sector assets, which directly increases corporate asset prices and reduces their yields (Gern et al. 2015, p. 208). The higher asset prices have a wealth effect on asset holders and this, should, in theory, boost their spending (Joyce et al. 2014, p. 7; Dunne et al. 2015, p. 67). Sovereign bond yields are used in the pricing of a broad range of interest rates relevant to the real economy (Larkin et al. 2019, p. 5). The lower yields across the economy should make loans cheaper, allowing households and firms to borrow more and repay their debt more cheaply. This should feed into higher consumption and investment and eventually feed through to higher prices, helping to achieve the ECB's overall objective of price stability (De Santis et al. 2018, p. 66).

Empirical evidence in support of this transmission mechanism has been found in a number of countries. Krishnamurthy and Vissing-Jorgensen (2013, p. 101) and Carpenter et al. (2015, p. 230), among others, showed evidence of this channel in the US associated with the Federal Reserve's QE programme. Joyce et al. (2014, p. 1) argued that investors shifted their portfolios away from government bonds towards corporate bonds due to the Bank of England's QE Programme. In the euro area, Urbach and Watzka (2017, p. 27), Neugebauer (2018, p. 22) and Larkin et al. (2019, p. 12) all show evidence of declining yields on sovereign government bonds, with peripheral countries' bond yields declining by more than core countries' bond yields. Albertazzi et al. (2018, p. 2) found that portfolio rebalancing played a relevant role in the transmission of the ECB's APP, with rebalancing

skewed more towards loans in non-vulnerable countries compared to vulnerable countries such as Ireland.

The literature also suggests that the APP may have impacted both targeted government and corporate bonds and non-targeted or non-eligible bonds (Albertazzi et al. 2018, p. 2). For example, Altavilla et al. (2015, p. 40) found that the ECB asset purchase programme significantly lowered yields in a broad set of market segments and there have been spill-overs to non-targeted assets, with this spillover accentuated by the low degree of financial stress prevailing at the announcement of the programme. In addition, Zaghini (2019, p. 21) found evidence of a significant impact of the CSPP on yield spreads, both directly on purchased and targeted bonds and indirectly on other bonds.

2.2. The Signalling Channel

Eggertsson and Woodford (2003, p. 67) have argued that the key to dealing with a situation in which monetary policy is constrained by the zero-lower bound on short-term nominal interest rates is “the skilful management of expectations regarding the future conduct of policy”. Gern et al. (2015, p. 207) and Moessner and Rungcharoenkitkul (2019, p. 83) consider the signaling channel to be one of the most prominent channels of central bank asset purchases and that, in practice, it takes the form of forward guidance communication strategies employed by many central banks to influence expected and actual short-term interest rates.

The ECB officially started using forward guidance in July 2013 by announcing that it expected “the key ECB interest rates to remain at present or lower levels for an extended period of time” (ECB 2014b, p. 65). Forward guidance has been maintained as a monetary policy since then. Gern et al. (2015, pp. 207–8) and Bhattarai et al. (2015, p. 32) suggest that QE actually strengthens the credibility of the central bank to keep interest rates low for a prolonged period of time because an earlier exit from this strategy would trigger losses for the central bank. The expectation of low-level of long-run real interest rates should encourage spending and increase credit demand. This should stimulate consumption, investment and net exports and ultimately increase inflation back up towards the ECB’s 2 percent target over the medium-term (ECB 2014b, pp. 65–66).

In addition, the signaling of the lower expected interest rates should weaken the currency and increase demand for exports. The weaker currency should also feed into higher import prices and so raise inflation and inflation expectations (Dunne et al. 2015, p. 69). This is sometimes referred to as the exchange rate channel (Glick and Leduc 2013, p. 19 and Haldane et al. 2016, p. 10). A related point is that when the ECB buys Euro-area bonds from non-euro area holders, the portfolio rebalancing effect outlined above should also weaken the exchange rate and, therefore, impact on prices.

Empirical evidence in support of the signalling transmission mechanism has been found in the euro area. Altavilla et al. (2015, p. 2) demonstrate that the bulk of the impact of asset purchase programmes is found to arise at announcement (“stock effects”), whereas “flow effects” generated by the actual implementation of the purchases are limited. Urbschat and Watzka (2017, p. 27) found that the effects in yield and spread reduction were most pronounced for the initial announcement on the PSPP but declined afterwards for additional announcements. Neugebauer (2018, p. 22), using an event study, found that the effects of ECB’s asset purchase announcements on euro-area government bond yields arose with a one-day delay. In an Irish context, Larkin et al. (2019, p. 22), who also uses an event study, showed that the announcement effect related to PSPP reduced Irish sovereign bond yields significantly and contributed to a flattening of the yield curve. In terms of the CSPP, Zaghini (2019, p. 21) found that the announcement of the CSPP programme in March 2016 had an immediate effect on bond trades.

Empirical evidence also exists for the exchange rate effect due to signaling effects. For example, Demertzis and Wolff (2016, p. 8) suggested the expected interest rate differential arising from announcements undermined EUR/USD, with much of the decline occurring with discussions about when and how the ECB would start the PSPP. Indeed, Ferrari et al. (2017, p. 25) found that the exchange rate was more sensitive to monetary policy when the effective lower-bound interest rate

became increasingly binding. This is supported by [Dedola et al. \(2018, p. 1\)](#), who found that the ECB's APP programme led a depreciation in the euro relative to the USD of 12 percent between September 2014 and the end of 2016 and that the signaling channel contributed to the exchange rate response to QE. This is especially important in the context of a small open economy like Ireland.

2.3. Bank Lending Channel

The traditional bank lending channel can occur directly, with institutions selling bonds to the ECB and using the proceeds to extend credit to the real economy ([ECB 2015](#)), or indirectly through banks' lending a proportion of their increased deposits, from investors who have sold bonds to the ECB and lodged the proceeds in their bank accounts, to households and firms ([Butt et al. 2014, p. 1](#)). In particular, banks keep a proportion of their increased deposits to meet their reserve, liquidity and capital requirements but will use excess funds to finance loans at higher interest rates than they could earn if they left it on deposit at negative interest rates at the ECB ([Dunne et al. 2015, p. 68](#)). Indeed, the negative ECB deposit facility rate (−40 basis points since March 2016) encourages lending and accentuates the effect of the APP on credit supply by increasing the cost of holding the reserves injected via the APP, thus incentivising banks to rebalance towards bank loans⁴ ([Altavilla et al. 2019, p. 35](#)). This channelling of funds from deposits to productive firms and households is essential to ensuring investment and growth ([Altavilla et al. 2019, p. 3](#)), especially in times of stress ([Bruno et al. 2017, p. 25](#)), and ultimately impacting on higher inflation levels and a return to price stability.

Empirical evidence in support of the traditional bank lending channel is mixed. For example, [Butt et al. \(2014, p. i\)](#) found no evidence to suggest that the Bank of England's QE operated via a traditional bank lending channel. [Tischer \(2018, p. 35\)](#), using data on German banks for 2014–2016, showed that QE encouraged banks to rebalance from securities to loans but that this was primarily motivated by portfolio rebalancing, as described above.

It is worth noting that there is another view that argues that the level of deposits or reserves in banks are not important in determining bank lending ([Disyatat 2010, p. 2](#)). This is reflected in the theory of 'endogenous money', which suggests that bank lending is not constrained by banks' level of deposits and reserves but by what banks view as 'credit-worthiness' in borrowers, the interbank market, quest for profitability, and liquidity controls by central banks ([Lavoie 2014, p. 193](#)). This theory has gained traction in central banking circles. For example, [McLeay et al. \(2014, p. 1\)](#) from the Bank of England and the [Bundesbank \(2017, p. 17\)](#), have suggested that banks can grant loans without any prior inflows of deposits. This is relevant to the ECB's APP as it suggests that central bank purchases of secondary market assets are not necessary to spur bank lending. [Fullwiler \(2013, p. 186\)](#), referring to QE specifically, argues that "since banks require neither reserve balances nor deposits to make loans ... adding to the stock of either does not in itself stimulate the economy".

The literature also suggests that well-capitalised banks are a prerequisite to an effective bank lending channel arising from unconventional monetary policy. For example, [Boeckx et al. \(2016, p. 3\)](#) found that better capitalised banks have, on average, responded more to ECB's credit support policies used in the pre-APP years. [Albertazzi et al. \(2016, p. 16\)](#) found that capital and economic constraints were the key dimension that determined the extent to which banks transmit non-conventional monetary impulses via shifts in lending supply. [Bruno et al. \(2017, p. 26\)](#), also focusing on the pre-APP years, showed that the main bank characteristics affecting lending are size, capitalisation, liquidity, and ownership and, to a lower extent, reliance on deposits. In addition, [Altavilla et al. \(2019, p. 38\)](#) reported that the APP led to increased loan volumes in the Euro area and the impact was stronger for banks with larger holdings of sovereign bonds.

⁴ [Andrade et al. \(2016, pp. 19–22\)](#); [Tischer \(2018\)](#) also suggest that quantitative easing can increase banks' equity through higher asset prices and that this also is conducive to a more productive lending environment.

3. Data Description and Analysis

The main research question for this study is to identify whether the ECB's APP in Ireland operated through the portfolio rebalancing channel, the signalling channel or the lending channel. This paper uses a quantitative descriptive analysis of some key data sets in the 2014–2018 period when the ECB was undertaking asset purchases. The aim is to identify trends and possible correlations in key variables over this period through time-series visualisation and trend analysis and point to areas for further investigation in the context of theoretical models.

Given the relative confidentiality of NCB-related purchases (ECB 2014c), finding data on the impact of the APP via these three channels in Ireland was difficult. In particular, it was necessary to find data on purchase quantities, programme participants and the market response. This data was, therefore, compiled from combining data from various sources. Data was sourced for the two core components of the APP, the PSPP and CSPP. The rationale for this was that these two programmes were the main constituents of the APP. Figure 2 shows the APP Net purchases by Programme in October 2018. It can be seen that the bulk of the APP centered on the PSPP (81.8 percent as at October 2018) and the CSPP (10.24 percent as at October 2018).

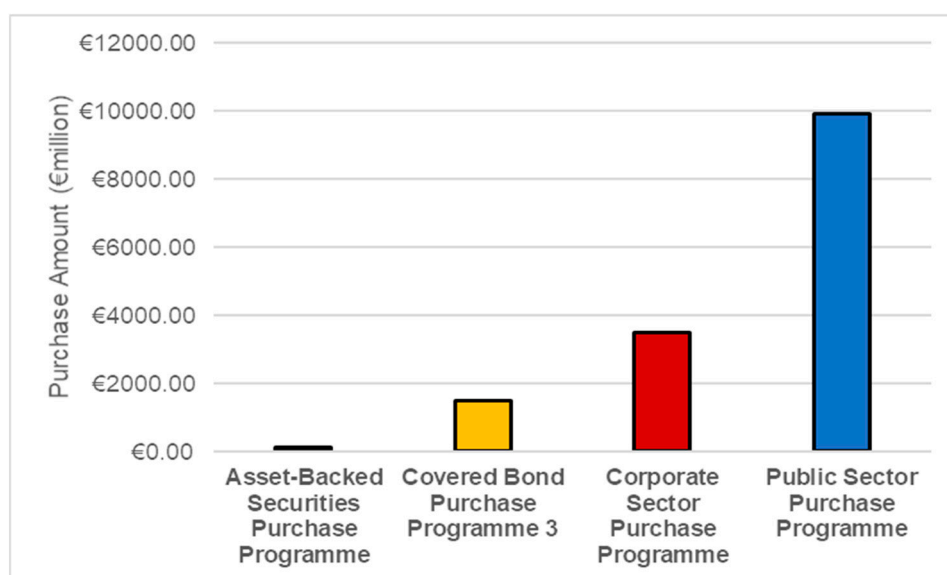


Figure 2. Asset purchase programme (APP) Net Purchases by Programme, October 2018.

Data for the PSPP purchases were sourced from Amundi Research's monthly compilation of statistics on each Eurozone nation's purchases under the PSPP. CSPP purchases and figures were sourced from UniCredit, whom disclosed the ECB's CSPP portfolio in research reports. Historical corporate bond data was garnered from ISIN codes published by the Central Bank of Finland (which conducted the CSPP purchases for Ireland).

The data sources used for the purposes of bank lending analysis were collated from the Central Bank of Ireland's *Credit and Banking Statistics* and *Quarterly National Accounts* data. Concerning securities holdings statistics, this report uses the aggregate balance sheets for *Irish Headquartered Credit Institutions*, as opposed to the broader *Domestic Market Credit Institutions* data. The rationale for this is that this data encompasses national banks that have accounts with the Irish central bank and domestic clients, as opposed to investment banks and so-called *O-SIIs* (*Other Systemically Important Institutions*) that operate outside of the regulatory parameters of depository financial institutions, and do not have accounts with the Irish central bank and, therefore, did not participate in the APP directly. Additional reference material has been taken from Bruegel's Sectorial Sovereign Bond Holdings database, as well as the European Central Bank's Statistical Data Warehouse on *Securities Holding Statistics*.

There are a number of caveats to this approach. First, there are limitations to the availability of the data. For example, aggregate bank balance sheets detail only security holdings by sector and not by maturity. Second, lending statistics from non-financial corporations (NFC) are not readily available, which would have been an insightful counterpart to the SME lending data gathered. However, SMEs form an intrinsic part of the Irish economy. There are currently 248,344 SMEs in Ireland ([Houses of the Oireachtas 2019](#), p. 29), which comprises 99.7% of all Irish NFCs (*ibid.*, p. 11). Additionally, as SMEs are generally restricted to domestic bank-based funding, they provide a more accurate picture of the effectiveness of the APP's bank-lending channel within Ireland.

Third, this approach does not derive an operational model from the theory and run regressions to test a hypothesis as per much literature cited here. However, it does shed light on the transmission channels for QE to the Irish economy and points to possible areas for further investigation. The links drawn are not definitive and more work will need to be done to disentangle the impact of the APP from other factors and consider these findings in the context of theoretical models.

4. Findings

This section describes the initial findings that the two main programmes in the APP, the PSPP and the CSPP, had on the Irish economy. It is divided into three sections. Section 4.1 presents findings arising from the PSPP on Irish government bonds and Irish debt. Section 4.2 shows the findings arising from the CSPP on corporate bonds. Section 4.3 considers the portfolio rebalancing of households and banks and the lending behavior of Irish banks from the APPs announcement in January 2015.

4.1. The PSPP and the Irish Economy

Between March 2015 and December 2018, the ECB conducted net purchases of public-sector securities under the PSPP. This section considers public-sector purchases in Ireland and is divided into three sections. Section 4.1.1 details the Irish Central Bank's purchase of bonds over the period March 2015 to December 2018. Section 4.1.2 shows the impact on Irish government bond yields. Section 4.1.3 reflects on the impact of the PSPP on Irish long-term debt.

4.1.1. Description of the Irish PSPP

As of 31 December 2018, cumulative net purchases of Irish government bonds by the ECB amounted to €30.1 billion ([Larkin et al. 2019](#), p. 7). Table 1 shows a breakdown of the Central Bank of Ireland's purchase of sovereign debt from March 2015 to November 2018.

Table 1. Irish public-sector asset purchase programme (PSPP) Monthly Purchases.

	Total Holdings	Monthly Purchase		Total Holdings	Monthly Purchase
	(€Billions)	(€Billions)		(€Billions)	(€Billions)
Mar-15	0.80	0.80	Feb-17	19.70	0.60
Apr-15	1.50	0.70	Mar-17	20.20	0.50
May-15	2.20	0.70	Apr-17	20.80	0.60
Jun-15	3.00	0.80	May-17	21.30	0.50
Jul-15	3.80	0.80	Jun-17	21.80	0.50
Aug-15	4.40	0.60	Jul-17	22.40	0.60
Sep-15	5.20	0.80	Aug-17	22.90	0.50
Oct-15	6.10	0.90	Sep-17	23.40	0.50
Nov-15	6.90	0.80	Oct-17	23.50	0.10
Dec-15	7.60	0.70	Nov-17	24.60	1.10
Jan-16	8.40	0.80	Dec-17	25.30	0.70
Feb-16	9.20	0.80	Jan-18	25.70	0.40
Mar-16	10.00	0.80	Feb-18	26.10	0.40

Table 1. Cont.

	Total Holdings	Monthly Purchase		Total Holdings	Monthly Purchase
	(€Billions)	(€Billions)		(€Billions)	(€Billions)
Apr-16	11.10	1.10	Mar-18	26.50	0.40
May-16	12.20	1.10	Apr-18	27.10	0.60
Jun-16	13.20	1.00	May-18	27.60	0.50
Jul-16	14.20	1.00	Jun-18	28.20	0.60
Aug-16	14.90	0.70	Jul-18	28.75	0.55
Sep-16	15.90	1.00	Aug-18	29.30	0.55
Oct-16	16.90	1.00	Sep-18	29.60	0.30
Nov-16	17.90	1.00	Oct-18	29.80	0.20
Dec-16	18.60	0.70	Nov-18	29.90	0.10
Jan-17	19.10	0.50			

Source: Amundi (2015–2019).

The table shows that the PSPP began with an initial purchase of €800 million of Irish bonds in March 2015. Irish bond purchases declined from November 2016, which could be referred to as an early ‘Irish tapering’, 13 months prior to the official ECB tapering of January 2018⁵. They increased in the month of November 2017 to €1.1 billion and then tapered, in line with the ECB official tapering. This pattern can also be seen in Figure 3.

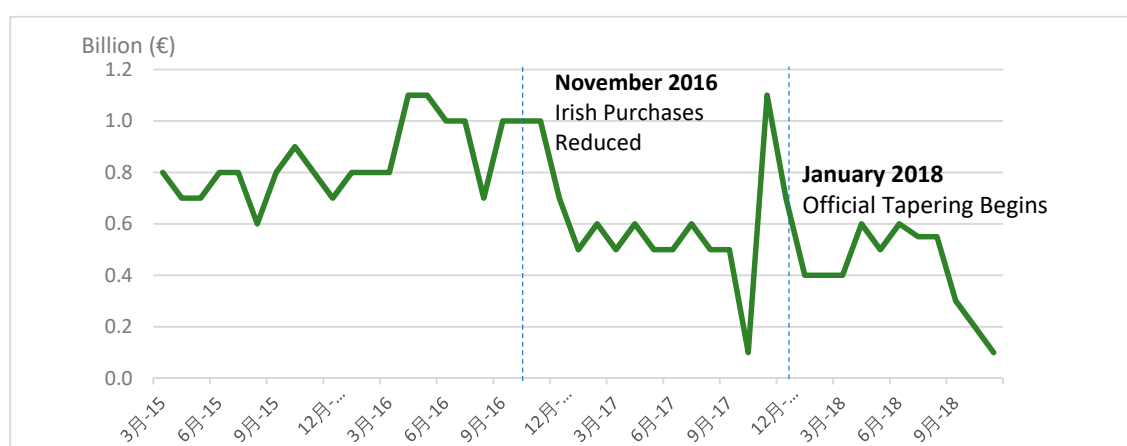


Figure 3. Irish PSPP Purchases Per Month. Data sourced: Amundi (2015–2018).

The ECB’s capital key was used to guide net purchases given that the ECB was buying bonds across many different sovereign bond markets on a monthly basis (ECB 2019a). Figure 4 shows Irish PSPP purchases as a percentage of all PSPPs versus the Irish allocated capital key of 1.65%. It can be seen that a precise achievement of the capital key was not achieved each month, with some flexibility built in to support the smooth implementation of the programme (ECB 2019a). However, as of 31 December 2018, cumulative net purchases of Irish government bonds by the ECB amounted to €30.1 billion, which represents a 1.55 percent share of total PSPP purchases (excluding supranational bonds) (Larkin et al. 2019, p. 7).

⁵ Official ECB tapering refers to the first major reduction of purchases from €60 billion until December 2017, to €30 billion in January 2018. See the chronology of asset purchases here: <https://www.ecb.europa.eu/mopo/implement/omt/html/index.en.html>.

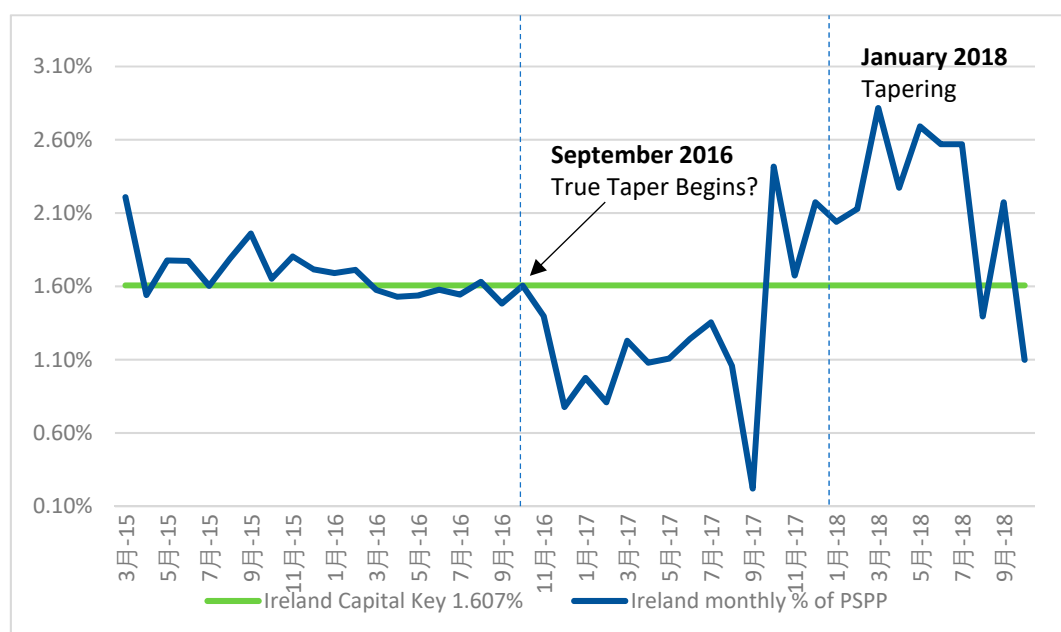


Figure 4. Irish PSPP Purchases (as % of all PSPP) vs. Allocated Capital Key. Source: Amundi (2015–2018).

4.1.2. Impact on Irish Government Bond Yields

Irish bond yields have fallen substantially since 2011. Figure 5 shows the decline in the yield on 10-year bonds from January 2011 to October 2018. As evidenced here, much of the drop in Irish bond yield was primarily caused by monetary policy outside of the PSPP, including the longer-term refinancing operations (LTRO) announced in December 2011 and Outright Monetary Transactions (OMT) announced in September 2012. In addition, some of the decrease can be attributed to continuously low interest rates employed by the ECB from 2012. Figure 5 also shows that the initial downward price action on government yields was far more driven by the announcements or forward guidance of the various policies than by the implementation of the policies themselves. For example, the PSPP was announced in January 2015 and implemented from March 2015, after which very little price action occurred.

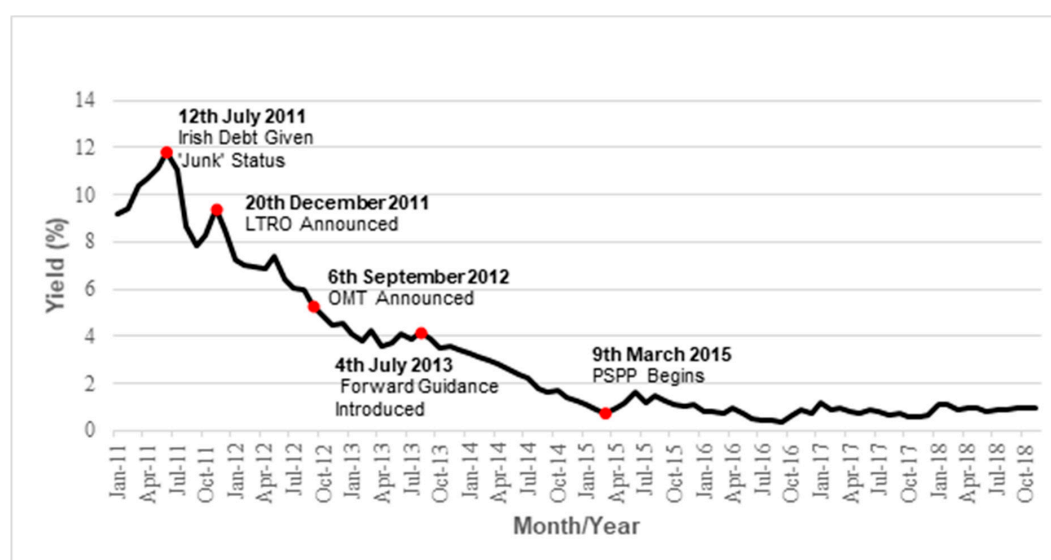


Figure 5. Irish 10-Year Bond Yield, January 2011–October 2018 Sources: St Louis. Fed, European Central Bank; Tabulated in Excel.

Figure 6 compares the yields on 2-, 5- and 10-year Irish treasury bonds. It can be seen that overall, yields did narrow but that this was prior to the PSPP's launch in March 2015. For example, the spread between 10- and 2-year bonds decreased from 242 basis points in May 2014 to just 78 basis points (a decline of 164 basis points) in May 2015. However, the following year when PSPP purchases were active, the spread actually increased on average. Similarly, the yield on 10-year (benchmark) bonds decreased from 3.02% in January 2014 to 0.757% year-on-year to March 2015, but only fell to 0.733% the following year. Two-year yields first entered negative territory at the beginning of the PSPP, logging −0.21% in March 2015, a trend which has held steady through tapering. Since March 2015, term spreads have remained at a relatively steady rate.

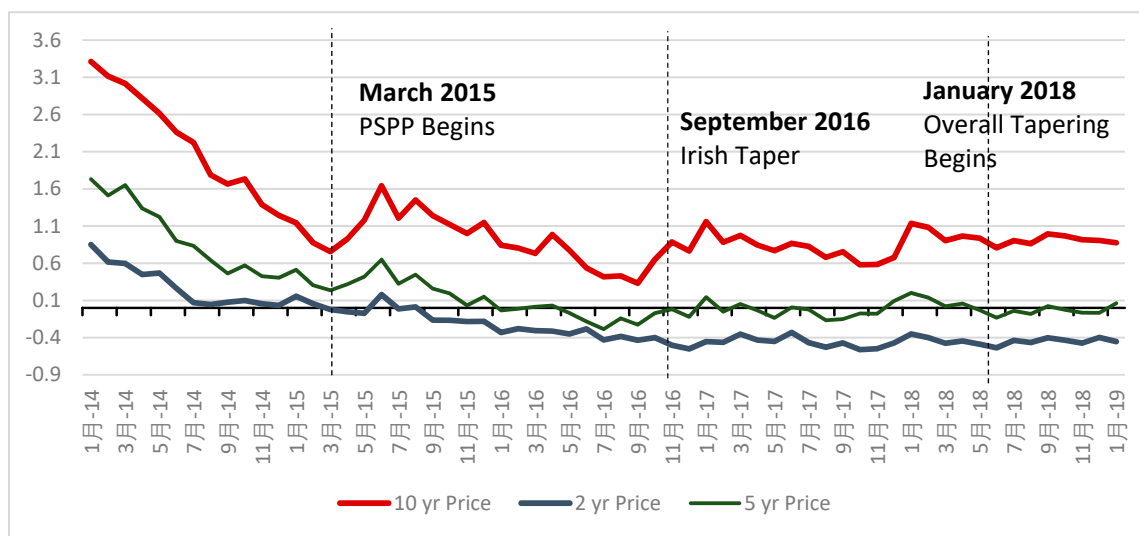


Figure 6. Term Spreads—2-, 5- and 10-Year Government Bond Yields, January 2014–January 2019.

Source: [Investing.com](https://www.investing.com).

4.1.3. Impact of PSPP on Irish Long-Term Debt

The findings suggest that the NTMA (National Treasury Management Agency), the Irish state agency that manages the national debt, used the APP to extend the maturity profile of Irish debt. Figure 7 shows an inverse relationship between the proportion of PSPP purchases in Ireland for a given quarter (as per national accounts) and the decrease in Irish long-term securities-based debt over that same period. Using ‘Q1 2015’ as the anchor-point (0%), Figure 7 shows that trajectory of the two variables are similar. Table 2 shows some descriptive statistics, which correspond to Figure 7. The correlation coefficient shows that there is a relatively strong correlation of 0.64 between the government level of long-term debt and PSPP purchases over the period Q1 2015 and Q3 2018. This suggests that there is a motivation for exploring this relationship further with regression analysis.

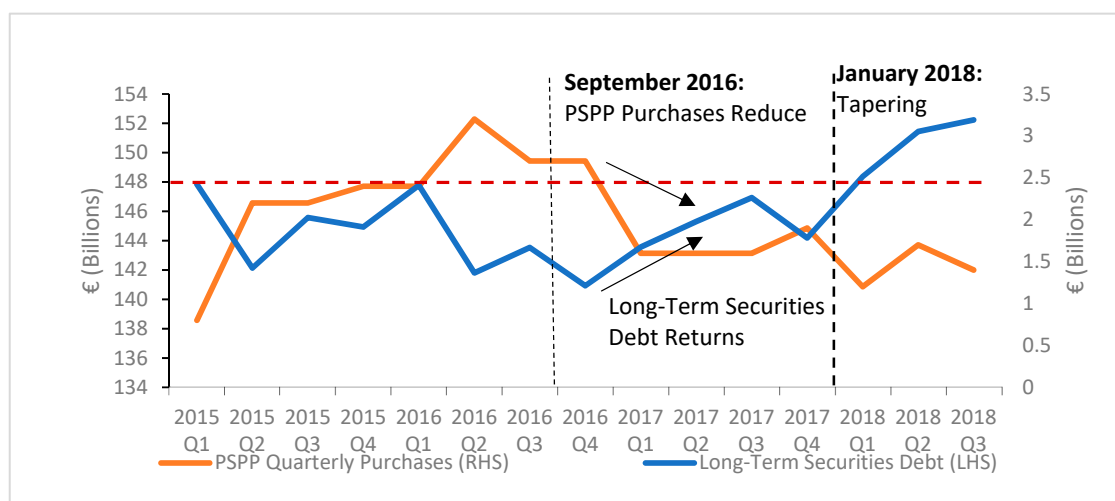


Figure 7. Irish Long-Term Security Debt to PSPP Purchases. Source: Central Bank of Ireland.

Table 2. Irish Long-Term Security Debt to PSPP Purchases.

	Government Long-Term Securities	PSPP Quarterly Purchases
Mean	146	1.973
Variance	11.162	0.416
Median	148.506	1.9
Standard deviation	3.341	0.645
Correlation coefficient	−0.6432	

Subsequently, government debt outstanding in long-term bonds have returned to pre-PSPP levels (0% level on fig above), first by the initial ‘Irish-only’ tapering that began in November 2016 and then the official ECB tapering from January 2018.

4.2. The CSPP and Corporate Bonds

Between June 2016 and December 2018, the ECB conducted net purchases of corporate-sector bonds under the corporate-sector purchase programme (CSPP) (ECB 2019a). This section considers the impact of the CSPP on corporate bonds in the Irish economy. Section 4.2.1 describes the CSPP in Ireland. Section 4.2.2 considers a case study of one company, Ryanair, as a targeted bond of the ECB. Section 4.2.3 looks at spill overs from the CSPP to non-targeted bonds.

4.2.1. The CSPP in Ireland

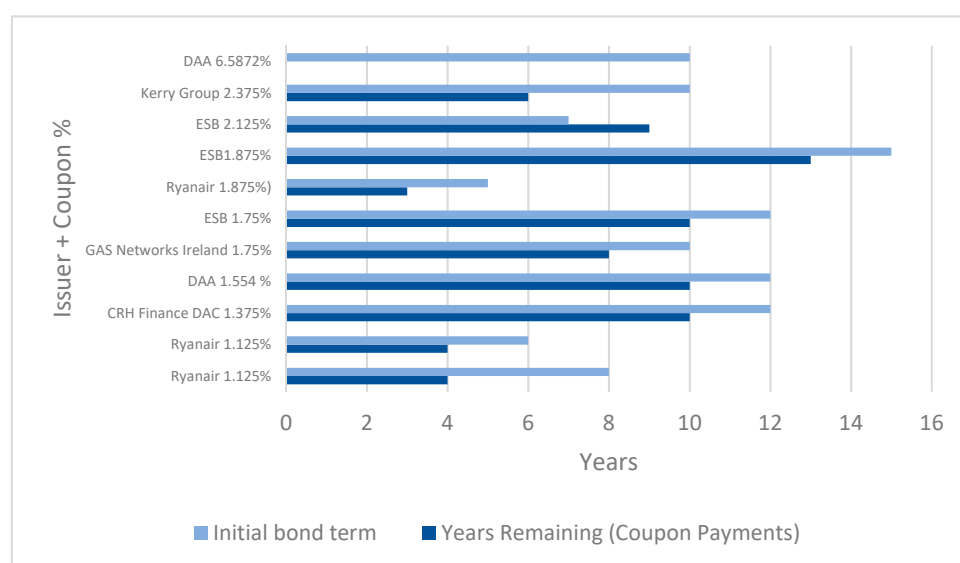
In Ireland, commencing from 8 June 2016, the Corporate-Sector Purchase Programme involved the ECB buying Irish non-sovereign bonds via the Finnish Central Bank (2016). Table 3 shows the Irish corporate bonds that were bought, all of which are or have been listed on the Irish Stock Exchange. These were identified by tracing the ISIN (International Securities Identification Number) codes published as eligible holdings for securities lending (Bank of Finland 2018).

Table 3. Irish corporate-sector purchase programme (CSPP) Bonds (listed by CSPP purchase date).

ISIN	Issuer	Coupon	Maturity	Date of Issue	CSPP Purchase Date	Initial Issue Volume (€mn)
XS1419674525	Dublin Airport Authority	1.554	7/06/28	07/06/16	15/07/16	290
XS1239586594	ESB	2.125	08/06/27	05/06/15	15/07/16	850
XS1288849471	Kerry Group	2.375	10/09/25	10/09/15	15/07/16	850
XS1077584024	Ryanair	1.875	17/06/21	17/06/14	15/07/16	500
XS1199964575	Ryanair	1.125	03/10/23	10/03/15	15/07/16	750
XS0375220588	Dublin Airport Authority	6.872	09/07/18	09/07/08	29/07/16	400
XS1428782160	ESB	1.875	14/06/31	14/06/16	29/07/16	600
XS1505896735	CRH	1.375	18/10/28	18/10/16	21/10/16	600
XS1529684695	Gas Networks Ireland	1.375	05/12/26	05/12/16	20/01/17	500
XS1560853670	ESB	1.75	07/02/29	07/02/17	10/02/17	500
XS1565699763	Ryanair	1.125	15/08/23	15/02/17	17/02/17	750

Sources: Bank of Finland, Finanzen De, Unicredit.

It can be seen that the Irish component of the CSPP was highly concentrated, with three of the beneficiaries being state-owned (ESB, Gas Networks Ireland) or semi-state bodies (DAA), most of which had multiple bonds bought. The remainder were purchased by Designated Activity Company (DAC) subsidiaries of private firms; Ryanair, Kerry Group and CRH⁶. The maturities of these bonds were varied in accordance with the CSPP's aim of lowering interest rates across the investment-grade spectrum. Figure 8 shows the initial bond term and the years remaining for these bonds as of March 2019.

**Figure 8.** Irish CSPP Bond Term Structure/Remaining (as at March 2019). Source: Bank of Finland (2018), Börse Frankfurt.

This programme has provided a select subsection of Irish NFCs with indirect funding with total net holdings of €1.345 billion by June 2018 (53 percent of Ireland's capital key of 1.607 percent). The following section considers a case study of one such company, Ryanair.

⁶ It is worth noting that the Irish corporate bond market is relatively thin compared to, for example, the French corporate bond market.

4.2.2. CSPP Case Study: Ryanair

This section takes a case study approach to consider the impacts of the CSPP on one company quoted on the Irish Stock Exchange (ISEQ). Ryanair is chosen as it was one of the largest beneficiaries of the CSPP. Table 4 shows the purchase of Ryanair's bonds by the Central Bank of Finland with an initial purchase made on 15 July 2016.

Table 4. Ryanair bond purchases by the Central Bank of Finland.

Initial ECB Purchase	15/07/2016	15/07/2016	17/02/2017	Total
ISIN	XS1077584024	XS1199964575	XS156569963	
Coupon	1.875	1.125	1.125	
Maturity	17/06/21	10/3/23	15/8/23	
Date of issue	17/06/2014	10/03/2015	15/02/2017	
Initial (€mn)	850	850	750	
Holdings as at Sept 2016	€38,484,542.53	€38,484,542.53		€76,969,085.06
Holdings as at Nov 2017	€147,381,620.72	€142,205,088.32	€125,249,704.23	€414,836,413.77
Holdings as at March 2018	€164,597,763.51	€159,594,371.03	€140,383,694.33	€464,575,828.87
Holdings as at June 2018	€169,361,040.92	€163,675,808.38	€143,799,186.96	€476,836,036.27
% of Irish CSPP Portfolio	12%	13%	11%	37%

Source: UniCredit (2016–2018).

Rather than expanding the purchases to different companies as the programme continued, the ECB increased net purchases within the existing portfolio each month. Shown here is that Ryanair net purchases increased sharply during the initial purchase phase, with holdings increasing from €76.83 to €414.84 million between September 2016 and November 2017. Purchases reflected a constant weighting of 0.32% in the overall CSPP and 37% in its Irish component in the financial statements observed. It is also worth noting that the ECB added the second 1.125% 2023 bond just two days after its first date of issuance.

While this data does not isolate the impact of the APP on Ryanair bond performance relative to other factors, such as Ryanair strikes and cancellations over this time period, it is, however, likely that admission to the CSPP created higher bond prices due, in part, to anticipated and actual CSPP demand. Figure 9 shows the Ryanair 1.875% 2021 bond performance through the CSPP. It can be seen that the 1.875% 2021 bond rose in value from €101.96 in January 2016 (on the announcement of the CSPP), to a high point of €108.60 in May 2016. With a sustained increase in purchases by the ECB held monthly between June 2016 and December 2017 (after which tapering began), these bonds remained on an elevated plateau of a price average of €105.74 over the CSPP's duration with a standard deviation of 0.79. Although an official ECB taper did not occur until December 2018, investment in the CSPP portfolio components slowed far sooner. After tapering, this price has declined down to €102.82 by February 2019.

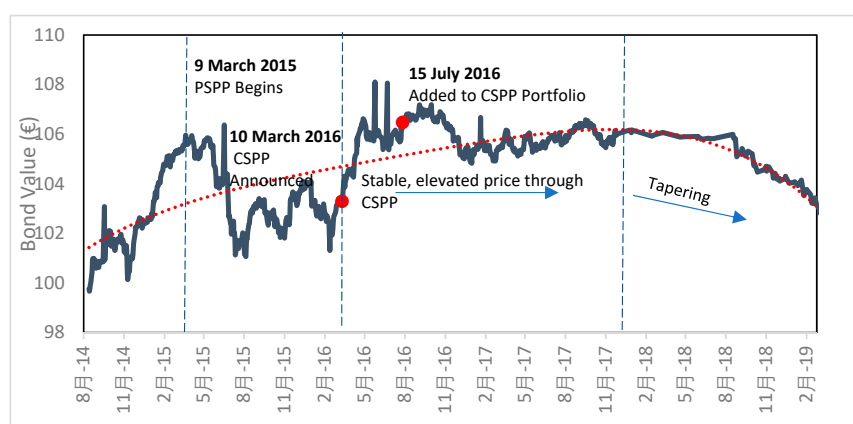


Figure 9. Ryanair 1.875% 2021 Performance through CSPP. Source: Bank of Finland (2018), Börse Frankfurt.

Regarding corporate performance, Ryanair's participation in the CSPP coincided with a significant jolt to its share price. Figure 10 shows that when CSPP commenced, Ryanair share prices rose from €12.97 on the date of Ryanair's first two CSPP bond commencements, 15 June 2016, to €14.18 on issuance of its third bond to the ECB on 17 February 2017. The share price reached a high of €18.60 on 13 August 2017 and has—since tapering—decreased significantly.

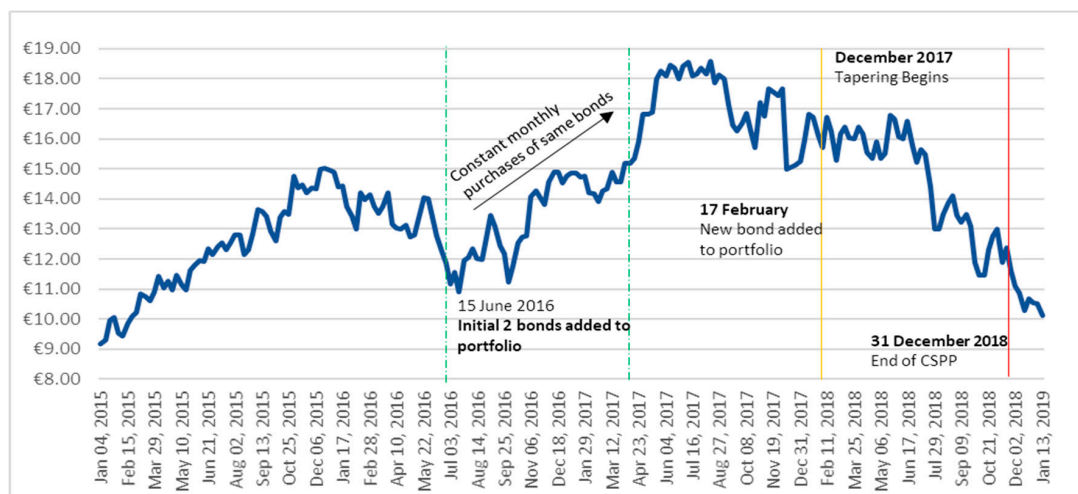


Figure 10. Ryanair Share Price through CSPP. Source: Börse Frankfurt.

Figure 11 shows the performance of Ryanair shares relative to the overall ISEQ index over the period January 2014 to March 2019. Pre the CSPP in 2016, it indicates that Ryanair share prices were closely correlated with the overall ISEQ index. Furthermore, Table 5 shows that Ryanair share prices had a very strong correlation of 0.956 to the market between January 2014 and May 2016. Figure 11 shows this correlation deteriorating after the introduction of CSPP, with the Ryanair share price outperforming the ISEQ. Table 5 shows the correlation coefficient fell to 0.576 from June 2016 to February 2017 with the introduction of the first two bonds to the CSPP. This fell further to 0.068 from February 2017 to January 2018 when the second Ryanair bond was added to the CSPP portfolio. The change in these correlations warrants further investigation to isolate the impact of CSPP on Ryanair's share price performance.

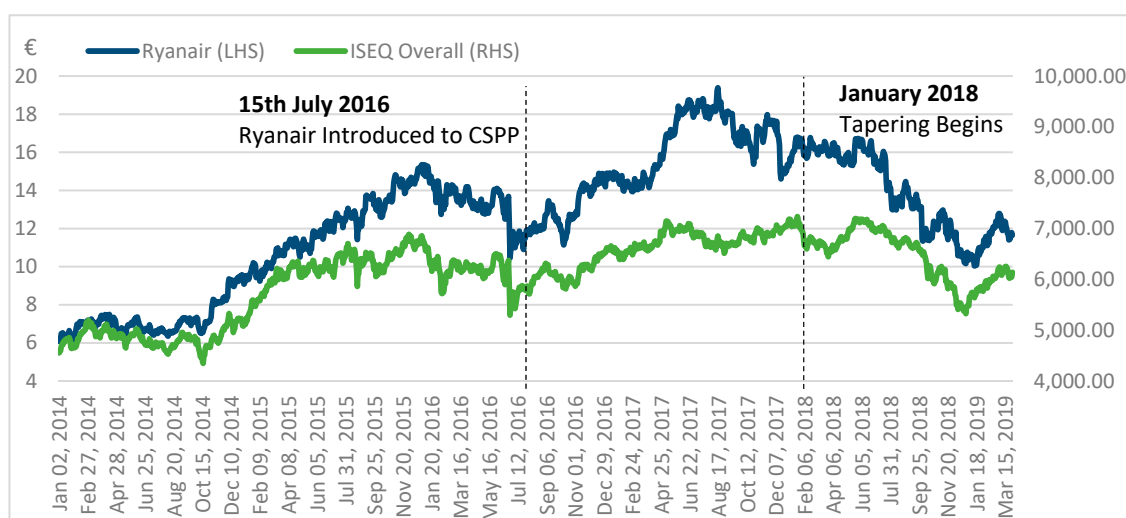


Figure 11. Ryanair Share relative to ISEQ Performance Through CSPP. Sources: [Investing.com](https://www.investing.com/), Börse Frankfurt.

Table 5. Ryanair Share Price and CSPP Statistics.

	January 2014–May 2016 (Pre-CSPP)	June 2016–February 2017 (First Bond Added to CSPP)	February 2017–January 2018 (Second Bond Added to CSPP)
Mean	€10.29	€13.24	€16.90
Variance	8.514239	1.297385	1.603317
Median	€10.23	€13.43	€16.81
Standard Deviation	€2.917917	€1.139028	€1.266222
Correlation coefficient (with ISEQ Average)	0.956	0.576	−0.068

4.2.3. CSPP Spillovers

The findings show that the CSPP may have enacted a market-wide response of increasing corporate bond prices and compressing corporate spreads across both targeted and non-targeted bonds. In general, Figure 11 shows that the ISEQ index saw rapid gains after the ECB made the formal announcement of the CSPP in March 2016, which may suggest spillovers from targeted to non-targeted bonds in general.

In particular, Figure 12 shows four bonds of similar term structure over the period 2014 to 2018. These include a 2022 Irish government bond, CSPP targeted 2021 and 2023 Ryanair bonds and an Irish issued 2022 General Electric bond. The GE bond, though eligible under the ECB's criteria, was not chosen for the CSPP programme. However, it shows that the non-targeted GE bond experienced a similar effect to the targeted Ryanair bonds. The findings show that, as with the PSPP, price action was far more driven by announcement than the purchases themselves.

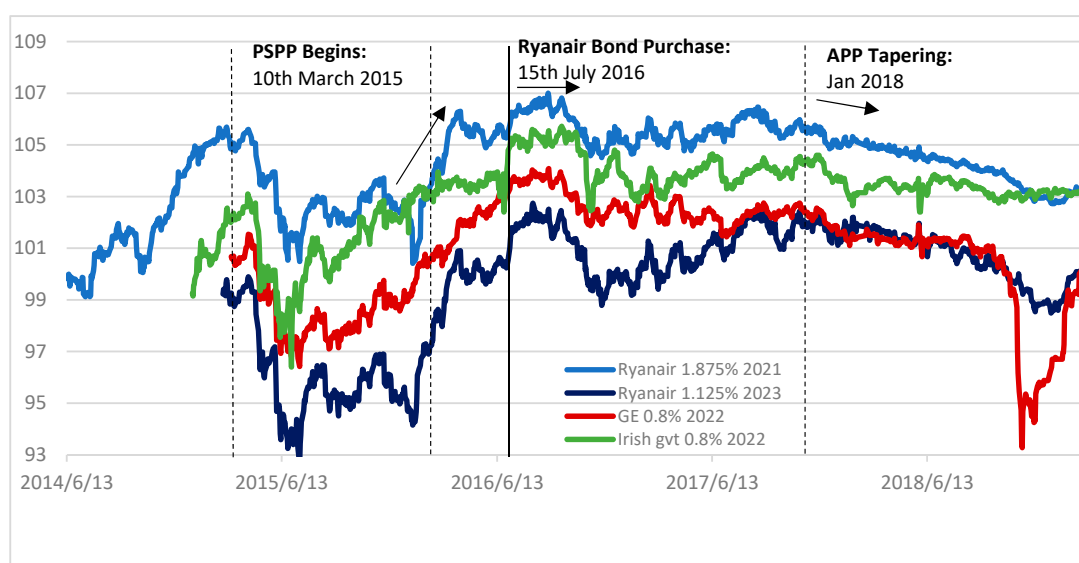


Figure 12. Bond prices for four bonds from 2014–2018. Sources: Irish Stock Exchange, Börse Frankfurt.

In addition, Table 6 shows some descriptive statistics, which correspond to Figure 12. The correlation coefficient shows that there is a strong correlation of 0.8687 between the General Electric 0.8 2022 bond and the Ryanair 1.875 2021 bond and a 0.7288 correlation coefficient between the General Electric 0.8 2022 bond and the Ryanair 1.125 2023 bond over the period March 2015 to March 2019. This suggests that further investigation is warranted on spillover effects between targeted and non-targeted bonds using regression analysis.

Table 6. Descriptive Statistics of Three Sampled Irish CSPP Bonds.

	Ryanair 1.875 2021 Bond	General Electric 0.8 2023 Bond	Ryanair 1.125 2023 Bond
Mean	104.498	100.8711	99.448
Variance	104.885	101.38	100.3
Median	1.875	4.378	24.906
Standard deviation	1.369	2.092	3.881
Correlation coefficient	0.8627	0.7288	

4.3. The APP and Its Transmission Channels

This section details the initial findings on portfolio rebalancing in banks and households (Section 4.3.1) and lending behaviour by banks (Section 4.3.2) on the back of the APP.

4.3.1. The APP and Portfolio Rebalancing

Irish Households

The findings show that households have rebalanced their portfolios away from government bonds and towards deposits initially and then ‘shares and other equity’ after 2015. Figure 13 shows a notable reduction in households’ holdings of long-term government bonds, which decreased from €421 million at the APP’s announcement in January 2015, to just €116 million by December 2018. Figure 14 shows a rapid increase in deposits and simultaneous transactions in ‘shares and other equity’ after 2015, which subsequently dies off with tapering from Q3 2018.

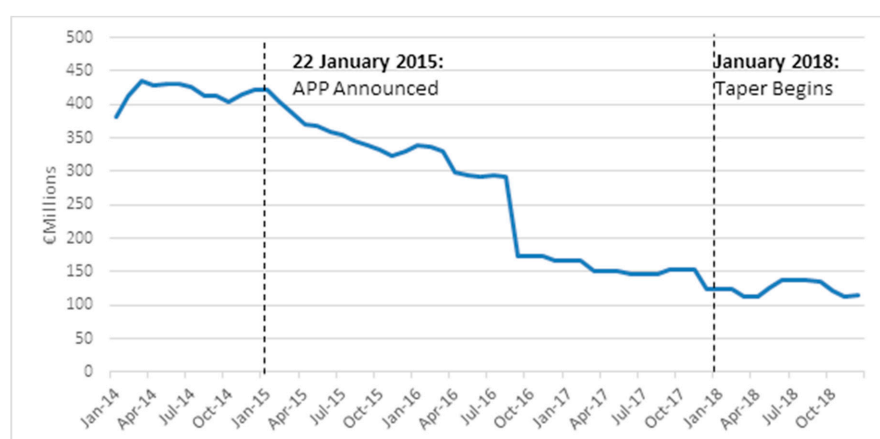


Figure 13. Irish Household Holdings of Irish Long-Term Government Bonds. Source: Central Bank of Ireland.

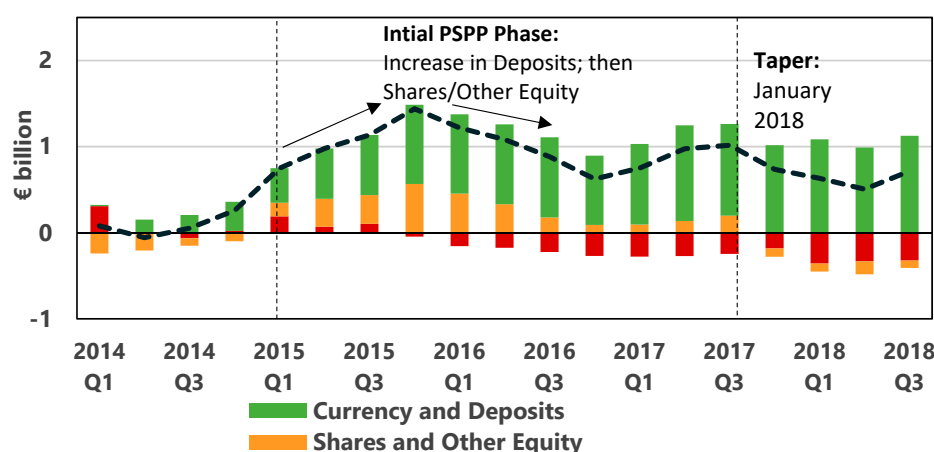


Figure 14. Household Transactions in Financial Assets (Quarterly Moving Average). Source: Central Bank of Ireland.

Irish Banks

Figure 15 shows the security holdings in Irish banks as a percentage of assets over the period 2014 to 2018. It can be seen that Irish banks held a relatively consistent proportion of Irish government bonds over the period 2014 to 2018. In addition, holdings from the private sector (often corporate bonds) consecutively declined, with the CSPP announcement inducing a short upswing between November 2015 and February 2016. However, banks increased their holdings of MFI securities, which refer to credit institutions' money market funds, and other resident financial institutions, over the period. Holdings of securities from other monetary financial institutions rose from 4.2% at the beginning of QE, to over 7.5% of total assets held as at January 2019.

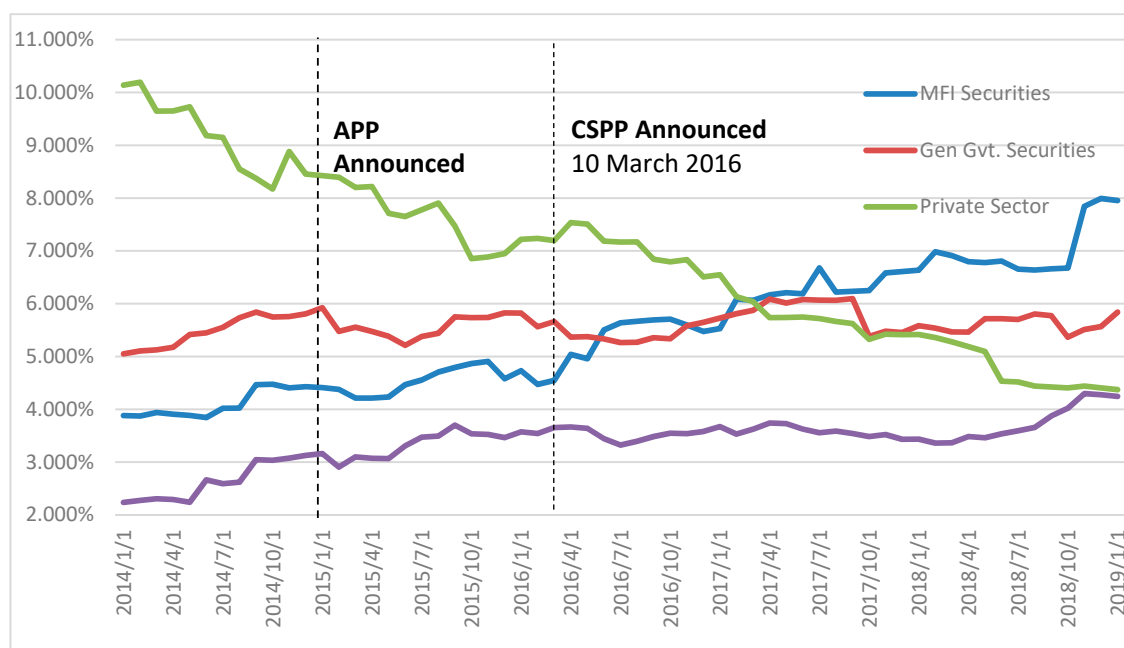


Figure 15. Irish Headquartered Banks—Security Holdings as % of Assets. Source: [Central Bank of Ireland \(2018\)](#).

4.3.2. The APP and Lending Behaviour by Irish Banks

Since the beginning of the APP in March 2015, the findings show that new loan growth to SMEs has grown in aggregate terms. However, this has been heavily biased towards lending for real-estate activities (primarily property investment). Figure 16 shows SME new loan issuance by Irish banks over the period 2014 to June 2018. Prior to the APP, SME real-estate lending made up 11.78% of all new lending, at €106 million for the month of December 2014. This increased to 25.24%, at €397 million, by the APP's tapering in December 2017.

As shown above, loans to SMEs, excluding real-estate-based lending, increased from €768 million in December 2014 to €849 million in September 2018. Indeed, it can be seen that the divergence in real-estate lending relative to other SME loans began around the beginning of the APP. Between March 2013 and March 2015, real estate-based loans bore a correlation coefficient of 0.767 to overall lending. By comparison, between June 2015 and December 2017, this correlation dropped to 0.559, marking a notable alteration in SME lending behavior throughout the APP period. Further investigation is warranted given these initial findings.

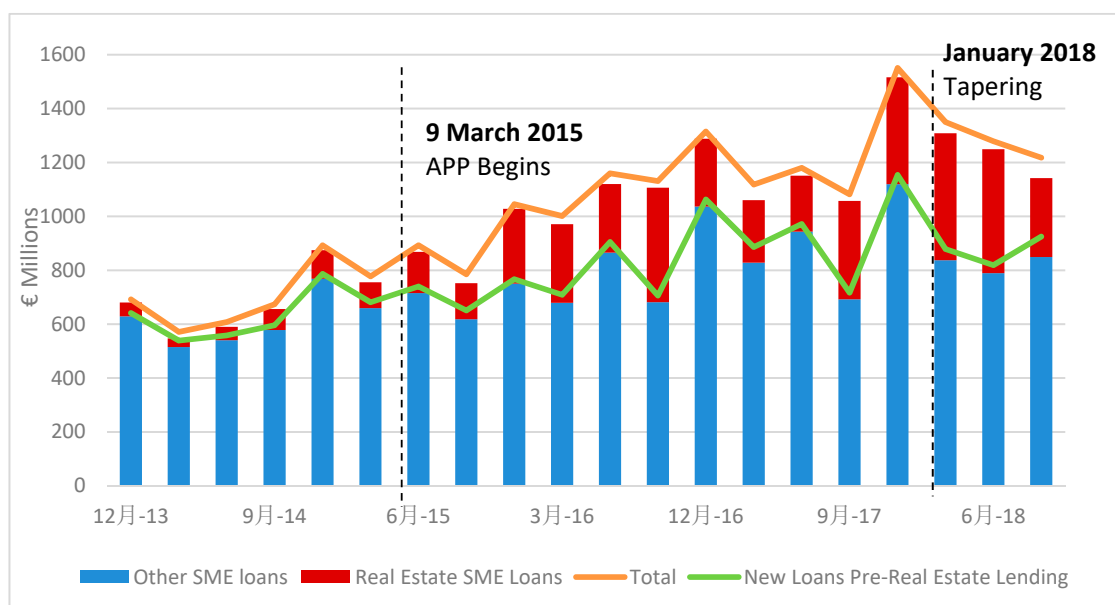


Figure 16. SME New Loan Issuance by Irish Banks. Source: Central Bank of Ireland.

5. Discussion

This paper has combined information from multiple sources in an attempt to identify whether the ECB's APP in Ireland operated through the portfolio rebalancing channel, the signalling channel or the lending channel. In particular, it focuses on the PSPP (from March 2015) and the CSPP (from March 2016), which made up the bulk of the APP. This section discusses four themes that emerged from the research findings and situates this discussion in the economics literature. It is divided into four sections. Section 5.1 considers the portfolio rebalancing channel with respect to government and corporate bonds. Section 5.2 discusses the portfolio rebalancing channel in relation to households and banks. Section 5.3 discusses the signaling channel. Section 5.4 reflects on the lending channel and Section 5.5 reflects on the restructuring of Irish debt.

5.1. Portfolio Rebalancing Channel: Government and Corporate Bonds

The economics literature suggests that the PSPP should act to raise the demand for government bonds directly and corporate bonds indirectly and decrease their yields (Beirne et al. 2011 and Dunne et al. 2015). In general, the findings show that this did occur in the Irish context and that the price action occurred due to signaling or announcement effects rather than actual Irish bond purchases by the Central Bank. The signaling channel will be discussed in greater detail below. In addition, the literature suggests that the CSPP would act to increase the demand and subsequent price for corporate bonds and reduce their yields directly (Gern et al. 2015, p. 208). The findings suggest that this may have been the case in Ireland.

In general, the findings show that the ISEQ saw rapid gains after the ECB formally signaled the CSPP in March 2016 and made further gains throughout the period of the CSPP, with declines occurring after the ECB's formal tapering began in January 2018. Of course, while it is impossible to detangle the impact of the CSPP on the rising ISEQ index over this period from other supportive factors such as improved macroeconomic fundamentals, it is, however, likely that the CSPP did, among other things, improve the performance of the ISEQ over its announcement and implementation phase.

In particular, the findings suggest that one ECB-targeted company, Ryanair, did experience higher corporate bond prices. As with PSPP, it can be seen that the announcement of the CSPP in March 2016 led to immediately higher prices for these corporate bonds and these higher prices remained elevated with monthly ECB purchases between June 2016 and December 2017, after which, prices declined in conjunction with the beginning of the ECB tapering. Other factors affecting Ryanair bond prices such

as strikes and cancellations over this period are not controlled for, but it is likely that, among other things, the CSPP did impact on Ryanair bonds.

The economics literature also suggests that ECB asset purchases had spill-over effects to non-targeted assets (Altavilla et al. 2015, p. 40; Albertazzi et al. 2018, p. 2; Zaghini 2019). The findings suggest that this may have also been the case in the Irish context. For example, the findings show that a non-targeted bond (a 2022 General Electric Bond) increased in line with a targeted bond (a Ryanair 2023 bond) after the announcement of the CSPP in March 2016, with both bond prices remaining elevated during the corporate bond-buying programme.

5.2. Portfolio Rebalancing in Banks and Households

The literature suggests that the portfolio rebalancing channel operates via incentivising banks to rebalance their portfolio from government bonds to riskier assets with higher returns like corporate bonds and loans (Albertazzi et al. 2018, p. 1 and Tischer 2018). However, contrary to expectations, the findings show that Irish banks actually held a relatively consistent proportion of Irish government bonds over the period 2014 to 2018. This shows that Irish banks may not have engaged with the conventional portfolio rebalancing channel cited in the literature or as the ECB initially intended (ECB 2015, pp. 7–8). There may be a few reasons for this.

First, it could be, in part, due to the functioning of Irish banks in the wake of regulatory measures of the Capital Requirements Directive IV, specifically the enforcement of retaining tier-1 capital, and consequences of holding risk-weighted assets (RWAs). As noted by Bonner (2016, p. 2), within these rules, government securities hold a 0% risk weighting, leading to what is termed a ‘regulatory effect’ of choosing to hold these bonds (Andreasen et al. 2015, p. 7). Indeed, the literature suggests that bank regulation, especially risk-based capital constraints, may weaken the effectiveness of non-standard monetary operations as banks ensure that they meet their capital requirements (Peek and Rosengren 1993, p. 36; 1995, p. 23; Albertazzi et al. 2016, p. 16 and Christensen and Krogstrup 2018, p. 20). Second, in an attempt to avoid negative deposit rates on excess reserves induced by the APP, banks may have managed their level of reserves and in particular, pushed on excess reserves like a ‘hot potato’ to other banks (Ryan and Whelan 2019, p. 36). In particular, Ryan and Whelan (2019, p. 36) found evidence that banks may be reducing their reserves by adding to their debt security holdings.

This is connected with a portfolio rebalancing channel that is distinct to that which dominates the literature. Christensen and Krogstrup (2018, p. 25) identify this as a ‘reserve-induced rebalancing’ channel arising from QE which runs through banks’ portfolio responses to reserves expansions and is independent of the types of assets purchased. In particular, banks react to the creation of excess reserves by preserving portfolio optimisation and satisfying balance sheet regulatory procedures.

This reserve-induced rebalancing may also help explain the findings that Irish banks increased their holdings of MFI securities over the QE period. Ryan and Whelan (2019, p. 36) suggest that money markets are another possible avenue for banks trying to push reserves off of their balance sheet, even though they assume that this is not being widely used as a mechanism for reserve management in euro-area banks. The reasons for this increase in MFI-based securities in Irish banks warrants further investigation.

The findings also suggest there was evidence of portfolio rebalancing in Irish households. In particular, the findings show that there was a notable reduction in households’ holdings of long-term government bonds and an increase in their holdings of shares and other equities during 2015 as they chased yield as per the portfolio rebalancing channel. It is likely that household’s portfolio holdings are managed, in the main, by pension and life-assurance funds set up to chase yield across markets. This is echoed in the literature. For example, Carpenter et al. (2015, p. 230) found that during the Federal Reserve QE programme, households (including hedge funds) were one of the investor classes most likely to sell assets to the Federal Reserve.

5.3. The Signalling Channel

In practice, the signalling channel amounts to forward guidance about the future path of monetary policy (Gern et al. 2015, p. 2), a tool used by the ECB since 2013. The economics literature suggests that the signalling of asset purchases by central banks can have a large impact on financial markets in terms of decreased yield and increased prices (Dunne et al. 2015, p. 69; Albertazzi et al. 2018). The findings show that the signaling channel was effective in the Irish context. In terms of the PSPP, the signaling effect seems to have had a more pronounced impact than the actual purchases themselves. Irish long-term yields declined sharply during the debate surrounding the PSPP and the announcement of PSPP in January 2015 and showed no major decline after PSPP purchases actually began in March 2015. In addition, Irish bond yield spreads between different dated securities narrowed before PSPP began in March 2015 with very little compression occurring after March 2015. This corresponds with findings elsewhere in the UK (Haldane et al. 2016, p. 12), the euro area (Altavilla et al. 2015, p. 3; Albertazzi et al. 2018, p. 4 and Neugebauer 2018, p. 22) and Ireland (Larkin et al. 2019, p. 22). It is worth noting that the findings suggest that prior to the PSPP, there is also evidence of the signaling effect on 10-year Irish government bond yields in response to the announcement of the LTRO announcement in December 2012 and the OMT announcement in 2012. This finding in the Irish context is also supported in the literature (Falagiarda and Reitz 2015, p. 287).

5.4. The Lending Channel

The economics literature suggests that the APP should lead to increased bank lending due to banks acting as financial intermediaries and lending out a proportion of their increased deposits arising from APP to households and firms. The findings suggest that there was no marked increase in loans to SME's over the period, with the exception of real-estate lending, on the back of the APP. In particular, this channel may have been relatively weak as Irish banks grappled with high rates of non-performing loans (NPLs). Donnery et al. (2018, pp. 58–59) argue that although the aggregate domestic Irish banking system NPL ratio fell from 32 percent in 2013 to below 14 percent at end-2017 and the volume of NPLs on Irish banks' balance sheets fell from over €80 billion to €30 billion over the period from 2013 to 2017, NPLs remain one of the primary sources of vulnerability facing the Irish economy (Donnery et al. 2018, p. 55). In particular, this impaired balance sheet performance can negatively impact on credit supply⁷ (Altavilla et al. 2019, p. 57 and Altavilla et al. 2019, p. 3). Albertazzi et al. (2018, pp. 19–20) also suggests that there was greater portfolio rebalancing by banks towards real-sector loans in 'non-vulnerable' than in 'vulnerable countries' like Ireland. This may have been because in 'non-vulnerable' countries, banks choices of higher yielding assets were diminished due to already compressed spreads pushing them towards real-sector loans (where spreads remained higher). In addition, bank capital constraints in the wake of the financial crisis referred to above may have increased the (effective or perceived) constraints of banks' ability to expand credit supply (Albertazzi et al. 2016, p. 16). It may also reflect the view that the level of deposits or reserves in banks are not important in determining bank lending that is expressed in the literature (Disyatat 2010, p. 2; Fullwiler 2013, p. 186; McLeay et al. 2014, p. 1; Bundesbank 2017, p. 17). Either way, more work needs to be done on the reasons why Irish banks did not increase lending substantially on the back of the APP. This reluctance by Irish banks to portfolio rebalance towards loans in response to central bank asset purchases has important implications for the wider economy as this channel is essential to ensuring investment and economic growth (Altavilla et al. 2019, p. 3).

The literature also suggests well-capitalised banks are a prerequisite to an effective bank lending channel arising from unconventional monetary policy (Boeckx et al. 2016, p. 3; Albertazzi et al. 2016, p. 16 and Bruno et al. 2017, p. 26; Albertazzi et al. 2018, p. 20). The Irish central banks extra capital

⁷ It is worth noting that the poor increase in loans to SME's over the period may also be driven by weak credit demand in this sector and it is difficult to separate these demand and supply effects in practice.

requirement, the “countercyclical capital buffer” or CCyB, on Irish banks is to be welcomed in this regard. The Irish CCyB ensures that banks must hold sufficient capital in relation to the loans they make and was increased from 0% to 1% from July 2019 (Central Bank of Ireland 2018). While the CCyB does not restrain lending in good times, it should ensure that Irish banks will be more likely to increase lending during recessionary periods in the future. In particular, the CCyB safeguards against cyclical risk by adding to capital requirements during positive phases, in order that credit supply can be preserved during downturns by corresponding subtractions in capital requirements (Central Bank of Ireland 2018; Lane 2019). This counter cyclical measure is supported in the literature. For example, Boeckx et al. (2016, p. 23) argues that banks need to have a sufficient buffer over their minimum capital requirements to be able to transmit the easier financial conditions of non-conventional monetary policy to the rest of the economy, especially in times of stress.

5.5. Irish Debt Restructuring

A related point is the debt restructuring undertaken by the NTMA that occurred as a result of the ECB’s APP. The findings suggest that there is a correlation between the proportion of PSPP in Ireland for a given quarter (as per the national accounts) and the decrease in Irish long-term debt over that same period. In particular, the NTMA used the PSPP to extend the maturity profile of Ireland’s debt and consequently lock-in the benefits of low interest rates, which has reduced their borrowing costs over the medium-term (NTMA 2019). Over the 2015–2017 period, the NTMA issued close to €40 billion in new benchmark bond funding at a weighted average yield of just over 1% and a weighted average maturity of almost 14 years (NTMA 2017, p. 5). This finding is corroborated in the literature. Larkin et al. (2019, p. 14) found that the APP indirectly supported increased issuance of Irish sovereign debt at lower interest rates, which in turn, has reduced Ireland’s debt servicing costs. It is worth noting, however, that while this somewhat insulates the NTMA from rising interest rates as the APP unwinds and interest rates eventually increase, the Irish Gross National Debt level remains high in absolute terms at over €214 billion (April 2019), as a legacy of the financial crisis.

6. Conclusions

The ECB ended new asset purchases as part of the expanded asset purchase programme in December 2018 and moved to a reinvestment phase as of January 2019. Therefore, it is an appropriate time to consider how the ECB’s APP was transmitted in Ireland. The main research question was to identify whether the ECB’s APP in Ireland operated through the portfolio rebalancing channel, the signalling channel or the lending channel. There are a number of preliminary findings. First, much of the downward pressure on sovereign debt yield and spreads occurred before the PSPP began in March 2015 due to previous accommodative monetary policy and the signalling channel. Second, the CSPP did impact on targeted bonds and had spill overs to non-targeted bonds. Third, the APP did not lead to substantial increased lending to the SME sector, with the exception of real-estate lending. Fourth, while households did engage in traditional portfolio rebalancing, Irish banks did not but were rather more likely to meet capital requirements and manage their reserve holdings. Some possible explanations for this bank behaviour are offered based on the literature. The links drawn are not definitive and more work will need to be done to detangle the transmission of the most recent APP from other factors and consider these findings in the context of theoretical models. This is left to future research. Such work is important to help inform policy makers on enhancing the transmission mechanism to the Irish economy of the recently launched new ECB asset purchase programme at a monthly pace of €20 billion from 1 November 2019 (ECB 2019b).

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References

- Albertazzi, Ugo, Andrea Nobili, and Federico Maria Signoretti. 2016. The bank lending channel of conventional and unconventional monetary policy. *SSRN; Working Paper Series*, No 1094; Banca d'Italia, December 15. Available online: https://www.bancaditalia.it/publicazioni/temi-discussione/2016/2016-1094/en_tema_1094.pdf?language_id=1 (accessed on 20 January 2019). [CrossRef]
- Albertazzi, Ugo, Bo Becker, and Miguel Boucinha. 2018. Portfolio rebalancing and the transmission of large-scale asset programmes: Evidence from the euro area. *European Central Bank working Paper Series*. No. 1225; European Central Bank, May 23. Available online: <https://www.ecb.europa.eu/pub/pdf/scpwps/ecb.wp2125.en.pdf> (accessed on 22 February 2019).
- Altavilla, Carlo, Giacomo Carboni, and Roberto Motto. 2015. Asset Purchase Programmes and Financial Markets: Lessons from the Euro Area. No. 1864. European Central Bank. Available online: <https://www.ecb.europa.eu/pub/pdf/scpwps/ecbwp1864.en.pdf> (accessed on 10 May 2018). [CrossRef]
- Altavilla, Carlo, Desislava Andreeva, Miguel Boucinha, and Sarah Holton. 2019. Monetary Policy, credit institutions and the bank lending channel in the euro area. *ECB Occasional Paper*. May. Available online: <https://www.ecb.europa.eu/pub/pdf/scpops/ecb.op222~{}834b5fece7.en.pdf?729d2503dea9870399465dc23c1d4f8e> (accessed on 30 May 2019). [CrossRef]
- Andrade, Philippe, Johannes Breckenfelder, Fiorella De Fiore, Peter Karadi, and Oreste Tristani. 2016. *The ECB's Asset Purchase Programme: An Early Assessment*. Working Paper No 1956. Frankfurt: ECB.
- Andreassen, Brian, Morten Haastrup, Thorston Larsen, and Lindis Oma. 2015. Favourable Treatment of Government Bonds in Financial Regulation. *Denmark National Bank Monetary Review*, 1st Quarter. Available online: https://www.nationalbanken.dk/en/publications/Documents/2015/03/Favourable%20treatment_Mon1-15_UK.pdf (accessed on 12 December 2018).
- Bank of Finland. 2018. CSPP Irish Holdings (ISIN Codes Only). Available online: https://www.suomenpankki.fi/find_v2/_click?_t_id=oNYtoRGqVUySELJjHJPXXw%3d%3d&_t_uuid=WVGsEmS4S9GGQ4LZYtjhug&_t_q=cspp&_t_tags=language%3afi%2csiteid%3a4a002108-dc8a-45da-be63-d5ceff3cc3a1%2candquerymatch&_t_hit.id=SuomenPankki_Web_Models_Media_GenericMedia/_6702ac02-5c82-40f9-aa72-b1200bb097f2&_t_hit.pos=5&_t_redirect=https%3A%2F%2Fwww.suomenpankki.fi%2Fglobalassets%2Ffi%2Fmedia-ja-julkaisut%2Fjulkaisut%2Fohjeet_ja_saannot%2Fvastapuoli%2Fdocuments%2Fcspp_isins_10122018.csv (accessed on 18 December 2018).
- Beirne, John, Lars Dalitz, Jacob Ejsing, Magdalena Grothe, Simone Manganeli, Fernando Monar, Benjamin Sahel, Matjaz Susec, Jens Tapking, and Tana Vong. 2011. The impact of the Eurosystem's Covered Bond Purchase Programme on the Primary and Secondary Markets. *Occasional Paper Series* No. 122; European Central Bank, January. Available online: <https://ssrn.com/abstract=1646280> or <https://www.ecb.europa.eu/pub/pdf/scpops/ecbocp122.pdf> (accessed on 22 October 2018).
- Benford, James, Berry Stuart, Kalin Nikolov, Chris Young, and Mark Robson. 2009. Quantitative easing. *Bank of England Quarterly Bulletin*, 2009, Q2. Available online: <https://www.bankofengland.co.uk/-/media/boe/files/quarterly-bulletin/2009/quantitative-easing.pdf?la=en&hash=0A59C421AC345729A53E1D976D0064E046884369> (accessed on 11 November 2018).
- Bhattarai, Saroj, Gauti B. Eggertsson, and Bulat Gafarov. 2015. Time Inconsistency and the Duration of Government Debt: A Signaling Theory of Quantitative Easing. *NBER Working Paper* No. 21336. July. Available online: <https://www.nber.org/papers/w21336> (accessed on 20 November 2018).
- Boeckx, Jef, Maite De Sola Perea, and Gert Peersman. 2016. The Transmission Mechanism of Credit Support Policies in the Euro Area. *Working Paper Research Series*, No 302; Nationale Bank van België/Banque Nationale de Belgique. Available online: https://www.ifo.de/DocDL/cesifo1_wp6442.pdf (accessed on 15 November 2018).
- Bonner, Clemens. 2016. Preferential Regulatory Treatment and Banks' Demand for Government Bonds. *Journal of Credit, Money and Banking* 28: 1195–21. Available online: <https://onlinelibrary.wiley.com/doi/abs/10.1111/jmcb.12331> (accessed on 10 May 2019). [CrossRef]

- Brózda, Dominika. 2016. Transmission Mechanism of the Federal Reserve System's Monetary Policy in the Conditions of Zero Bound on Nominal Interest rates. *Equilibrium. Quarterly Journal of Economics and Economic Policy* 11: 751–67. Available online: https://www.researchgate.net/publication/332259296_Transmission_Mechanism_of_the_Federal_Reserve_System%27s_Monetary_Policy_in_the_Conditions_of_Zero_Bound_on_Nominal_Interest_Rates (accessed on 13 June 2019). [CrossRef]
- Bruno, Brunella, Alexandra D'Onofrio, and Immacolata Marino. 2017. Determinants of Bank Lending in Europe and the US: Evidence from Crisis and Post Crisis Years. Centre for Studies in Economics and Finance. Working Paper, No. 402. January. Available online: <http://www.csef.it/WP/wp462.pdf> (accessed on 22 February 2019).
- Bundesbank. 2017. The Role of Banks, non-Banks and the Central Bank in the Money Creation Process. Bundesbank.de. Deutsche Bundesbank Monthly Report. April. Available online: <https://www.bundesbank.de/resource/blob/654284/df66c444d065a7f519e2ab0c476df58/mL/2017-04-money-creation-process-data.pdf> (accessed on 4 May 2019).
- Butt, Nicholas, Rohan Churm, Michael F. McMahon, Arpad Morotz, and Jochen F. Schanz. 2014. QE and the Bank Lending Channel in the United Kingdom. Bank of England, Working Paper No. 511. September. Available online: <https://www.bankofengland.co.uk/-/media/boe/files/working-paper/2014/qe-and-the-bank-lending-channel-in-the-uk.pdf?la=en&hash=6AF72E1A11C9CCCE53D1A8CBA0D35AB8D95D8E31> (accessed on 11 November 2018).
- Carpenter, Seth, Selva Demiralp, Jane Ihrig, and Elizabeth Klee. 2015. Analysing Federal Reserve Asset Purchases: From whom does the Fed buy? *Journal of Banking & Finance* 52: 230–44. Available online: <https://www.sciencedirect.com/science/article/pii/S0378426614002052> (accessed on 5 April 2019).
- Central Bank of Ireland. 2018. Banks Directed to Adhere to New Capital Requirements from July 2019. *Press Release*. July 5. Available online: <https://www.centralbank.ie/news-media/press-releases/banks-directed-to-adhere-to-new-capital-requirements-from-july-2019-5-july-2018> (accessed on 15 March 2019).
- Christensen, Jens, and Signe Krogstrup. 2018. A Portfolio Model of Quantitative Easing. Working Paper 2016-12. Federal Reserve Bank of San Francisco. Available online: <https://www.frbsf.org/economic-research/files/wp2016-12.pdf> (accessed on 11 February 2019).
- De Santis, Roberto A., André Geis, Aiste Juskaite, and Lia Vaz Cruz. 2018. The impact of the corporate sector purchase programme on corporate bond markets and the financing of euro area non-financial corporations. *Economic Bulletin Articles* 3: 66–84. Available online: https://www.ecb.europa.eu/pub/pdf/other/ecb.ebart201803_02.en.pdf (accessed on 15 March 2019).
- Dedola, Luca, Georgios Georgiadis, Johannes Gräb, and Arnaud Mehl. 2018. Does a Big Bazooka Matter? Central Bank Balance-Sheet Policies and Exchange Rates (2018-11-02). Globalization and Monetary Policy Institute Working Paper No. 350. Available online: <https://ssrn.com/abstract=3289012> or <http://dx.doi.org/10.24149/gwp350> (accessed on 5 January 2019).
- Demertzis, Maria, and Guntram B. Wolff. 2016. The Effectiveness of the Central Bank's Asset Purchase Programme. Bruegel Policy Contribution, Issue 2016-10. June. Available online: http://bruegel.org/wp-content/uploads/2016/06/pc_2016_10-1.pdf (accessed on 21 March 2019).
- Disyatat, Piti. 2010. The Bank Lending Channel Revisited. BIS working Papers. No. 297. Available online: <https://www.bis.org/publ/work297.pdf> (accessed on 19 October 2018).
- Donnery, Sharon, Trevor Fitzpatrick, Darren Greaney, Fergal McCann, and Micheal O'Keeffe. 2018. Resolving Non-Performing Loans in Ireland: 2010–2018. Special Article, Central Bank of Ireland. *Quarterly Bulletin*. April 2, pp. 54–70. Available online: [https://www.centralbank.ie/docs/default-source/publications/quarterly-bulletins/quarterly-bulletin-signed-articles/resolving-non-performing-loans-in-ireland-2018-\(donnery-fitzpatrick-greaney-mccann-and-o%27T1%20textquoterightkeeffe\).pdf?sfvrsn=6](https://www.centralbank.ie/docs/default-source/publications/quarterly-bulletins/quarterly-bulletin-signed-articles/resolving-non-performing-loans-in-ireland-2018-(donnery-fitzpatrick-greaney-mccann-and-o%27T1%20textquoterightkeeffe).pdf?sfvrsn=6) (accessed on 5 April 2019).
- Dunne, Peter, Mary Everett, and Rebecca Stuart. 2015. The Expanded Asset Purchase Programme—What, why and How of Euro Area QE. *Central Bank of Ireland Quarterly Bulletin*. July 3, pp. 61–71. Available online: <https://www.centralbank.ie/docs/default-source/publications/quarterly-bulletins/quarterly-bulletin-signed-articles/the-expanded-asset-purchase-prog.pdf?sfvrsn=4> (accessed on 22 October 2018).
- ECB. 2014a. ECB announces operational details of asset-backed securities and covered bond purchase programmes. *ECB Press Release*. October 2. Available online: https://www.ecb.europa.eu/press/pr/date/2014/html/pr141002_1.en.html (accessed on 22 September 2018).

- ECB. 2014b. The ECB's Forward Guidance. *ECB Monthly Bulletin*. April. Available online: https://www.ecb.europa.eu/pub/pdf/other/art1_mb201404en_pp65-73en.pdf (accessed on 11 October 2018).
- ECB. 2014c. Recommendations of the European Central Bank. *Official Journal of the European Union*. March 27. Available online: https://www.ecb.europa.eu/ecb/legal/pdf/oj_joc_2014_186_r_0001_en_txt.pdf (accessed on 17 October 2018).
- ECB. 2015. ECB Announces Expanded Asset Purchase Programme. Available online: https://www.ecb.europa.eu/press/pr/date/2015/html/pr150122_1.en.html (accessed on 12 February 2019).
- ECB. 2016. ECB adds corporate sector purchase programme (CSPP) to the asset purchase programme (APP) and announces changes to APP. *ECB Press Release*. March 10. Available online: https://www.ecb.europa.eu/press/pr/date/2016/html/pr160310_2.en.html (accessed on 16 October 2018).
- ECB. 2019a. Public Sector Purchase Programme (PSPP)—Questions & Answers, 2.1. Allocation of Purchases. Available online: <https://www.ecb.europa.eu/mopo/implement/omt/html/pspp-qa.en.html> (accessed on 19 October 2018).
- ECB. 2019b. Press Release Monetary Policy Decisions. September 12. Available online: <https://www.ecb.europa.eu/press/pr/date/2019/html/ecb.mp190912~{j08de50b4d2.en.html> (accessed on 12 September 2019).
- Eggertsson, Gauti, and Michael Woodford. 2003. The Zero Bound on Interest Rates and Optimal Monetary Policy. *Brookings Papers on Economic Activity*. No. 1. Available online: <http://www.columbia.edu/~{mw2230/BPEA.pdf> (accessed on 15 February 2019).
- Falagiarda, Matteo, and Stefan Reitz. 2015. Announcements of ECB unconventional programs: Implications for the sovereign spreads of stressed euro area countries. *Journal of International Money and Finance* 53: 276–95. Available online: <https://www.sciencedirect.com/science/article/pii/S0261560615000200> (accessed on 17 October 2019). [CrossRef]
- Ferrari, Massimo, Jonathan Kearns, and Andreas Schrimpf. 2017. Monetary policy's rising FX impact in the era of ultra-low rates. *BIS Working Papers* No 626. SSRN; Monetary and Economic Department, March 21. Available online: <https://www.bis.org/publ/work626.pdf> (accessed on 15 February 2019).
- Fullwiler, Scott T. 2013. An endogenous money perspective on the post-crisis monetary policy debate. *Review of Keynesian Economics* 1: 171–94. Available online: https://www.researchgate.net/publication/256043652_An_Endogenous_Money_Perspective_on_the_Post-Crisis_Monetary_Policy_Debate (accessed on 15 October 2018). [CrossRef]
- Gern, Klaus-Jürgen, Nils Jannsen, Stefan Kooths, and Maik Wolters. 2015. Quantitative Easing in the Euro Area: Transmission Channels and Risks. *Quantitative Easing in the Euro Area: Transmission Channels and Risks*. Available online: <https://archive.intereconomics.eu/year/2015/4/quantitative-easing-in-the-euro-area-transmission-channels-and-risks/> (accessed on 8 November 2018).
- Glick, Reuven, and Sylvain Leduc. 2013. The Effects of Unconventional and Conventional U.S. Monetary Policy on the Dollar. *Federal Reserve Bank of San Francisco Working Paper Series* 2013-11. Available online: <https://www.frbsf.org/economic-research/files/wp2013-11.pdf> (accessed on 16 October 2018).
- Haldane, Andrew, Matt Roberts-Sklar, Chris Young, and Tomasz Wieladek. 2016. QE: The story so far. *Bank of England Staff Working Paper* No. 624. Available online: <https://www.bankofengland.co.uk/working-paper/2016/qe-the-story-so-far> (accessed on 16 October 2018).
- Houses of the Oireachtas. 2019. Small and Medium Sized Businesses in Ireland. *Seanad Public Consultation Committee Report*. Available online: https://data.oireachtas.ie/ie/oireachtas/committee/dail/32/seanad_public_consultation_committee/reports/2019/2019-05-16_small-and-medium-sized-businesses-in-ireland_en.pdf (accessed on 16 July 2019).
- Joyce, Michael, Zhuoshi Liu, and Ian Tonks. 2014. Institutional investor portfolio allocation, quantitative easing and the global financial crisis. *Bank of England Working Paper* No. 510. Available online: <https://www.bankofengland.co.uk/working-paper/2014/institutional-investor-portfolio-allocation-quantitative-easing-and-the-global-financial-crisis> (accessed on 18 October 2018).
- Krishnamurthy, Arvind, and Annette Vissing-Jorgensen. 2013. The Ins and Outs of LSAPs. Paper presented at Proceedings—Economic Policy Symposium—Jackson Hole, Federal Reserve Bank of Kansas City, Jackson Hole, WY, USA, August 21–23; Available online: <http://faculty.haas.berkeley.edu/vissing/jh.pdf> (accessed on 17 October 2018).

- Lane, Philip. 2019. Tail Risks and the Irish Economy. Lecture delivered to UCD School of Economics. April 16. Available online: <https://www.centralbank.ie/news/article/tail-risks-and-the-irish-economy-governor-philip-r-lane> (accessed on 20 May 2019).
- Larkin, John, Pj Anderson, and Sean Furlong. 2019. The Irish Government Bond Market and Quantitative Easing. *Central Bank of Ireland Quarterly Bulletin*. April 2. Available online: [https://www.centralbank.ie/docs/default-source/publications/quarterly-bulletins/quarterly-bulletin-signed-articles/the-irish-government-bond-market-and-quantitative-easing-\(larkin-anderson-and-furlong\).pdf](https://www.centralbank.ie/docs/default-source/publications/quarterly-bulletins/quarterly-bulletin-signed-articles/the-irish-government-bond-market-and-quantitative-easing-(larkin-anderson-and-furlong).pdf) (accessed on 23 May 2019).
- Lavoie, Marc. 2014. *Post-Keynesian Economics: New Foundations*, 1st ed. Cheltenham: Edward Elgar Publishing.
- McLeay, Michael, Amar Radia, and Ryland Thomas. 2014. Money Creation in the Modern Economy. Bankofengland.co.uk. Available online: <https://www.bankofengland.co.uk/-/media/boe/files/quarterly-bulletin/2014/money-creation-in-the-modern-economy> (accessed on 4 May 2019).
- Moessner, Richhild, and Phurichai Rungcharoenkitkul. 2019. The zero lower bound, forward guidance and how markets respond to news. *BIS Quarterly Review*. March 5. Available online: https://www.bis.org/publ/qtrpdf/r_qt1903h.htm (accessed on 10 May 2019).
- Neugebauer, Frederic. 2018. The Effects of the ECB's Asset Purchase Announcements on Euro Area Government Bond Yields. Available online: https://cepr.org/sites/default/files/40021_Neugebauer_ECB%20announcements_Neugebauer.pdf (accessed on 19 October 2018).
- NTMA. 2017. NTMA Annual Report 2017. Available online: <https://www.ntma.ie/download/publications/NTMA-Annual-Report-2017.pdf> (accessed on 23 May 2019).
- NTMA. 2019. NTMA Investor Presentation January 2019. Available online: <https://www.ntma.ie/uploads/publication-articles/Investor-Presentation-January-2019.pdf> (accessed on 23 May 2019).
- Peek, Joe, and Eric Rosengren. 1993. Bank Regulation and the Credit Crunch. Federal Reserve Bank of Boston Working Paper Series No. 93. February 2. Available online: http://scholar.google.com/scholar_url?url=https://www.bostonfed.org/-/media/Documents/Workingpapers/PDF/wp93_2.pdf&hl=en&sa=X&scisig=AAGBfm1CNHhYA0ZpEEzUnW4ltwjAmkiTxQ&nossl=1&oi=scholar (accessed on 17 September 2019).
- Peek, Joe, and Eric Rosengren. 1995. Bank Regulatory Agreements in New England. *New England Economic Review*, May/June.
- Ryan, Ellen, and Karl Whelan. 2019. Quantitative Easing and the Hot Potato Effect: Evidence from Euro Area Banks. Research Technical Paper. SSRN. February 4. Available online: [https://www.centralbank.ie/docs/default-source/publications/research-technical-papers/01rt19-quantitative-easing-and-the-hot-potato-effect-evidence-from-euro-area-banks-\(ryan-and-whelan\).pdf](https://www.centralbank.ie/docs/default-source/publications/research-technical-papers/01rt19-quantitative-easing-and-the-hot-potato-effect-evidence-from-euro-area-banks-(ryan-and-whelan).pdf) (accessed on 22 April 2019).
- Tischer, Johannes. 2018. Quantitative Easing, Portfolio Rebalancing and Credit Growth: Micro Evidence from Germany. Bundesbank Discussion Paper, No. 20. Available online: <https://www.econstor.eu/bitstream/10419/180673/1/1027069444.pdf> (accessed on 15 September 2018).
- Urbschat, Florian, and Sebastian Watzka. 2017. Quantitative Easing in the Euro Area. Munich Discussion Paper No. 2017-10. Department of Economics University of Munich. Available online: <https://pdfs.semanticscholar.org/3c25/7a16bbc130d1a96c6875736228ef7edcc7bc.pdf> (accessed on 16 September 2018).
- Zaghini, Andrea. 2019. The CSPP at work, yield heterogeneity and the portfolio rebalancing channel. ECB working Paper Series, No. 2264. *Journal of Corporate Finance* 56: 282–97. Available online: <https://www.ecb.europa.eu/pub/pdf/scpwps/ecb.wp2264~{c4382400c5.en.pdf?aa27b02e90dfab19b28f36dd5c8e3ed0> (accessed on 5 June 2019). [CrossRef]

