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The Irish Government
Bond Market and Quantitative Easing

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The Irish Government Bond Market and Quantitative Easing

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Abstract

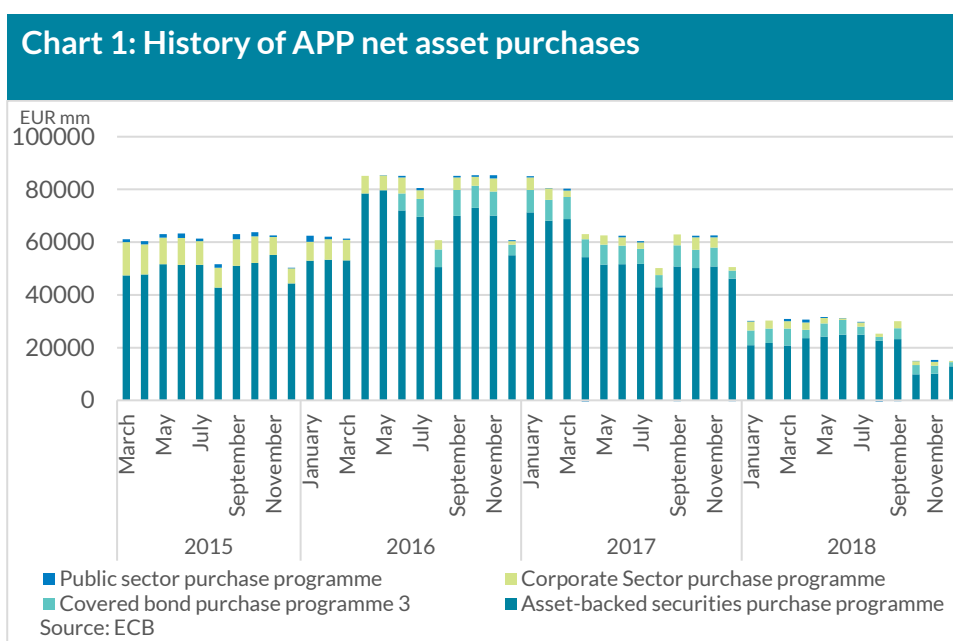
Between September 2014 and the end of 2018, under the ECB's Asset Purchase Programme (APP), the Eurosystem purchased over €2.5 trillion worth of securities. By the end of December 2018, over €30bn of Irish government bonds, a significant portion of the Irish government bond market, had been purchased under the programme. As might be expected after such an event, the bond market has undergone a number of changes. We examine these changes under three key themes. Firstly, we look at the impact on yields. Secondly, we look at the market structure in terms of the duration, the cost of Irish government debt and the change in the structure of the investor base. Finally, we examine the impact on the liquidity of Irish government bonds over the period. We present strong evidence that announcement effect of the APP caused a compression of Irish bond yields. This has contributed to financing conditions that indirectly support increased issuance of Irish sovereign debt at lower interest rates, which in turn has reduced Ireland's debt servicing costs. The maturity profile of Irish government debt has also been extended. Finally, we find little evidence that liquidity conditions deteriorated over the period, contrary to expectations when the programme was announced.

¹ The authors work in the Financial Markets Division. The views expressed in this article are those of the authors only, and do not necessarily reflect the views of the Central Bank of Ireland. The authors would like to thank Peter Sinnott, Daragh Cronin, Elizabeth Frayne, Robert Goodhead, John Nash, Patrick Haran, as well as Rossa White and David Purdue of the NTMA for their helpful comments and suggestions.

1. Introduction

In January 2015, the ECB's Governing Council decided to introduce the Public Sector Purchase Programme (PSPP), commonly known as quantitative easing (QE), to its suite of existing private sector asset purchase programmes. Under the PSPP, the Eurosystem purchased euro area bonds, issued by central governments, on a large scale in pursuit of its price stability objective². This built on the existing private sector purchase programmes, the Third Covered Bond Purchase Programme (CBPP3) and the Asset-Backed Securities Purchase Programme (ABSPP), which were initiated in October and November 2014 respectively. The Corporate Sector Purchase Programme (CSPP) was added later, in June 2016.

While the ECB had purchased government bonds in the past under the Securities Markets Programme (SMP), the scale and objectives of the PSPP represented uncharted territory for the ECB³. The first purchases under the PSPP were conducted on 9 March 2015. Following the end of net purchases in December 2018, the cumulative net purchases under the PSPP across the euro area amount to €2.17tn. Chart 1 shows the evolution of APP purchases over time across its four component purchase programmes. The monthly APP net purchase pace was adjusted a number of times in response to an evolving inflation outlook.



² The securities purchasable under the PSPP also included bonds issued by recognised agencies, regional and local governments, international organisations and multilateral development banks located in the euro area.

³ The SMP was an asset purchase programme introduced in 2010, with the aim of alleviating market tensions in particular sovereign bond markets, which were hampering the transmission of monetary policy. In contrast to the PSPP, the SMP was designed to be neutral with respect to the supply of central bank liquidity as purchases under SMP were sterilised.

Purchasing bonds on a large scale reduces the supply of those securities in the secondary market, which puts upward pressure on the price and downward pressure on yields. The compression of yields on government bonds is among the primary channels through which central bank bond buying affects inflation.⁴ Sovereign bond yields are used in the pricing of a broad range of interest rates relevant to the real economy. Given that the ECB had reached the effective lower bound on interest rates, the purchase programme has been a powerful non-standard tool to lower financing conditions more generally in order to stimulate economic activity and put upward pressure on inflation. Purchases also affect inflation through other transmission channels such as the portfolio-rebalancing channel, the signalling channel and the exchange rate channel.

From the outset, the ECB acknowledged the “potential distortive effects of central bank action on the formation of market prices”, and set out a strategy for minimising such unintended consequences, including on bond market liquidity.⁵ This strategy included a number of safeguards that would aim to protect both market functioning and market liquidity. The measures imposed included limits⁶ on the proportion of each issuer’s outstanding PSPP-eligible debt that could be held by the ECB and the prohibition of purchases of public sector debt in the primary market. Purchases were conducted in the secondary market at the prevailing market price and in a market neutral manner, while the PSPP holdings were made available to the market for securities lending, with the aim of supporting market liquidity by alleviating bond scarcity borrowing.⁷

This article investigates the evolution of the Irish government bond market since the beginning of the PSPP. The analysis captures some of the effects of PSPP on the market. Section 2 examines the background of the PSPP from an Irish implementation perspective. Section 3 examines the impact of APP on Irish sovereign bond yields. Section 4 looks at the developments in the Irish bond market over time, in terms of the duration and cost of Irish government debt and the change in the structure of the investor base.

⁴ For a description of the channels through which the APP affects inflation, see Box 1 ‘The Governing Council’s Expanded Asset Purchase Programme.’ ECB Economic Bulletin Issue 1, 2015.

⁵ “*Embarking on public sector asset purchases*”, speech by Benoît Cœuré, Member of the Executive Board of the ECB, at the Second International Conference on Sovereign Bond Markets, Frankfurt, 10 March 2015.

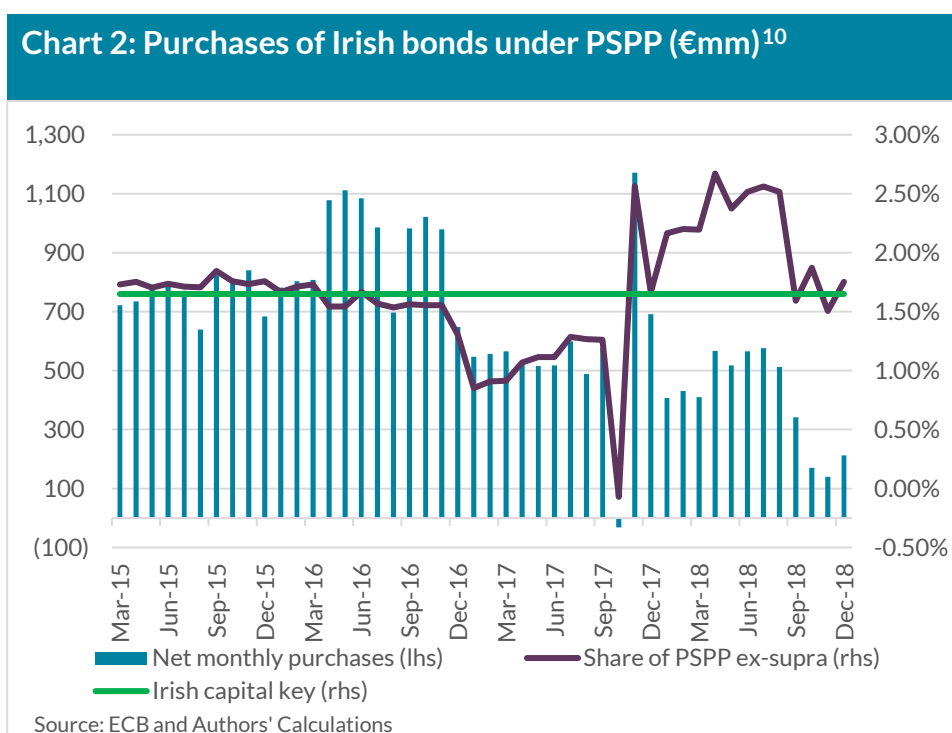
⁶ Eurosystem holdings of PSPP-eligible bonds such as Securities Markets Programme (SMP) and any other portfolios owned by NCBs are included in the calculation for the issuer limit and issue limit.

⁷ For an overview of the initial modalities around the programme see “Box 1: The euro area expanded asset purchase programme”, Central Bank of Ireland Annual Report 2015.

Section 5 assesses what impact the PSPP has had over the period on the liquidity of the Irish government bond market. Section 6 concludes.

2. Implementation of QE in Ireland

As with other Eurosystem monetary policy operations, while the ECB coordinates operations on a system wide basis, the PSPP is implemented on a decentralised basis. Thus, one significant difference between the ECB's QE programme and that of other major global central banks is that it is implemented in nineteen sovereign states and thus multiple sovereign bond markets. In order to provide an appropriate guide for the implementation of purchases across euro area countries, the ECB's capital key was considered the most appropriate metric since it is based on the population and the size of the economy in each country. For Ireland, this meant that the capital key of 1.65 per cent would guide the allocation of PSPP purchases of Irish government bonds.⁸ Chart 2 presents the evolution of Irish purchases under PSPP.⁹



⁸ While each NCB is responsible for purchasing domestic bonds in its own jurisdiction, the ECB also purchases in each jurisdiction in order to maintain the risk-sharing profile of the PSPP.

⁹ The sharp decrease in October 2017 is due to the redemption of PSPP holdings of the Irish government bond that matured in this month. Due to the size of the redemption, the Bank opted to reinvest the maturing principal over two months rather than one, in accordance with the flexibility granted by the Governing Council.

¹⁰ The share of PSPP ex-supra refers to PSPP purchases excluding the 10% allocation for marketable debt instruments issued by international or supranational institutions located in the euro area (from March 2015 until March 2016 this figure was 12%).

The volume of monthly purchases of Irish government bonds under the PSPP fluctuated over time for two reasons: firstly, volumes were adjusted in accordance with the total PSPP target, and secondly, the Irish purchase share was adjusted due to issuer limit constraints. In order to preserve market functioning the Central Bank, similar to other National Central Banks (NCBs), is restricted to a maximum holding of 33 per cent of the nominal amount of the total outstanding PSPP-eligible bonds, and 33 per cent of any individual government bond. Due to the Eurosystem's legacy holdings of Irish government bonds related to the SMP, as well as the size of the Central Bank's so-called "Special Portfolio"¹¹ holdings, the issuer limit was a binding constraint to Irish purchases throughout much of the implementation period.¹² As a result, after purchasing Irish government bonds at close to the capital key share for the first two years of the programme, this share dropped sharply in early 2017 following the extension of the programme to the end of that year.

However, the ability to purchase Irish bonds under the Programme improved during late 2017 due to: (i) higher than expected National Treasury Management Agency (NTMA) issuance, (ii) accelerated disposals of Floating Rate Notes (FRNs) from the Special Portfolio by the Central Bank, and (iii) lower projected APP purchase pace in 2018, the share of Irish government bond purchases increased. For many months of 2018, Irish monthly purchases were above the capital key share (1.65 per cent), with the objective of reducing the negative deviation from capital key on a stock basis. As of 31 December 2018, cumulative net purchases of Irish government bonds by the Eurosystem (purchases by both the CBI and the ECB) amounted to €30.1bn, which represents a 1.55 per cent share of total PSPP purchases (excluding supranational bonds).

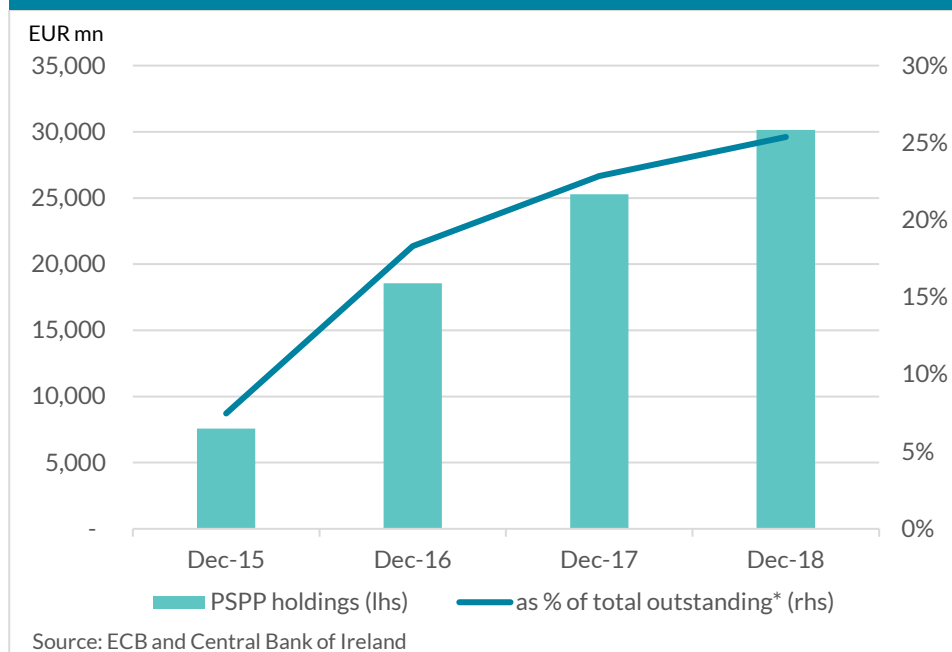
Net PSPP purchases ended in December 2018 and the Governing Council announced that the full reinvestment of maturing principal amounts in PSPP (and private sector purchase programmes) would continue "for an extended period of time past the date when it starts raising the key ECB interest rates". Accordingly, the period from January 2019 onwards can be referred to as the APP "reinvestment phase". The Governing Council also announced that during the PSPP reinvestment phase, the capital key would continue to guide purchases on a stock basis. This means that in principle redemptions are reinvested in the jurisdiction in which principal repayments are made. Furthermore, adjustments will be made to bring

¹¹ Special Portfolio refers to the Central Bank's holdings of Irish government bonds (floating rate notes (FRNs)) acquired as part of the liquidation of Irish Bank Resolution Corporation (IBRC).

¹² The lack of Irish government bond issuance during the years preceding the programme also limited the supply available for purchase under PSPP.

individual NCBS' shares of PSPP holdings into closer alignment with ECB capital key.

Chart 3: Evolution of PSPP holdings in terms of percentage of outstanding amount¹³



3. The impact of APP on yields

This section quantifies the impact of the APP on Irish sovereign bond yields. Irish yields declined sharply across the curve in the years preceding the introduction of the APP in the euro area. This was primarily due to the improving economic and fiscal position of the sovereign, coupled with associated upgrades from credit ratings agencies, in the aftermath of the sovereign debt crisis in the euro area. Chart 4 graphs the evolution of Irish yields since 2014. Yields declined over the course of 2014 and generally remained at suppressed levels since. Since the beginning of 2015, the 'generic' 10-year yield has traded between a high of 1.78 per cent, reached in June 2015 and low of 0.33 per cent, reached in September 2016.¹⁴

¹³ The outstanding amount of fixed rate Irish government bonds. This amount differs from the PSPP eligible universe that is utilised in the calculation of issuer limit.

¹⁴ Bloomberg compile generic bond prices by creating a time series that links consecutive on-the-run government bonds. For the time-period used in this paper, there are periods where there were no available on-the-run 2-year, 5-year and 10-year Irish government bonds, resulting in data gaps. For those periods of missing data, we substitute in the closest bond available by maturity.

Chart 4: Irish sovereign bond yields 2014-2018



We apply an event study methodology to quantify the immediate effects of the announcement of the APP on Irish sovereign bond yields. Event studies are popular in the literature and focus on changes in asset prices over certain dates. They are based on the assumption that new information is incorporated into the prices of the bond yields very quickly. With an event study approach, the choice of events can be subjective. There have been various different approaches taken in the literature. We follow the approach of Gagnon et al. (2011) where the events focus on a narrow set of official communications. A key assumption in this approach is that the chosen announcements are the only thing to affect the markets' expectations of APP decisions. More specifically, we focus on APP announcements at ECB press conferences that contained new information concerning the size, composition and duration of various elements of the APP. There is one exception to this, where we use one event that is not an official Governing Council meeting, a dovish speech given by President Draghi in October 2015. Details of the chosen events are outlined in Table 1.

We analyse the change in Irish sovereign 2-year, 5-year and 10-year bond yields over a one-day and two-day window. The one-day window is measured as the difference between the relevant bond yield at the end of the trading day previous to the announcement and its value at the end of the trading day of the announcement, while the two-day window uses the day following the announcement. The choice of window length is important as it involves a trade-off between it being small enough to avoid

contamination of prices by developments elsewhere in the markets (such as economic data releases) and it being wide enough to allow sufficient time for revised expectations to become fully incorporated into bond prices. Even within a short window, there is still the potential for contamination. For example, the US Employment report is sometimes released the day after the ECB policy decision. We attempt to alleviate this problem by controlling for macroeconomic news surprises in our econometric specification. It should also be noted that during some of these events, the APP announcements formed a part of a broader monetary policy package such as changes to forward guidance on interest rates. While we concentrate on dates with changes to the APP, it is not possible to disentangle the effects of other policy measures that may have been announced at the same time.

Table 1: Key announcement dates used in event study and the two-day change in Irish government bond yields over event set

Date	GC Meeting	Details	2-day change		
			IE 2Y	IE 5Y	IE 10Y
04/09/2014	Yes	Decision to launch ABSPP and the CBPP3.	-0.05***	-0.18***	-0.16***
02/10/2014	Yes	ABSPP and the CBPP3 modalities published.	0.007	0.04*	0.04***
06/11/2014	Yes	President Draghi's dovish comments suggesting further unconventional policy tools	-0.01	-0.06***	-0.08***
22/01/2015	Yes	APP announced	0.00	-0.12***	-0.17***
05/03/2015	Yes	Details of PSPP purchases provided	0.01	-0.06**	-0.05*
22/10/2015	Yes	President Draghi indicates he is prepared to expand PSPP.	-0.04	-0.08	-0.09
03/12/2015	Yes	APP extended	0.11	0.18	0.20
10/03/2016	Yes	APP extended, purchases increased from EUR 60 bn to EUR 80 bn. CSPP announced	-0.01	0.03	-0.03
02/06/2016	Yes	The Eurosystem began purchasing CSPP	-0.01	-0.02	-0.06**
08/12/2016	Yes	APP extended, purchases reduced to EUR 60bn	-0.04	0.00	0.15***
26/10/2017	Yes	APP extended, purchases reduced to EUR 30bn from Jan 2018	-0.07***	-0.09***	-0.09***
14/06/2018	Yes	End-date announced and final taper to EUR 15bn between Oct and Dec 2018	-0.03	-0.09**	-0.11***
13/12/2018	Yes	Confirmation of end net asset purchases and details on reinvestment phase provided	0.00	-0.05***	-0.02***
Cumulative change over events			-0.14	-0.51	-0.49
Actual change Sept 2014 - Dec 2018			-0.50	-0.56	-0.78

* 10% significance level, ** 5% significance level, *** 1% significance level, no asterisks – effect is not significant

Our analysis focuses on the period from September 2014 to December 2018. Following Gagnon et al (2011) and Ambler and Rumler (2017), we begin with some descriptive analysis over the event dates by analysing the change in yields in the two-day window over the announcement dates. This is illustrated in Table 1. Overall, the Irish sovereign yield curve flattened considerably over the events, with the 2-year, 5-year and 10-year yields declining by a cumulative 14, 51 and 49 basis points respectively in the two-day window over the event set. The statistical significance of each change is estimated by means of a t-test.¹⁵ The magnitude of the change over the event set, particularly at the longer end of the curve, is quite large when compared with the overall change in yields during the period. This illustrates the importance of these events for overall yield movements over the period.

Focussing on the impact of the individual announcements, the largest downward movements occurred at the initial announcements of the ABSPP and CBPP3 and again the announcement of the APP to include the PSPP in January 2015. It is notable that sovereign bonds reacted positively to the news of purchases in another asset class. This could be attributable to market anticipation that the ECB would eventually purchase sovereign bonds, once an asset purchase programme commenced. A notable upward movement occurred following the December 2015 Governing Council meeting, when the programme horizon was extended but the monthly purchase pace remained unchanged. This disappointed markets, which had expected the Governing Council to both extend the horizon and increase the pace of purchases. Two months previously, in October of that year, President Draghi had indicated that he was prepared to expand the programme. This led to a significant fall in yields at the time but perhaps prepared the ground for the market to be disappointed in December. The final three events are associated with a tapering of the programme, firstly the announcement in October 2017 of a reduction in monthly purchases to €30bn, then in June 2018 the announcement of a further reduction to €15bn and finally confirmation of the end of the net purchase phase and details of the reinvestment phase in December 2018. These three events led to a significant fall in yields. The favourable reaction in terms of yield movements could be attributed to dovish communication during the press conferences. For instance, the programme was extended at two of the meetings and in June 2018, there was an unexpected change in the forward guidance on interest rates.

¹⁵ Our t-test assesses whether the change in bond yields is significantly different from the 'normal' change as calculated as the average of the preceding 30 days. A similar approach is taken by Pereira (2016) and Ambler and Rumler (2017).

On relative value basis, Irish sovereign bond yields outperformed core bond yields over the event dates in the study. This is illustrated in Table 2. The largest tightening was witnessed at the longer end of the curve. In 2014, there was a sizable credit risk premium built into peripheral bond yields. At that time, Ireland was trading in line with peripheral countries, whereas in recent times it has been trading closer to the semi-core. Over the announcement days in relation to the purchase programmes, the 5-year and 10-year spreads tightened considerably, with the expectation of a guaranteed purchaser of peripheral debt. This finding is consistent with other studies such as Urbschat and Watzka (2017) that show a stronger downward impact in the periphery than in the core, which suggests a reduction in the credit risk premium in peripheral countries.

Table 2: Two-day change in the spread over Germany over event set (basis points)

	IE 2-year	IE 5-year	IE 10-year
Cumulative change over event set	-0.01	-0.24	-0.26

We extend the above descriptive analysis by adopting an econometric framework frequently used in event study literature. At this point, we broaden the analysis by examining the change in the one-day and two-day window. Using daily data, we regress Δy_t , the one-day or two-day change in Irish sovereign bond yields on D_t , which represents a dummy variable that takes a value of 1 for each of the events and zero for all other dates. As discussed above, there are many factors that can cause yields to increase or decrease over the window in question. The risk of this contamination increases with a wider window. We control for macroeconomic surprises by including the one-day and two-day change in Global Citi Economic Surprise Index. This is represented by z_t in the equation below.¹⁶

$$\Delta y_t = \alpha + \beta D_t + \lambda \Delta z_t + \varepsilon_t$$

The regressions are estimated using ordinary least squares¹⁷, in the first instance over the entire period of the APP from September 2014 to December 2018. The results indicate a downward impact on yields that is statistically significant for 5-year and 10-year yields for the one-day change but not statistically significant for the two-day change. Given the results of our descriptive analysis above and the body of empirical studies that show that QE policies have the largest effect at the announcement of the policy,

¹⁶ As a robustness check, we also included a measure of volatility. When the one and two-day change in the VIX index is included in the specification, our results are unchanged.

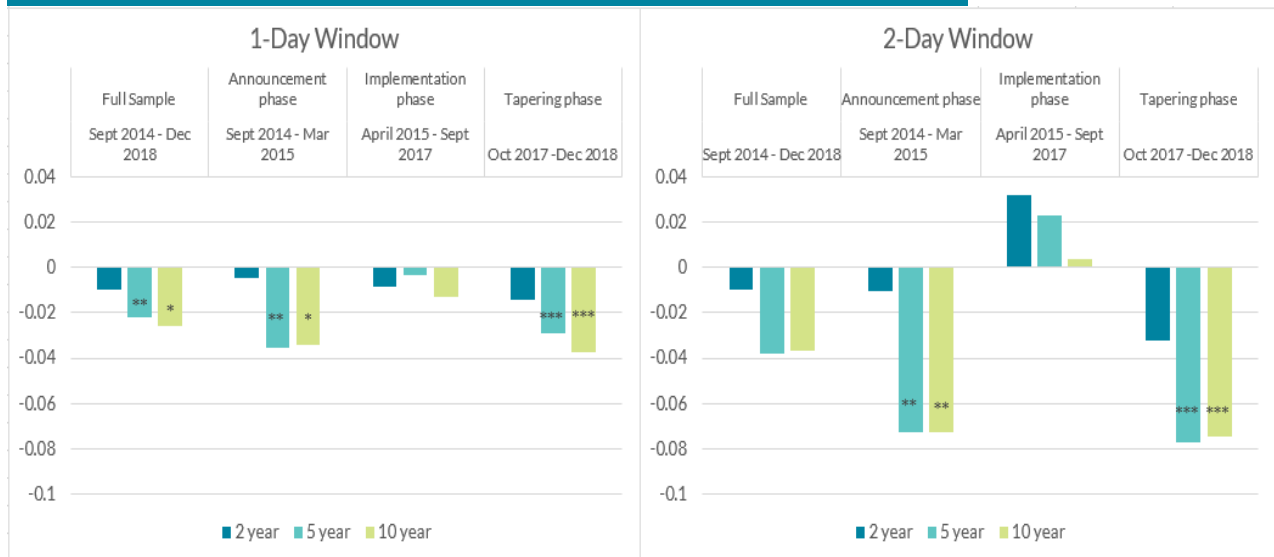
¹⁷ Newey West HAC standard errors are used for robustness.

we split our sample into three. The first sample could be described as the ‘announcement phase’ from June 2014 to March 2015. The second could be described as the ‘implementation and recalibration phase’ from April 2015 to September 2017. The third sample could be described as the ‘tapering phase’ from October 2017 to December 2018.

The coefficients on the dummy variable in our regressions are illustrated in Chart 5. We see a strong and statistically significant downward impact in the ‘announcement phase’ in the 5-year and 10-year bonds for both the one-day and two-day changes. However, in the ‘implementation and recalibration phase’, the impact is not statistically significant from zero in both cases. In the tapering phase, we see a similar impact as during the announcement phase for both one-day change and the two-day change.

The result that QE has a large downward impact on yields at the initial announcements of the programme is consistent with findings elsewhere.¹⁸ Subsequent purchases, policy announcements and the build-up of the stock of assets likely helped maintain yields at relatively low levels over the course of the programme.¹⁹ The decline in yields during the tapering phase is interesting as it is perhaps counter-intuitive. It illustrates the strong impact that communication can have during the press conference.

Chart 5: Coefficient (β) on the event dummy over different phases – one-day and two-day window



* 10% significance level, ** 5% significance level, *** 1% significance level

¹⁸ See for instance Haldane et al (2016).

¹⁹ Praet, P. (2017), “Maintaining price stability with unconventional monetary policy measures”, speech at the MMF Monetary and Financial Policy Conference, London, 2 October.

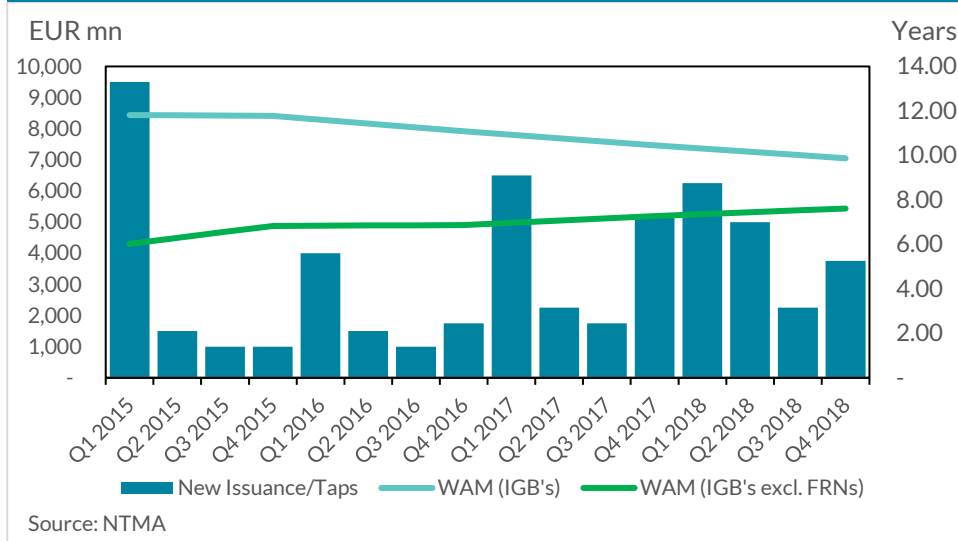
4. Structural developments

Since the start of the PSPP in March 2015, the Eurosystem has made significant purchases of euro area sovereign debt in the secondary markets. This likely had an impact on the structure of the Irish government bond market in terms of the duration, the cost of Irish government debt and the change in the structure of the investor base. As the previous section outlines the PSPP has had the effect of reducing Irish sovereign bond yields significantly and contributed to a flattening of the yield curve. Consequently, while the objective of the PSPP is not to support debt issuance by sovereigns, the PSPP has contributed to conditions that have supported increased issuance of Irish sovereign debt at lower interest rates and for longer maturities.

From 2015 to the end of 2018, Ireland's NTMA issued approximately €54bn of benchmark Irish government long-term bonds, equating to a net additional supply of €28bn over the period. During this period, the Central Bank also disposed of €13bn of long-term floating rate notes (FRNs) from the Special Portfolio, which were subsequently cancelled by the NTMA²⁰. The NTMA extended the maturity profile of outstanding Irish government debt, over the horizon of the PSPP, through its issuance of long-term fixed rate bonds. The weighted average maturity (WAM)²¹ of the universe of Irish government bonds (IGBs), as illustrated in Chart 6, now stands at approximately 10 years, which is above the euro area average of approximately 8 years. Excluding the FRNs, the NTMA's issuance of longer maturity benchmark fixed rate Irish government bonds has steadily increased the WAM for these securities, from about 6 years in Q1 2015 to almost 8 years in Q4 2018.

²⁰ On 8 February 2013, the NTMA issued €25.034 billion nominal of Floating Rate Notes, with original maturities ranging from 25 to 40 years, which were exchanged for the Promissory Notes held by the Central Bank, on foot of the liquidation of IBRC.

²¹ This WAM includes the FRNs and at the beginning of 2015, the WAM for these bonds stood at approximately 33 years.

Chart 6: Irish debt new issuance & weighted average maturity

Looking at Table 3 it is clear that this longer maturity issuance achieved weighted average yields that were much lower over the course of the PSPP than pre-PSPP. The lower average yields, which were attained despite the increased supply and maturity profile of outstanding Irish sovereign debt, demonstrates that the PSPP indirectly led to a favourable impact on the cost of servicing Irish debt.

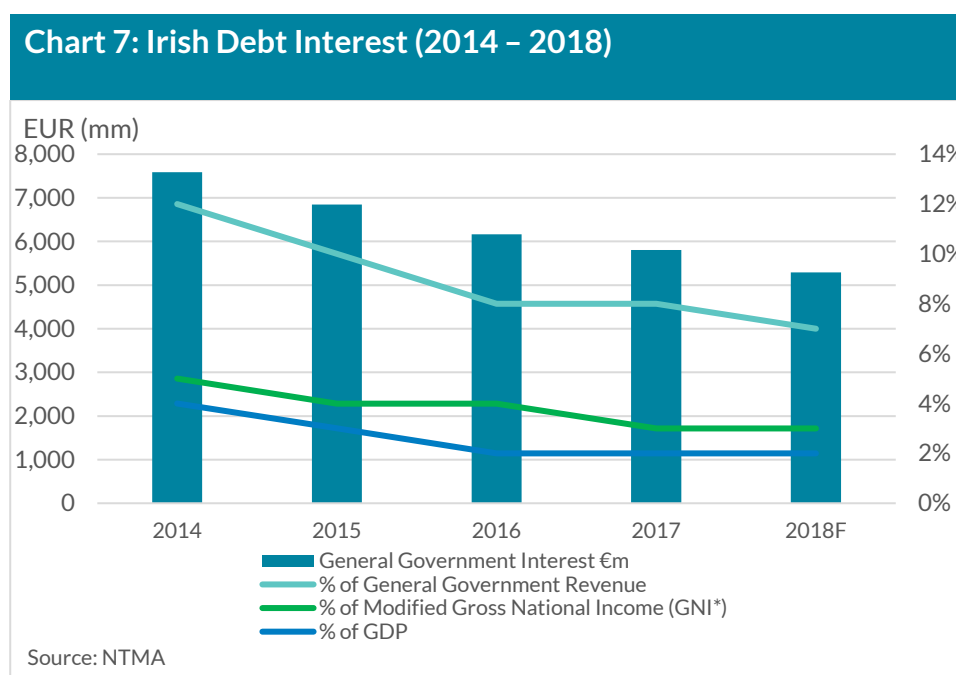
Table 3: Irish Government Bond Issuance (2014 – 2018)

Year	Amount Issued (EUR bn)	WAM (yrs)	Weighted Avg. Yield
2014	11.75	12	2.84%
2015	13	18	1.51%
2016	8.25	10	0.82%
2017	15.75	12	0.89%
2018	17.25	12	1.07%

Source: NTMA

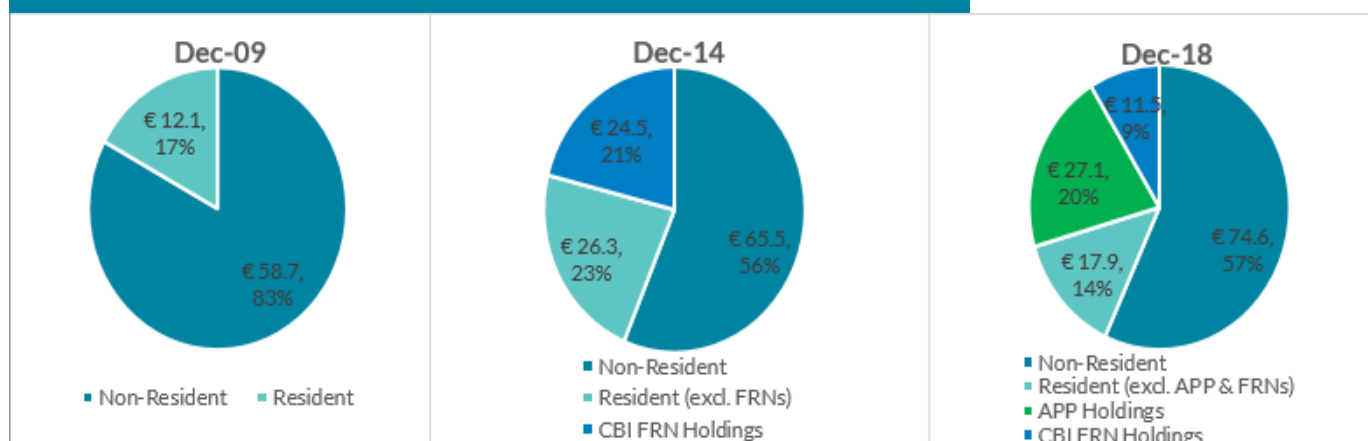
Delving deeper, it is clear in Chart 7 below that the interest cost of servicing general Irish government debt has declined considerably over the horizon of the PSPP. Given the favourable low interest rate environment, the NTMA actively replaced higher cost debt with cheaper new issuance (i.e. early repayment of loans from the IMF, Sweden and Denmark). In absolute terms, the amount paid on interest fell from €7.6bn in 2014 to a projected €5.3bn as at the end of 2018, a reduction of 30 per cent. Given

Ireland's robust economic growth throughout this period the fall as a percentage of GNI*²² is even greater.



The composition of holders of Irish sovereign debt has changed over the course of the last decade, as illustrated in Chart 8. In 2009, prior to the sovereign debt crisis, non-resident investors accounted for greater than 80 per cent of holdings. Some argue that non-residents represent a less stable source of demand for sovereign debt (Arslanalp and Tsuda 2012). This could be due to their sensitivity to factors such as the fiscal position and the business cycle position (Jalles 2018). The NTMA has historically maintained a sizable investor base outside Ireland, reflecting Ireland's position as a small open economy with a relatively small domestic financial system. Chart 8 shows a marked reduction in the share of debt held by non-residents between 2009 and 2018, however, this is distorted by the issuance of the FRNs in February 2013 that would form part of the Central Bank's "Special Portfolio", thus inflating the share of resident holdings. In absolute terms non-resident holdings actually increased during the sovereign debt crisis and non-residents remained net buyers of Irish debt during the APP. This suggests that non-resident investors have been a resilient source of financing for the NTMA, even during times of stress.

²² GNI* refers to "modified gross national income" and is designed to filter out the statistical noise associated with multinationals or, as Ireland's Central Statistics Office (CSO) notes, remove the effects of globalisation.

Chart 8: Holders of Irish Government Long-Term Bonds (€mm)

Although the overall share of resident and non-resident holdings are relatively unchanged between Q4 2014 and Q4 2018, the composition of resident holdings has changed considerably throughout the lifetime of the PSPP. The NTMA cancelled a considerable amount of long term FRNs on foot of disposals by the Central Bank during this period, while also issuing a substantial amount of Irish sovereign debt. Through its purchases of Irish government bonds in the secondary markets (€30bn in total), the PSPP indirectly absorbed a portion of the increased NTMA bond issuance. The composition of Irish sovereign debt holders as at Q4 2018 indicates that the PSPP led to a reduction in the share of debt held by Irish residents (excluding CBI).

Table 4: Change of sovereign bond holdings by institutional sector (Q4 2014 - Q2 2018)

Country	Resident banks	Central bank	Other public institutions	Other residents	Non-residents
France	-3.20%	15.90%		-1.70%	-11.00%
Germany	-4.10%	16.20%		-0.20%	-11.90%
Ireland	-7.70%	7.40%	-1.10%	0.20%	1.20%
Italy	-2.70%	13.60%		-7.10%	-3.80%
Netherlands	-1.80%	18.00%		1.10%	-17.30%
Portugal	-2.80%	17.10%		-0.90%	-13.40%
Spain	-13.30%	17.60%	-4.30%	-3.40%	3.40%

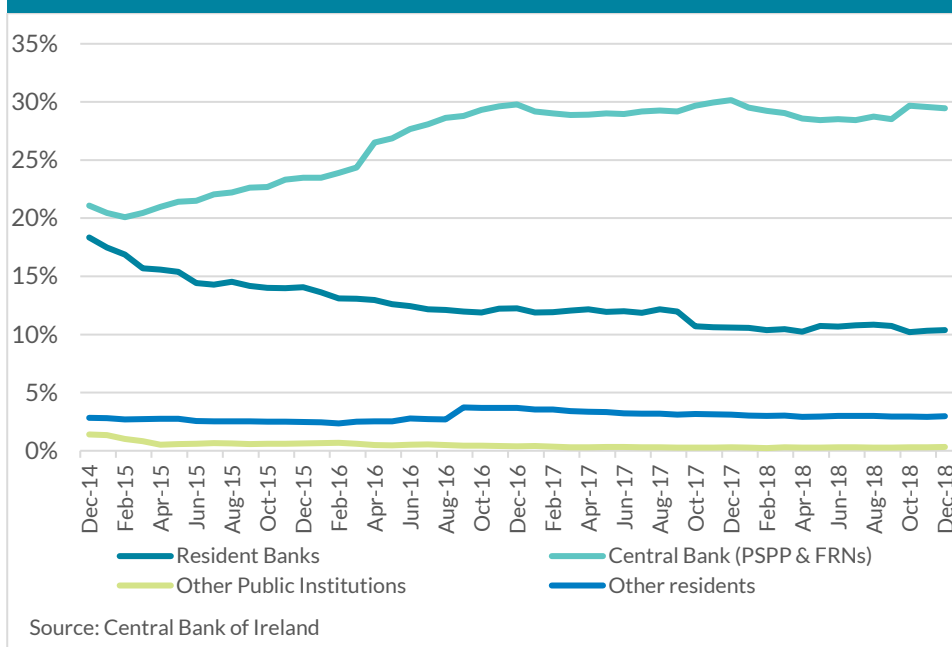
Source: Bruegel & Central Bank of Ireland

With sovereigns exposed to bank risk and banks exposed to sovereign risk, the resulting two-way exposure creates a link between the default risk of governments and banks ²³ (the so-called bank-sovereign 'doom loop'), which became one of the major challenges to stabilising the euro area

²³ Arslanalp and Tsuda (2012), Working Paper WP/12/284, IMF.

financial system during the crisis period. Against this background, a reduction in holdings of Irish government bonds by resident banks could potentially be seen as a positive for financial stability. In comparison to most of its euro area peers, Ireland (together with Spain) is an outlier in terms of the decline in the resident banks' holdings of sovereign debt and in terms of the increase in non-resident holdings. This is illustrated in Table 4. Looking deeper into the investor profile in Chart 9 we can see that this decline in Irish resident holdings (ex CBI) is mostly accounted for by resident banks, whose share of outstanding Irish government bond debt has declined from about 18 per cent at the start of 2015 to approximately 10 per cent at the end of 2018.

Chart 9: Resident Irish Government Bond Holders (percent of total outstanding bond debt)



5. Market Liquidity

Market liquidity is generally defined as the ability to rapidly execute sizable securities transactions at a low cost and with limited price impact. As set out by the IMF (2015), QE can have both positive and negative effects on market liquidity.²⁴ While the introduction of a large committed buyer to the market should be supportive of market liquidity, the central bank as a buy-to-hold investor simultaneously reduces the net supply of bonds to private investors, thus increasing scarcity. At the time of the introduction of the PSPP in March 2015, the ECB was cognisant of the potential implications of large-scale asset purchases by the central bank on bond market liquidity.²⁵

²⁴ Global Financial Stability Report, October 2015, IMF.

²⁵ "Embarking on public sector asset purchases", speech by Benoît Cœuré, Member of the Executive Board of the ECB, at the Second International Conference on

In order to avoid exacerbating any existing market frictions, and limit distortions within sovereign bond markets, the Eurosystem would avoid the cheapest-to-deliver bonds for futures contracts, and purchasing bonds trading ‘special’ in repo markets. Large-scale purchases would also increase scarcity for private market participants and potentially impact broader market liquidity. Further measures, such as the imposition of issue and issuer limits, and the Eurosystem’s securities lending programmes aimed to mitigate this possible adverse impact on smooth market functioning.

Since the launch of QE by the world’s main central banks, a number of studies have looked at the impact of QE on sovereign bond markets. The findings have been mixed. Kandrac and Schlusche (2013) found no significant liquidity effects of the Federal Reserve’s QE programme on the US Treasury markets, while Christensen and Gillan (2013) found that the Fed’s purchases of US Treasury Inflation-Protected Securities (TIPS) had a positive impact on liquidity in this market. With respect to the ECB’s APP, Schlepper (2017) found a negative impact on German bond market liquidity.

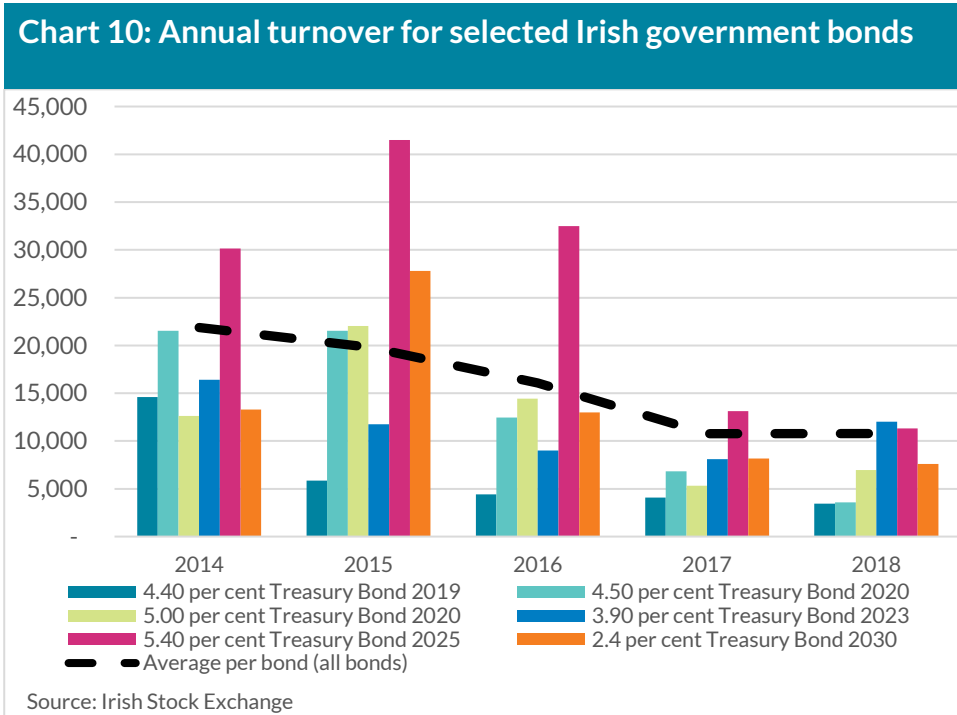
This section looks at a number of liquidity indicators in order to examine the evolution of liquidity in the Irish government bond market throughout the PSPP: i) turnover data; ii) real trade data; and iii) indicative price data.²⁶

(i) Turnover data

The turnover, or volume traded, in a securities market, while not necessarily a measure of liquidity, can be an indicator of liquidity conditions in a market, with higher turnover pointing to higher liquidity. Chart 10 sets out total annual turnover for a selection of Irish government bonds. In order to capture the evolution of traded volumes over the period of PSPP, the selected bonds are those that were issued pre-PSPP and remain outstanding. This turnover data displays a downward trend since 2015, the year of the PSPP’s introduction. This trend reflects a logical intuition; with the Eurosystem entering the market as a significant new buy-to-hold investor, the market of remaining “free float” bonds for private investors to transact in diminishes.

Sovereign Bond Markets, Frankfurt, 10 March 2015. https://www.ecb.europa.eu/press/key/date/2015/html/sp150310_1.en.html

²⁶ A comparison of before and during the APP would in theory be useful in this section, however, it is not utilised given the large distortions in the Irish market before the APP due to the sovereign debt crisis.

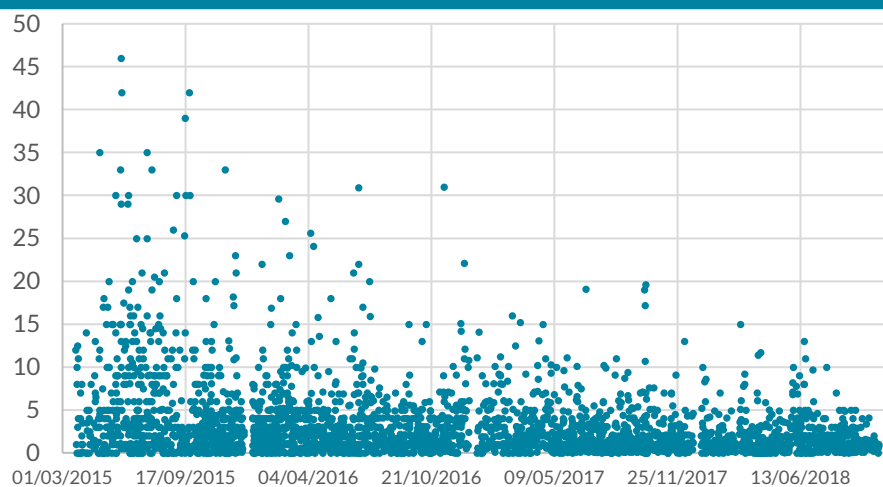


In order to assess whether the reduction in turnover has led to a decrease in liquidity, we can look at other metrics of market liquidity.

(ii) Real trade data

The Central Bank has conducted over 3,000 trades in the Irish government bond market under PSPP since March 2015. Data gathered on these trades include the competitive quotes received for each executed trade. A more liquid market should facilitate greater price transparency and discovery, meaning that competitive quotes are less widely dispersed than in a less liquid market. Chart 11 shows that through time, the cover (i.e. distance between second best price and best price in an executed trade) on PSPP trades has tightened, and become more clustered closer to zero. This trend is also visible in Table 5, which presents the standard deviation of the distance between traded price and second best price on all trades, for each year that PSPP has been active. This suggests improving liquidity between early 2015 and today. A similar yet less obvious trend is also visible if we consider the distance between the third best quote, and the best price.

Chart 11: Distance between traded price and second best price (trade level data, in cents)



Source: Central Bank of Ireland and Authors' Calculations

Table 5: Standard deviation between traded price and second best price

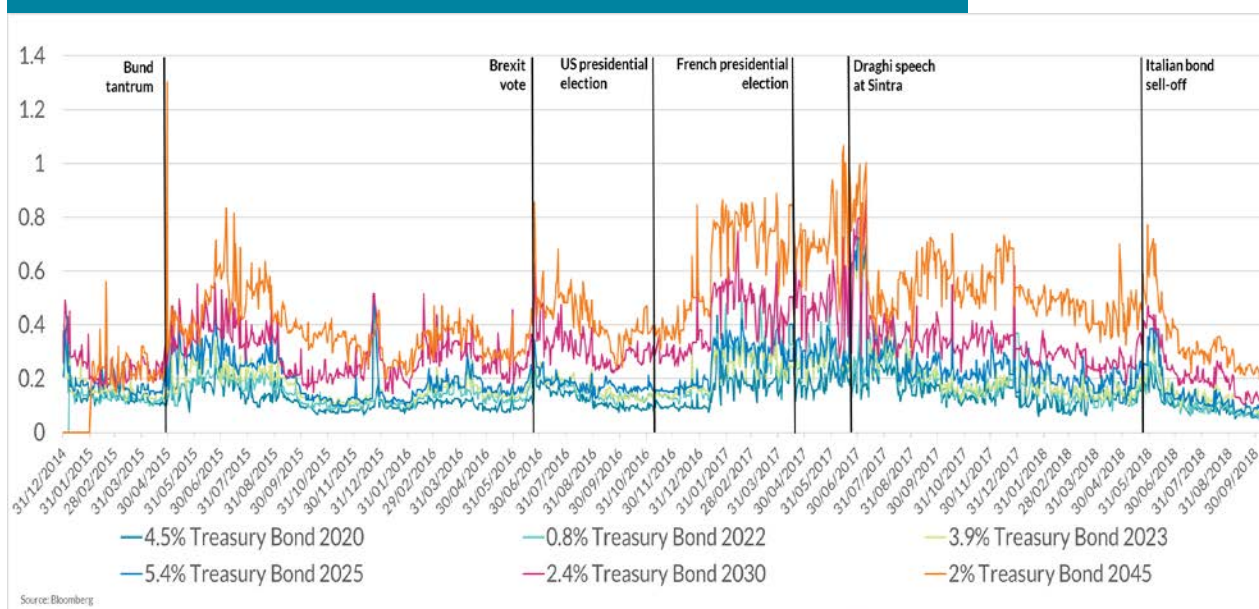
Year	Volatility of Second Price Cover
2015	6.8
2016	3.8
2017	2.9
2018	2.0

(iii) Indicative bid-ask spread data

Market makers present inventory and indicative prices at which they are willing to trade securities on platforms such as Bloomberg and Tradeweb. These platforms also calculate a single generic “bid” and “offer” price for each security, which is derived from the indicative prices quoted by dealers. We can use these indicative prices to calculate a bid-offer spread for each trading day. Charting the evolution of this measure over time, this indicator can provide information on how the liquidity of a bond has changed. Chart 12 illustrates the evolution of the bid-offer spreads for a selected number of Irish government bonds that were issued prior to PSPP and are still outstanding today. While the day-to-day data is somewhat volatile, we can observe some trends. Bid-offer spreads did not display an obvious widening or tightening through much of the first two years of PSPP implementation. Thereafter, a clear widening can be observed from the end of 2016 through most of 2017. This widening is most likely explained by a number of events affecting global uncertainty during this period, such as the Brexit referendum in June 2016 and the US presidential election outcome in

November 2016. The tightening of bid-offer spreads in late 2017 and into 2018 suggests that the underlying impact of QE was not significant. It is particularly notable that spreads have continued to tighten throughout 2018, during a period of gradual wind-down of QE coupled with Brexit uncertainty.

Chart 12: Bid-Offer spreads for selected Irish government bonds



6. Conclusions

The scale of bond purchases under the APP was always likely to have a significant impact on the markets in which they were active. Now that the net asset purchase phase of the APP has ended, it is an appropriate time to examine this impact in greater detail. This article specifically focuses on the Irish government bond market.

Based on an event study approach, we estimate that the announcement effect related to the programme reduced Irish sovereign bond yields significantly and contributed to a flattening of the yield curve. This result is consistent with findings elsewhere. We find that the largest and most significant downward impact on yields occurred over the initial announcements of the programme, but also, somewhat surprisingly, over the final announcements during the tapering phase. Irish sovereign bonds have also performed well over the period, relative to German bunds.

The PSPP has contributed to conditions that support increased issuance of Irish sovereign debt at lower interest rates. As a result, this reduced the State's interest burden. The NTMA have also extended the maturity profile of Ireland's debt. The composition of holdings of Irish debt has also changed over the period. While the share of non-resident holdings has remained resilient, the share of domestic banks' holdings has declined.

With regard to liquidity, the evidence based on a number of metrics, although somewhat mixed, does not show a significant deterioration in conditions. Certainly, liquidity in Irish bonds proved sufficient in order to facilitate a smooth implementation of the PSPP in Ireland without resulting in major market distortions.

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