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Abstract

We assess the real economy impact of the Bank of England's quantitative easing (QE) operations through the corporate bond market between 2009 and 2021. Using difference-in-difference exercises on secondary market yields, and the cost of borrowing and issuance in the primary market, we document increased issuance of investment-grade bonds with long maturity resulting from the lower cost of borrowing caused by QE. Corporates directed additional funds towards share buybacks and reduced bank borrowing rather than increasing real investment. We also isolate the marginal impact of purchases under the Corporate Bond Purchase Scheme (CBPS), the direct effect, from the total effect (arising from all purchases) of QE on the corporate bond market. We find that yields of eligible bonds fell by 40–60 basis points relative to ineligible bonds. However, this fall did not translate into a lower cost of borrowing or higher issuance in the primary market.

Key words: Quantitative easing, corporate bond purchase scheme, bond issuance, bond yields, cost of borrowing.

JEL classification: E22, E58, G12, G30, Q51.

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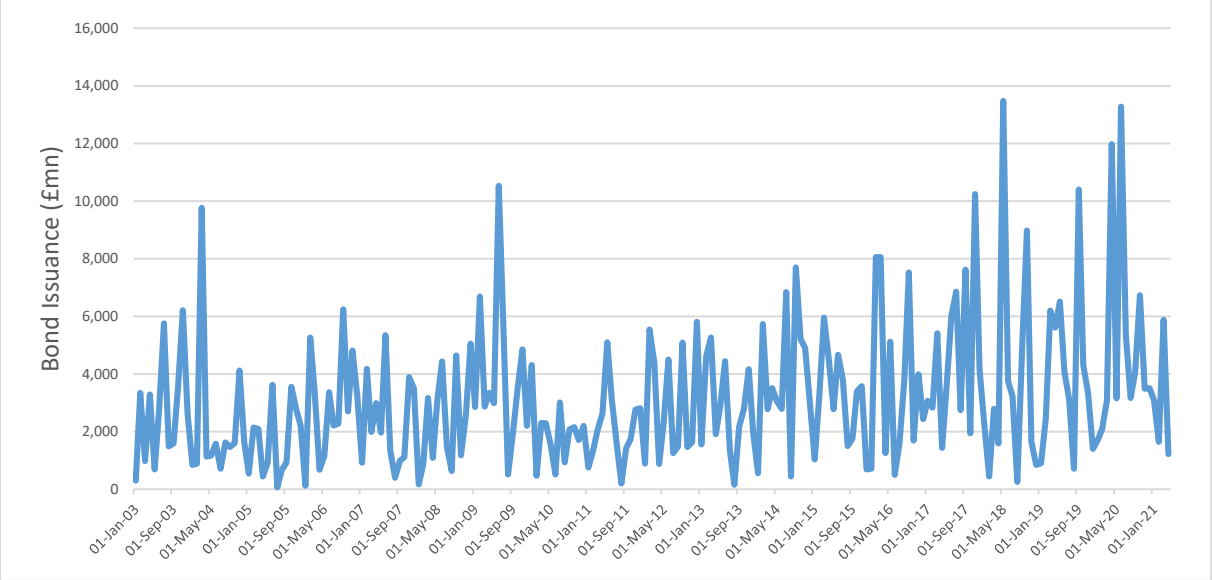
1. Introduction

Since its introduction, several studies have investigated the main channels through which the impact of quantitative easing (QE) transmits to the real economy (Joyce, Tong, and Woods 2011; Todorov, 2020; Fatouh, Markose, and Giansante 2021). Most channels go through asset prices and yields. The large-scale asset purchases by central banks increase the prices and reduce the yields of the assets targeted by the purchases. Through signalling, liquidity and portfolio rebalancing effects[2], this impact then spreads to other assets, especially those that can be considered as close alternatives to the targeted assets. Unlike QE in the US and euro area, UK QE has mainly concentrated on purchasing government bonds (gilts), especially during earlier waves. At their peak, following Covid-19 stress, gilt holdings stood at £875bn. Alongside gilts, the Bank of England (the Bank) purchased £20bn in corporate bonds in the more recent rounds (after the Brexit vote and Covid) under the Corporate Bond Purchase Scheme (CBPS). As a result of this design, UK QE operations can impact the prices and yields of corporate bonds via two effects. First, gilt purchases can stimulate a portfolio rebalancing towards corporate bonds (especially investment grade), increasing their prices and reducing their yields; we refer to this as the *indirect effect* of QE on corporate bonds. Meanwhile, purchases under CBPS can increase the prices and reduce the yields of the corporate bonds purchased by the Bank; we refer to this as the *direct effect*[3]. The reduction in yields in the secondary market may translate into a lower cost of borrowing and more issuance in the primary market, possibly leading to higher investment spending and output (i.e., real effects). The fall in corporate bond yields appears to have caused a boom in issuances by nonfinancial companies in the UK. Between January 2003 and the end of February 2009, these companies issued a total of £180.85 billion. Meanwhile, since the introduction of QE and up until the end of May 2021, the total issuance was £506.18bn (£262.31bn by end of May 2015, for a like-for-like comparison). Figure 1 shows gross issuance by nonfinancial companies in the UK.

[2] This channel leads to the lower yields as the sellers try to buy higher-yielding assets.

[3] We provide more details on the two effects in Section 3.

Figure 1: Bond issuance by UK nonfinancial corporates 2003-2021 (£million)



Source: Bank of England

The increase in bond issuance raises questions on how corporates have used the additional funds they received[4]. Firms can use the proceeds of bond issuance either to fund investment in projects or for financing purposes, such as paying-off maturing debt, restructuring debt to benefit from the lower cost of borrowing, paying dividends or buying back their own shares to boost their prices. In other words, the question is whether the additional funding translated into additional real investment or just ended up fuelling increases in asset prices. This paper examines the real economy implications of QE through effects on the domestic bond markets. It does so by assessing whether QE caused a boom in bond issuances, and whether the issuing companies have used the additional funds to increase real investment, restructure their debt (substituting away from bank borrowing), invest in financial assets, or boost their share prices (through buybacks).

Since earlier papers have investigated the impact of QE on secondary market yields (for example, Todorov, 2020), our analysis focuses on the relative impacts of the direct and indirect effects on the cost of borrowing and bond issuance in the primary market. Nevertheless, we contribute to the literature on the impact of QE on bond yields by assessing the marginal impact of corporate bond purchases under CBPS on the yields of eligible bonds in the secondary market.

[4] Note that we are referring only to the funds firms raised in the bond market.

Our empirical exercise is divided into three main parts. The first part aims to assess the implications of QE purchases on the cost of borrowing and issuance in the corporate bond market. We start by checking whether the QE period was associated with an increased issuance of corporate bonds compared to the pre-QE period. We test that at both the aggregate and company levels, documenting that the QE period witnessed a rise in total issuance, total issuance per company, number of issuers, and average issuance amount per company. We find an indication that these trends are caused by QE as they appear to be largely driven by the fall in gilt yields when these yields are added to the estimation models. To establish the causal link between QE and the increasing bond issuance, we check whether the impact of QE on yields in the secondary market has translated into a lower cost of borrowing (i.e., yields at issuance or origination). The portfolio rebalancing effects of QE gilt purchases are likely to be stronger for assets that represent good alternatives for gilts, such as high-quality corporate bonds. This is largely because the sellers of gilts (non-bank financials) are restricted in terms of the assets they can invest in (for instance, investment-grade bonds). The effects are also likely to be stronger for longer-term bonds which offer relatively higher yields, driving the well-documented flatting of the yield curve caused by QE (for example, Todorov, 2020). Hence, to establish whether QE caused a fall in yields at issuance, the yields (at issuance) on investment-grade longer-term bonds should fall relative to non-investment-grade and shorter-term bonds. We investigate this by dividing our sample into sub-samples based on rating (quality) and maturity at the bond level and assess whether corporate bonds with higher quality and/or longer maturities witnessed larger falls in their yields at issuance (cost of borrowing). Indeed, we find evidence of larger reductions in the yields of higher quality (investment-grade) and longer-term corporate bonds post QE. If QE caused an increase in bond issuance, we should see an relative increase in the issuance of investment-grade longer-term bonds, given their yields fell relatively more, compared to other bonds. To check this, we employ a difference-in-differences (DiD) approach that compares the relative changes in the issuance of a treatment group of bonds, made up of investment-grade and long maturity, versus a control group (other bonds) after the introduction of QE. We find that the *treated* bonds' amounts were on average £200mn higher than the control group post QE, suggesting that QE caused the rise in bond issuance.

In the second part, we check the way companies used the additional funds from the bond issuance by testing the interaction between bond issuance at the company level and the main uses of liquidity, which we collect from cash flow statements and balance sheets. We find that companies directed the additional liquidity towards share buybacks and reducing bank borrowing rather than real investment. In other words, our results suggest that QE has been successful at reducing not only corporate bond yields in the secondary market, but also the cost of borrowing in the primary market, hence increasing bond issuance. However, the additional low-cost funding has not translated into real effects, as the issuing companies chose to use the funds to substitute away from bank borrowing and buy back their shares to boost their prices.

The third part aims to isolate the marginal impact of purchases under CBPS, or the *direct* effect of QE on corporate bond market. We do that by implementing DiD specifications that compare changes in the secondary market yields of eligible bonds under CBPS and the yields at issuance and the amounts issued by the issuers of these eligible bonds following CBPS[5]. We use propensity score matching to control for the possible impact of any bond and company characteristics on the estimated treatment effects. We find that the yields of eligible bonds fell by 40-60bps relative to ineligible bonds. However, this did not reflect the cost of borrowing and issuance in the primary market.

The remainder of the paper is structured as follows. Section 2 reviews the relevant literature. Section 3 further explains the direct and indirect effects of QE on the bonds market. Section 4 outlines our methodology, and Section 5 presents the results of our empirical specifications. Section 6 concludes.

2. Related literature

As mentioned above, most of the past literature focused on the impact of QE on asset prices and yields points to an increase in bonds prices and a fall in yields. Joyce and Tong (2012) show that asset purchases by the Bank decreased the yields of gilts. This is supported by Mclaren, Banerjee, and Latto (2014), who argue that these asset purchases reduced not only gilt yields but also the yields of corporate bonds through local supply effects (asset purchases by the Bank reduce the supply of gilts

[5] CBPS was introduced with the QE wave following the Brexit vote in June 2016, so this exercise compares the treatment and control group before and after the latest two QE rounds.

remaining for the private sector). Boneva et al. (2018) assess the impact of *eligibility* under CBPS on yields of *eligible* corporate bonds relative to similar bonds. Their results show that yields of eligible bonds fell by 2-5bps relative to ineligible bonds and 13-14bps compared to foreign bonds. We improve on the assessment relative to ineligible bonds by using propensity score matching to create a more comparable control group amongst ineligible bonds, as well as by covering the additional purchases made during the stress caused by the Covid-19 pandemic (£10bn). We find a much stronger impact of CBPS purchases of a 40-60bps reduction in eligible bond yields relative to ineligible bonds.

D'Amico and Kaminska (2019) assess the impact of the indirect and direct effects of QE and credit easing, respectively on bond yields and issuance. They suggest that the direct effect has a stronger impact on secondary market yields and hence represents a stronger stimulation for bond issuance. Our analysis goes a step further by inspecting the causal link between QE and the increase in bond issuance and includes the additional corporate bond purchases during the Covid-19 stress. While yields in the secondary market and primary market are highly linked, additional bond issuance is likely to be determined by the latter rather than the former. In other words, new issuances are driven by the cost of borrowing at the time of issuance (yields at issuance) rather than yields of existing bonds traded in the secondary market (Todorov, 2020). Hence, to establish the causal link between QE and bond issuance, we focus on effective yields at issuance. By isolating the direct effect using a diff-in-diff exercise, similar to that of Boneva et al. (2018), our analysis explores the effects of CBPS eligibility on bond issuance by the issuers of the eligible bonds.

Isolating the direct effect from non-corporate bond purchases is particularly useful when comparing the UK CBPS with the ECB's Corporate Sector Purchase Programme (CSPP). The impact of the latter on Euro-denominated corporate bonds is studied by Todorov (2020), who confirms the positive effect of QE in lowering market yields and increasing liquidity in the secondary market, particularly for riskier eligible bonds with longer maturity. By extending this analysis to the primary market as well as estimating both direct and total effects of UK QE, we shed a light on the implication of different implementations of these programs, their timing and size of corporate bond purchases.

In terms of how companies used the additional liquidity, some studies (Butt et al. 2014; Fatouh, Markose, and Giansante 2021) indicate that corporates have substituted bank loans with capital

market financing (bonds) to lower their total cost of funding. Our analysis extends that by investigating the other uses of the additional liquidity, including investment in real assets and share buybacks. We focus on the main bond-issuing nonfinancial corporates. Semi-annual data from cash flow statements and balance sheets is used to assess the main sources and uses of cash and whether there have been any structural changes in the way nonfinancial corporates use cash flows (e.g., real investment vs. financing activities) after the introduction of UK QE. Corporates that raised cheaper funding during the UK QE waves increased their share buybacks and substituted away from bank loans, instead of increasing real investments. In line with our findings, Todorov (2020) documents no real investments stimulated by the EU CSPP as corporates used the attracted funds mostly to increase dividends.

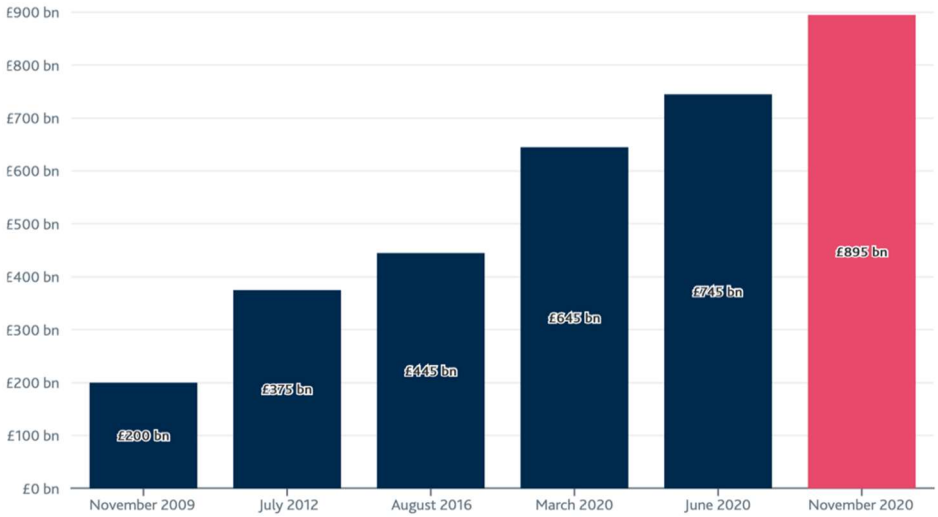
3. Direct vs Indirect Effects

Given the unique characteristic of the APP in the UK (Fatouh, Markose, and Giansante 2021), QE can affect the cost of borrowing and bond issuance via two effects. First, the portfolio rebalancing and liquidity (and policy signalling) effects of gilt purchases increase the demand for high-quality corporate bonds, increasing their prices and reducing their yields. The reduction in yields in the secondary market can be reflected in a lower cost of borrowing for issuers in the primary market, making them more likely to issue bonds. Second, direct purchases of a set of *eligible* corporate bonds increase their prices and reduce their yields. This can reduce the cost of borrowing for the issuers of these bonds and make them more likely to issue new bonds. We call the first effect the *indirect effect* of QE on bond issuance, whereas we call the second the *direct effect*. The direct and indirect effects overlap during the latest waves of QE in the UK (since the Brexit vote), as they operate in the same direction for the issuers of the CBPS *eligible* bonds. Our analysis accounts for this by assessing the marginal impact of the direct effect using a diff-in-diff estimation based on the identification of the eligible bonds for direct purchase.

The relative size of gilt purchases compared to corporate bond purchases (£875bn vs. £20bn) suggests that the indirect effect is likely to dominate in almost all QE waves. The only exemption could be the wave that happened around the Brexit referendum in 2016, where corporate bonds purchases were relatively larger compared to other waves (£10bn out of a total of £75bn were corporate bond purchases). Yet, even in that wave the direct effect is likely to be much smaller, given that corporate

bonds purchases started more than 7 years after the introduction of QE in 2009 – a period during which corporate bonds yields already fell considerably.

Figure 2: UK asset purchase program size over time



Source: Bank of England (https://www.bankofengland.co.uk/monetary-policy/quantitative-easing). Dates in the chart reflects the announcement dates rather than the actual purchase dates.

4. Methodology

We are interested in the changes in yields and amounts of bond issuances by nonfinancial corporations as a result of QE and the real effects caused by the program.

4.1. Data

We build our dataset using data at the bond-level, company-level and macro level. The main source of the bond-level data is internal datasets on bond issuance and share buybacks collected from multiple sources (including both confidential and publicly available databases) and maintained by the Bank of England. These datasets include information about bond issuances by nonfinancial corporates in the UK since 2000, including amounts issued, ratings, coupon rates, and information about issuers. Our sample runs until April 2021 and includes more than 3,500 bond issuances. We combine the bond issuance dataset with secondary market yields for gilts and corporate bonds (on daily basis) collected from Bloomberg. We use LSEG Workspace to collect financial statement data of the issuing companies to build our company-level dataset, which includes more than 4,000 observations (on semi-annual basis). Lastly, we collect semi-annual GDP growth rates from the Office for National Statistics (ONS). Table 1 provides a summary of the data used.

Table 1: Descriptive Statistics

		Obs.	mean	St. dev	min	P25	median	P75	Max
Bond-level									
Issuance amount	Principal Amount of a bond issuance (£mn)	3415	408.68	743.9794	0.013495	91.82551	204.789	421.3588	8616.835
Yield at issuance	Effective yield of a bond issuance at the time of issuance	3515	0.111373	0.269837	-0.00396	0.037075	0.0602	0.110553	10.50594
Time to maturity	Time remaining to maturity of an issuance in years	3515	13.73531	15.71503	0.172603	5.664	10.111	13.444	101.458
Min rating	1-7 reflecting lowest rating of a bond by the 3 main rating agencies; 1 = AAA	3515	5.174964	1.804424	1	4	6	7	7
Yield to worst[1]	Daily yield to worst for a bond issuance	4,172,476	0.050918	0.17157	-0.99848	0.02026	0.03719	0.05652	9.9972
Firm-level									
Total assets	Total assets of an issuing company	4172	9499.688	38352.3	0.00167	607.8289	1765.556	5126.35	681404
Market Cap	Market capitalisation of an issuing company	2336	72709.53	558974.5	0.02555	27.28929	289.3051	1652.74	8643196
Intangible assets	Net intangible assets reported by an issuing company	2796	1126.806	4172.504	0.004814	25.14225	150.55	525.7123	117785
Current assets	Current assets of an issuing company	4139	1756.178	5324.068	0.00167	125.661	449.419	1372.1	127386
Current ratio	Current ratio of an issuing company	4138	1.566421	2.337813	0.00792	0.77685	1.16979	1.639863	56.7013
Quick ratio	Quick ratio of an issuing company	4137	1.169264	2.13157	0.00318	0.617515	0.8708	1.18652	56.7013
Total liabilities	Total liabilities of an issuing company	4172	5765.953	28915.44	0.004	340.425	1081.75	3291.325	661304
Current liabilities	Current liabilities of an issuing company	4138	1679.865	4733.548	0.004	92.9035	402.25	1170.575	63174
Long-term debt	Long-term debt of an issuing company	4138	1875.078	5226.985	0	103.96	419.466	1260.65	97198
Current portion of long-term debt	The part of long-term debt and capital leases maturing within 12 months	4138	291.0179	1106.097	0	0	12.5	114.5	16543
EBIT	Earnings before interest and tax for the last half year	5185	197.9846	925.2697	-8550	0	32	129.4	30609
Share buybacks	Repurchase of equity shares within the last half year	4174	42.94175	419.704	0	0	0	1.4565	18170.62
Fixed assets purchases	Purchases of fixed assets within the last half year	4203	225.157	1102.474	0	2.656	23.2	118	42906
Intangible assets purchases	Purchases of intangible assets within the last half year	4203	40.16989	498.3407	0	0	0	4.701	21450.07
Purchase of business	Acquisition of business within the last half year	4207	100.0754	705.53	0	0	0	18	17657
Changes in working capital	Net changes in working Capital within the last half year	4207	33.39929	280.1949	-1756	-1	0	21.4	9500
Dividends	Cash dividends paid to common equity shareholders within the last half year	4207	148.7863	541.5554	0	0.263	18.06048	75.4	10984
Purchase of Investments	Purchases of investment securities within the last half year	4207	92.30093	948.2568	0	0	0	2.5	28477
Purchased R&D (CF)	Acquisition of research and development within the last half year	4207	0.000903	0.036608	0	0	0	0	2
Macro-level									
GDP	Half-yearly GDP growth rate	43	0.007881	0.045391	-0.2176	0.005303	0.008835	0.014596	0.184293
Gilt yields	Current yields on 10 year UK government gilts	5741	0.031376	0.016544	0.00079	0.015405	0.03439	0.046895	0.05882

Source: Bank of England internal databases (bond-level variables) and Refinitiv Eikon (for other variables). This table reports summary statistics for the variables used in the firm and bond level analysis. The sample period is 2000-2021. Bond level variables are daily, firm level variables are semi-annual.

[1] Yield to worst refers to the lowest possible yield to be received on a bond with an early retirement (often the same as yield to call)

4.2. Empirical Design

We start our assessment of QE's impact on the corporate bond (primary) market by checking whether the QE period is associated with a rise in the issuance of corporate bonds compared to the pre-QE period. We test that at the aggregate or macro level, company level and bond level using the following model:

$$Y_{i,t} = \beta_i + \delta \boldsymbol{QE}_t + \theta X_{i,t} + \varsigma\left(X_{i,t}\boldsymbol{QE}_t\right) + \upsilon_{i,t} \quad (1)$$

Where, $Y_{i,t}$ is the issuance value, β_i is issuer fixed effect, $\boldsymbol{QE}_t$ is an indicator variable that becomes one after the introduction of the QE wave in March 2009. $X_{i,t}$: is a matrix of controls that includes macro controls (GDP growth and Gilts yields), company-level controls (size, leverage, current intangible debt, dividends and profitability) and bond-level controls (rating and maturity), depending on the level of aggregation (macro, company, or bond level). We also include interaction terms $X_{i,t} \times \boldsymbol{QE}_t$ in some exercises as a robustness check for possible heterogeneous responses by companies of different nature. All standard errors are clustered at the company level to allow for serial correlation across time. We are interested in the element δ from equation (1), which represents the coefficient of the association between the QE time window and the dependent variables.

To establish the causal link between QE and the cost of borrowing, we dig deeper into this issue by investigating and comparing changes in the yields at issuance for bonds with different levels of riskiness and maturities in Section 5.1. If QE caused an increase in bond issuance, the increase would be larger for bonds whose yields at issuance fell more after QE. These are likely to be higher quality longer maturity bonds, as Section 5.1 shows. As such, we employ a DiD approach that compares the relative changes in the amounts of a set of bonds (investment-grade and longer maturity) that represents our treatment group versus a control group (other bonds) after the introduction of QE.

We then investigate in Section 5.2 the way companies used the additional liquidity from the bond issuance. To do so, we run a set of pooled regressions at the company level, assessing the interaction

between bond issuance and the main uses of liquidity we collect from cash flow statements and balance sheets. The model is as follows:

$$Y_{i,t} = \beta_i + \omega \boldsymbol{TotIss}_{i,t} + \theta X_{i,t} + \varepsilon_{i,t} \quad (2)$$

Where, $Y_{i,t}$ is a set of cash flow statement and balance sheet variables of company *i* at time *t*, including the acquisition of assets, business and securities, long-term debt, dividends and share buybacks. β_i is company fixed effects. $\boldsymbol{TotIss}_{i,t}$ is total bond issuance by company *i* at time *t*. $X_{i,t}$ is a set of company-level and macro-level controls. Section 5.3 aims to isolate the marginal impact of corporate bond purchases under CBPS (i.e., the *direct* effect) from the total effect of QE on the bonds market. The section employs DiD specifications that compare changes in secondary market yields, yields at issuance and amounts of eligible bonds under CBPS as a treatment. We employ propensity score matching to control for the possible impact of bond and company characteristics on the estimated treatment effects.

5. Results

This section presents the results for our main empirical specifications and discusses three main sets of results. The first one investigates the total impact (direct and indirect effects) of UK QE on the cost of borrowing by nonfinancial corporates via bond issuance. Specifically, we are interested in measuring changes in yields and amounts at origination. The second set of results aims at disentangling the direct effect of QE via corporate bond purchases (under CBPS) from the total impact. By testing both effects on secondary market yields and yields at origination, we can shed light on the link between market price changes and the cost of borrowing by issuers of bonds.

As a preliminary check, we validate the increase of corporate bond issuance by checking whether the QE period is associated with a rise in the issuance of corporate bonds compared to the pre-QE period. A correlation matrix is provided in Table 2. Table 3 indicates the increases in total issuance, number of issues and issuer as dependent variables in equation (1) over the QE period at the macro level, when

controlling for GDP only. Interestingly, these effects are completely absorbed by gilt yields. In line with our prior, this indicates that the boost in bond issuance was potentially driven by QE purchases, which caused a substantial fall in gilt yields. These results are confirmed by further tests on this association at both the company and bond levels, as presented in Table 4.

To further assess QE's impact on bond issuance, model (2) of Table 4 panel (b) runs regression equation (1) with bond yields at issuance as the dependent variable. Estimations from the latter model do not convey any robust impact of QE on the cost of borrowing, measured by yields at issuance, across all bonds. This result is not surprising (Todorov, 2020) as QE effects are expected to be heterogeneous across bonds with different levels of riskiness and different maturities.

Specifically, the portfolio rebalancing effects of QE gilt purchases are likely to be stronger for assets that represent good alternatives for gilts, such as high-quality corporate bonds. This is largely because the sellers of the gilts (non-bank financials) are restricted in terms of the assets they can invest in (for instance, investment-grade bonds). The effects are also likely to be stronger for longer-term bonds that offer relatively higher yields.

5.1. The impact of QE on the cost of borrowing

We begin the analysis of the impact of QE by inspecting the characteristics of bonds issued in the UK since 2000. Figure 3 shows the maturity-rating distribution of bonds for the whole 2000-2021 period, panel (a), as well as for each of the QE waves. Medium (3-10 years) and medium-long (10-30) maturities are the most popular across the different time windows, with most bonds being of investment grade (up to BBB). Within the investment-grade category, the riskiest BBB bonds increase their relative share compared to other safer issuances. This evidence is in line with Todorov's (2020) findings in the EU context, where investors prefer riskier eligible bonds that would provide higher returns. This is also true for longer maturities as short-term issuances become less and less popular towards the end of our timeframe.

Table 2: Correlation matrix

	Total bond issuance	Size	Market Cap	Market LR	Book LR	Current to total assets	Intangibles to total assets	Quick ratio	Long-term to total debt	Current to total liabilities	Current portion of LT debt	EBIT to total assets	Cash flow to total assets	Market to book ratio	Dividends
Total bond issuance	1														
Size	0.131**	1													
Market Cap	0.141**	0.900***	1												
Market LR	-0.0342	0.0950*	-0.151***	1											
Book LR	-0.00821	0.0199	0.00956	0.0146	1										
Current to total assets	0.00515	-0.238***	-0.0668	0.0334	0.0333	1									
Intangibles to total assets	-0.0409	-0.112*	-0.109*	0.0262	-0.0153	-0.0905*	1								
Quick ratio	-0.00147	-0.0823	-0.0368	-0.0382	-0.0121	0.127**	-0.0798	1							
Long-term to total debt	0.0606	0.530***	0.488***	-0.0794	0.0326	-0.217***	-0.153***	0.059	1						
Current to total liabilities	-0.0421	-0.483***	-0.374***	-0.0811	0.0143	0.372***	0.131**	-0.175***	-0.726***	1					
Current portion of LT debt	-0.018	0.381***	0.378***	-0.0116	-0.00843	-0.064	0.000775	-0.0247	-0.00111	-0.0658	1				
EBIT to total assets	0.0373	0.423***	0.264***	-0.0134	0.011	-0.246***	-0.0651	-0.00266	0.298***	-0.290***	0.0401	1			
Cash flow to total assets	0.00825	0.100*	0.0514	-0.0936*	0.00513	-0.00668	-0.0231	0.100*	0.0654	-0.0567	0.0121	0.396***	1		
Market to book ratio	-0.00161	0.244***	0.302***	-0.0611	-0.00564	-0.0755	0.227***	-0.0462	0.0781	-0.0605	0.176***	0.0651	0.0146	1	
Dividends	-0.0194	0.296***	0.302***	-0.0369	-0.00587	-0.0503	-0.0175	-0.0122	-0.00162	-0.0506	0.865***	0.0341	-0.00158	0.0978*	1

*** p<0.01, ** p<0.05, * p<0.1

Table 3: Macro level model of corporate bond issuance

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
VARIABLES	Total Issuance (£mn)		Number of Issuances		Number of Issuers		Issuances per issuer		Average amount issued (£mn)	
QE	**4,583*** **	-2,564	**15.15** **	-3.377	**8.827** **	6.797	-0.132	-0.161	19.06	-23.80
	(1,646)	(2,869)	(6.753)	(11.04)	(3.647)	(6.552)	(0.0907)	(0.227)	(19.49)	(30.97)
GDP	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Gilt Yields	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES
Observations	43	43	43	43	43	43	42	42	43	43
R-squared	0.162	0.291	0.109	0.163	0.115	0.117	0.052	0.053	0.028	0.070

Macro-level analysis of bond issuance during the QE period. QE is an indicator variable that becomes one after the introduction of the QE wave in March 2009. Robust standard errors are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 4: Firm and bond level model of corporate bond issuance

a) Firm level

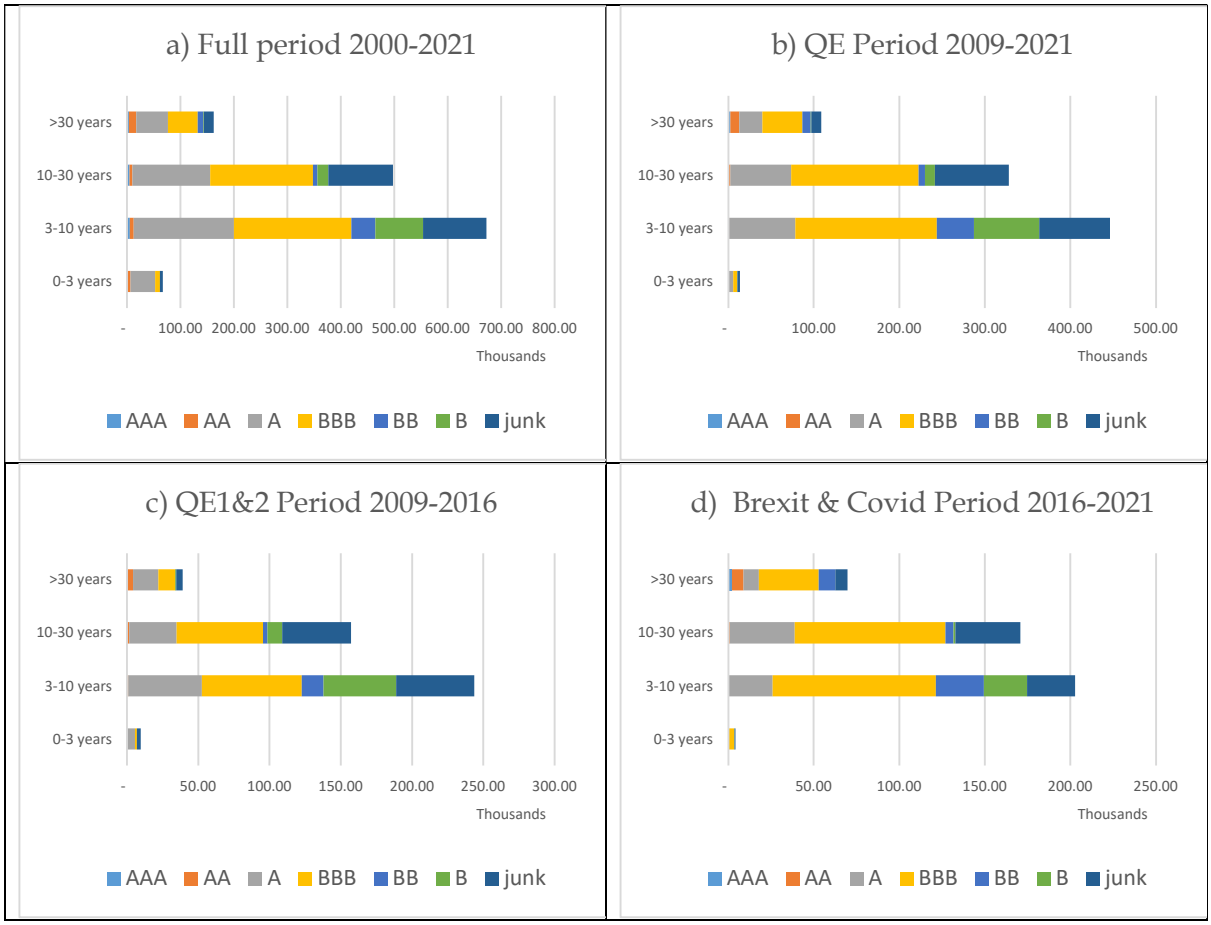
	(1)	(2)
VARIABLES	Issuance	
QE	**1.190e+07***** (3.361e+06)	516,417 (4.851e+06)
Firm Controls	YES	YES
GDP	YES	YES
Gilt Yields	NO	YES
Firm FE	YES	YES
QE * CONTROLS	YES	YES
Observations	1,848	
Observations	618	618
R-squared	0.073	0.079

b) bond level

	(1)	(2)	(3)	(4)
VARIABLES	Issuance		Yields	
QE	**214.7***** (54.55)	**456.7***** (140.6)	-0.0120 (0.0110)	0.594* (0.342)
Maturity	2.138** (0.949)	-0.400 (0.345)	-0.000469*** (0.000151)	-0.0177 (0.0268)
Rating	0.283 (9.726)	-11.53 (7.227)	0.00664** (0.00280)	-0.0389 (0.0344)
Firm Controls	NO	YES	NO	YES
GDP	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES
Broker FE	YES	YES	YES	YES
QE * CONTROLS	YES	YES	YES	YES
Observations	3,157	223	3,164	223
R-squared	0.447	0.992	0.215	0.237

Firm-level and bond-level analysis of bond issuance during the QE period are shown in panel (a) and (b) respectively. QE is an indicator variables that becomes one after the introduction of the QE wave in March 2009. Firm controls are size measured as log of total assets, leverage, current intangible debt, dividends and profitability measured as the ratio between earnings before interest and tax (EBIT) and total assets. Dividends is an indicator variable that equals 1 if the company pays dividends and 0 otherwise. Robust standard errors are clustered at the firm level and reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Figure 3: Maturity rating distribution of bond issuance



Source: Bank of England

In order to control for the characteristics of the bonds, we follow Krishnamurthy and Vissing-Jorgensen (2011) and Todorov's (2020) decomposition approach to assess the impact of QE on specific bond categories that are most likely to be affected by portfolio rebalancing channel, mainly investment-grade bonds. Table 5 presents three sets of estimation results using equation (1) with the yields at origination used as the dependent variable. The whole sample of bond issuances is first split into two buckets, namely investment-grade bonds (from AAA to BBB) and non-investment grade bonds (< BBB). Table 5 panel (a) identifies the investment-grade bonds as the only ones affected, with an average reduction of 235bps in the cost of borrowing during the whole QE period. This is expected as (i) non-bank financials that sold gilts to the Bank cannot invest in non-investment grade bonds as a substitute for gilts, and (ii) non-investment grade bonds are not eligible for direct purchase under CBPS. The whole sample is also split into several maturity buckets from 10th percentile to the 90th percentile of

the distribution. Although no direct eligibility criteria are linked to the age of the bond, studies have found long maturity bonds to benefit the most as a result of the flattening of the yield curve (Todorov, 2020). Our test indicates that this is marginally (at 5% significance) reflected in the primary market yields of the highest 25th and 75th percentiles of the maturity distribution, although non-linearity might be expected. The last panel (c) combines both risk dimensions by splitting the sample into default risk and maturity pair buckets. The results show that investment-grade bonds with longer maturities saw the largest fall in yields (around 2.5 percentage points post QE).

If QE caused an increase in bond issuance, the increase would be larger for investment-grade longer-term bonds, given that their yields at issuance fell relative to other bonds. Hence, we now turn our attention to the amounts issued by corporates. With a cheaper cost of borrowing caused by QE via portfolio rebalancing and direct purchases, we should expect companies to issue more investment-grade bonds, as suggested by Figure 3, and probably with longer maturities. Supported by the evidence above, we use the following diff-in-diff model:

$$Y_{i,t} = \beta_i + \gamma \boldsymbol{QE}_t + \delta(Treated_i \boldsymbol{QE}_t) + \theta X_{i,t} + \varsigma\left(X_{i,t} \boldsymbol{QE}_t\right) + \upsilon_{i,t} \qquad (3)$$

Where $Y_{i,t}$ is the amount issued, β_i is an individual (bond/issuer) fixed effect, $Treated_i$ is an indicator variable that equals 1 for either investment-grade bonds, long-maturity bonds in the highest 25th quintile, or both, and 0 otherwise, $\boldsymbol{QE}_t$ is an indicator variable that becomes one after the introduction of QE in March 2009. In some model specifications we also use alternative QE indicators for specific waves, i.e., $\mathbf{QE}_2$, $\mathbf{QE}_{Brexit}$ and $\mathbf{QE}_{Covid}$ for the second, third and fourth wave of QE respectively. Recall that $\mathbf{QE}_2$ is an indicator variable that becomes one after July 2012, $\mathbf{QE}_{Brexit}$ after August 2016 and $\mathbf{QE}_{Covid}$ after March 2020 as reported in Figure 2. $Treated_i * \boldsymbol{QE}_t$ is the interaction term of the treatment status and QE period. $X_{i,t}$ is a matrix of controls that includes include macro controls (GDP and gilt yields), company-level controls (size, leverage, current intangible debt, dividends and profitability) and bond-level controls (rating and maturity). We also include the interaction terms $X_{i,t} \times \boldsymbol{QE}_t$ as a robustness check for possible heterogeneous responses to the treatment. We are interested in the element δ from equation (3), which represents the DiD coefficient.

Table 5: Total impact of QE on corporate cost of borrowing

Panel (a) – Default Risk Decomposition

	(1)	(2)	(3)
		Yields at issuance	
VARIABLES	All	Investment Grade	Non Investment Grade
QE	-0.00938	**-0.0235****	0.0161
	(0.0112)	(0.00925)	(0.0324)
Observations	3,164	1,505	1,599
R-squared	0.214	0.243	0.203

Panel (b) – Maturity Decomposition

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
						Yields at issuance				
VARIABLES	lowest 10%	highest 90%	lowest 25%	highest 75%	lowest 50%	highest 50%	lowest 75%	highest 25%	lowest 90%	highest 10%
QE	-0.0216*	-0.00424	0.0198	**-0.0371*****	0.106	-0.0167*	0.00333	**-0.0229****	-0.00267	-0.0220
	(0.0120)	(0.0476)	(0.0399)	(0.0128)	(0.139)	(0.00981)	(0.0703)	(0.00992)	(0.0484)	(0.0161)
Observations	197	2,151	421	1,782	961	1,141	1,718	494	2,193	158
R-squared	0.772	0.332	0.346	0.469	0.367	0.501	0.328	0.579	0.331	0.620

Panel (c) – Default-Maturity Risk decomposition

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Yields at issuance - Investment Grade				Yields at issuance - Non Investment Grade			
VARIABLES	lowest 50%	highest 50%	lowest 75%	highest 25%	lowest 50%	highest 50%	lowest 75% -	highest 25%
QE	-0.0199	-0.0227*	-0.0335*	**-0.0245****	0.269	-0.0217	0.0123	0.000927
	(0.0241)	(0.0120)	(0.0201)	(0.00960)	(0.344)	(0.0295)	(0.158)	(0)
Observations	370	448	624	232	543	631	1,023	240
R-squared	0.566	0.424	0.444	0.561	0.345	0.570	0.303	0.624

Bond-level analysis of cost of borrowing during the QE period. QE is an indicator variable that becomes one after the introduction of the QE wave in March 2009. Robust standard errors are clustered at the firm level and reported in parentheses. *** p<0.01, ** p<0.05, * p<0.

The estimates from Table 6 provide evidence of an increased bond issuance after QE, especially when using the investment-grade only criteria for the treatment group in models (1-2), with an average increase of £227.1mn per issuance post QE. The lack of evidence of the long-maturity criteria for the treatment group in models (3-4) is in line with our finding that maturity at issuance alone does not provide any indication of a potential QE impact on the cost of borrowing (yields at issuance). The last two models (5-6) also confirm the findings of the first two models when both riskiness and maturity are used as a criterion for the treatment group. Note, however, that this approach is not as robust as the first one due to the possible non-linear effects of maturity on the issuance. As an alternative robustness test, we run the model of equation (1) instead of the DiD approach of equation (3), splitting the whole sample into several default and maturity risk buckets, as we did for yields at issuance. Appendix Table 16 shows that our findings are robust under different model specifications.

5.2. The real impact of QE via the bond market

In this section, we check how companies that benefited from a lower cost of borrowing, and therefore issued more bonds due to QE, used the funds. We are interested in testing whether the extra funds translated into further investment spending, creating a real effect. We run the regression equation (1) with company-level (cash flow statement and balance sheet) values as dependent variables. Table 7 shows no significant coefficients of the interaction between QE and the company total issuance except for share buybacks. The latter show a positive value of 0.129, suggesting that for every £1 of bond issuance during the QE period, companies spent about 13 pence on share buybacks. No evidence of real investments that would support a real effect of QE via the bonds market is found. These results complement Todorov's (2020) evidence on the euro area QE, which, similar to the UK QE, did not translate into real effects. Instead, they found companies issuing more eligible bonds in the EU to increase dividends compared to the control group. The insignificant coefficient on long-term debt seems contradictory, given the increase in bond issuance.

Table 6: Difference-in-Difference model of corporate bond issuance amount

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
	Issuance DiD Investment Grade		Issuance DiD Long Term Maturity		Issuance DiD Investment grade & Long Term Maturity	
treated * **QE**	89.92*	**227.1*** **	-28.66	-100.8	**176.8** **	-82.56
	(51.67)	(75.89)	(52.77)	(72.47)	(84.16)	(106.8)
QE	YES	YES	YES	YES	YES	YES
treated	YES	YES	YES	YES	YES	YES
Bond FE	YES	NO	YES	NO	YES	NO
Firm FE	NO	YES	NO	YES	NO	YES
Observations	3,504	3,157	3,504	3,157	3,504	3,157
R-squared	0.067	0.448	0.002	0.447	0.016	0.448

Bond-level analysis of bond issuance during the QE period. treated is an indicator variable that equals to 1 for either investment-grade bonds (models 1-2), long maturity bonds in the highest 25th quintile (models 3-4), or both (models 5-6), and 0 otherwise QE is an indicator variables that becomes one after the introduction of the QE wave in March 2009. Robust standard errors are clustered at the firm level and reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 7: Real effects of QE

VARIABLES	(1) Share Buybacks	(2) Cash Dividends	(3) Purchase of Fixed Assets	(4) Purchase of Intangible Assets	(5) Acquisition of Business	(6) Change in Working Capital	(7) Total Long-term Debt	(8) Purchase of R&D	(9) Purchase of Securities
QE * Firm Tot Issuance	**0.129** **	-0.0148	0.264	-0.00808	-0.285	**0.266*** **	-0.337	5.79e-07	-0.0315
	(0.0513)	(0.0832)	(0.170)	(0.0294)	(0.243)	(0.0832)	(0.785)	(1.54e-06)	(0.0421)
Firm Controls	YES	YES	YES	YES	YES	YES	YES	YES	YES
Dividend	YES	NO	NO	NO	NO	NO	NO	NO	NO
GDP	YES	YES	YES	YES	YES	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Observations	4,161	618	618	618	618	618	618	618	618
R-squared	0.079	0.783	0.802	0.064	0.076	0.546	0.798	0.599	0.590

Firm-level analysis of the interaction between firm total bond issuance and the main uses of liquidity. Data is collected semi-annually from cash flow statements and balance sheets. QE is an indicator variable that becomes one after the introduction of the QE wave in March 2009. Firm controls are size measured as log of total assets, leverage and current intangible debt. Dividend is an indicator variable that equals 1 if the company pays dividends and 0 otherwise. Robust standard errors are clustered at the firm level and reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

However, the increase in bond issuance has been associated with a reduction in bank borrowing[6], in line with Fatouh, Markose, and Giansante (2021)'s findings. The positive coefficient of working capital results from the change in the liabilities composition towards more long-term (non-current) liabilities and fewer current liabilities. The last leads to an increase in working capital.

To sum up, our results suggest that QE has been successful at reducing not only corporate bond yields in the secondary market but also the cost of borrowing in the primary market, hence increasing bond issuance. However, the additional low-cost funding has not translated into real effects, as the issuing companies have chosen to use the funds to substitute away from bank borrowing and buy back their shares to boost their prices.

5.3. The direct impact of QE on corporate bonds

This last section uses a set of empirical models to disentangle the potential effects of corporate bond purchases under CBPS. As discussed earlier, CBPS was introduced in the latter waves of QE (in the Brexit wave specifically), at a time when corporate bond yields had already fallen substantially due to the portfolio rebalancing and liquidity effects of the earlier waves. We therefore expect very little or no marginal impact of CBPS on the cost of borrowing and the total issuance of bonds. Direct purchases of (CBPS) eligible bonds would first cause a reduction of their yields in the secondary market and, potentially, translate into a lower cost of borrowing for their issuers. We first attempt an analysis in the secondary market by running diff-in-diff regression equation (3) with secondary market yields as the dependent variable. For this section, our treatment is CBPS eligibility, called *treatedDirect*.

Table 8 reports the effectiveness of our matching in limiting the differences between the treatment and the control groups. As expected by the eligibility criteria, eligible bonds have a better rating, longer maturity, higher liquidity and slightly higher face value (model (1)). Those differences disappear post matching, providing a valid control group for our models. The χ^2 test also confirms that we cannot reject the hypothesis that all coefficients are jointly equal to zero in the post-matching models, as reported by the p-value of 0.420.

[6] The data on bank borrowing by companies is highly scattered and does not allow us to implement a meaningful test for bank borrowing similar to other variables in this section.

The estimations reported in Table 9 show robust evidence of a reduction of yields of eligible bonds as a result of CBPS purchases. Those changes are, however, quite small compared to those reported earlier for the total (direct and indirect) effects. We estimate that direct purchases reduced the market yields of eligible bonds by 40-60bps in QE Brexit only (Table 4 panel b), which is a tenth compared to the overall impact shown in Section 5.1. This is in line with the relative size of CPBS purchases compared to total QE purchases during the Brexit wave (£10bn out of £75bn) and Covid-19 wave (£10bn out of £450bn). Our results are robust under several different specifications. To further test the robustness of these results, we run a placebo test by truncating the data prior to the actual direct purchase in August 2016. The results are presented in Table 10. The lack of significant DiD coefficients in the placebo tests confirms that the main reduction in market yields is caused by CBPS purchases and was not affected by any pre-selected characteristic or market preference for those eligible bonds. Furthermore, to address any issues that might arise the width of the period covered by our baseline DiD (2009-2021), such as interactions with other interventions and factors, we rerun the same exercise using a shorter period (2013-2021). The results or this experiment are presented in Appendix Table 17, and are consistent with the baseline analysis in Table 9.

We finally turn our attention the primary market and test whether the reduction in market yields for eligible bonds translates into a reduction in the cost of borrowing and more issuance in the primary market. We follow the same procedure for constructing a control group. The probit estimation of the correlations between treatment and bond characteristics as well as the effects of the propensity score matching are reported in Table 11.

While CBPS purchases appear to have caused a non-negligible reduction in the yields of the eligible bonds in the secondary market, this did not translate into a reduction in the cost of borrowing for their issuers in the primary market. We also run robustness tests on the potential short-term effects that could explain the change in yields, aimed at isolating short-term shocks that could disappearing over the entire CBPS period. We propose an experiment that considers the first 6 month of a QE wave as short term (Table 18). Results confirm that no impact on primary market is observed even in the short run.

Table 8: Multivariate regression between eligible bonds treatment and individual characteristics in secondary market

VARIABLES	(1) *treatedDirect*	(2)
Rating	**-0.179*** **	-0.014
	(0.061)	(0.070)
maturty	**0.013** **	-0.007
	(0.005)	(0.006)
HQLA_elgble	**0.987*** **	-0.027
	(0.178)	(0.233)
Face value	0.167*	0.141
	(0.092)	(0.125)
Constant	-3.798**	-1.445
	(1.906)	(2.628)
Matching	-pre	-post
$Adj\ R^2$	0.193	0.012
p-value	0.000	0.420
N	520300	146390

Probit regressing the treatment on bond characteristics. The dependent variable is the bond treatment status treatedDirect for CBPS eligible bonds. Model (1) reports the pre-matching results while model (2) reports the post matching results with matching ratio 1:1. Coefficients and standard errors are reported for each variable. Standard errors are clustered at the firm level and reported in brackets, * p<0.10 ** p<0.05 *** p<0.01.

Table 9: DiD direct effect of QE on market yields 2009-2021

VARIABLES	(1)	(2)	(3)	(4)
	Yield 2009-2021			
treatedDirect * **QE**brexit	**-0.00534*** **	**-0.00638*** **	**-0.00424*** **	**-0.00419*** **
	(0.00196)	(0.00158)	(0.00151)	(0.00130)
treatedDirect * **QE**covid	-0.00137	-0.00124	-0.00112	-0.00102
	(0.000915)	(0.000914)	(0.000732)	(0.000768)
Controls	YES	YES	YES	YES
treatedDirect	YES	YES	YES	YES
QE	YES	YES	YES	YES
QE * Controls	YES	YES	YES	YES
Firm FE	NO	NO	YES	YES
Time FE	NO	YES	NO	YES
Observations	146,390	146,390	146,390	146,390
R-squared	0.489	0.581	0.654	0.723

Bond-level analysis of the secondary market yields. QEbrexit and QEcovid are indicator variables that become one after the introduction of the third QE wave in August 2016 and forth one in March 2020 respectively. treatedDirect is an indicator variable that becomes one if the bond is CBPS eligible and zero otherwise. Controls are bond rating, maturity, liquidity measured as HQLA eligible and face value. Robust standard errors are clustered at the firm level and reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 10: Placebo tests of direct effect of QE on market yields 2009-2016

VARIABLES	(1)	(2)	(3)	(4)
	Yield 2009-2016			
treatedDirect * **QE**placebo	-0.000957	-0.00380	0.00264	0.000134
	(0.00305)	(0.00275)	(0.00281)	(0.00240)
Controls	YES	YES	YES	YES
treatedDirect	YES	YES	YES	YES
QEplacebo	YES	YES	YES	YES
QEplacebo * Controls	YES	YES	YES	YES
Firm FE	NO	NO	YES	YES
Time FE	NO	YES	NO	YES
Observations	46,999	46,999	46,999	46,999
R-squared	0.486	0.588	0.672	0.763

Bond-level analysis of the secondary market yields from March 2009 (first QE wave) until August 2016 (pre-Brexit QE wave). QEplacebo an indicator variables that become one after January 2013. treatedDirect an indicator variable that becomes 1 if the bond is CBPS eligible and 0 otherwise. Controls are bond rating, maturity, liquidity measured as HQLA eligible and face value. Robust standard errors are clustered at firm level and reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 11: Multivariate regression between eligible bonds treatment and individual characteristics in primary market

VARIABLES	(1)	(2)
	treatDirect	
Maturity	**0.014****	0.005
	-0.007	-0.009
log(value)	0.08	-0.089
	-0.15	-0.135
Size	-0.008	0.113
	-0.232	-0.348
Cur to TAs	**-5.603*****	-1.91
	-2.081	-3.417
Lng term to Tot Debt	0.11	-0.917
	-2.445	-2.263
Cur to TLs	**4.612****	-0.438
	-2.17	-2.224
Dividend	1.182	0.633
	-1.222	-1.115
Constant	-5.124	-5.937
	-6.288	-8.002
Matching	-pre	-post
$Adj\ R^2$	0.188	0.051
p-value	0	0.763
N	239	206

Probit regressing the treatment on bond characteristics. The dependent variable is the bond treatment status treatedDirect for CBPS eligible bonds. Model (1) reports the pre-matching results while model (2) reports the post matching results with matching ratio 1:1. Coefficients and standard errors are reported for each variable. Standard errors are clustered at the firm level and reported in brackets, * p<0.10 ** p<0.05 *** p<0.01.

Table 12: DiD direct effect of QE on corporate cost of borrowing and issuance amount

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Yield at issuance				Issuance			
	2009-2021	2009-2021	2013-2021	2013-2021	2009-2021	2009-2021	2013-2021	2013-2021
treatedDirect * **QE**brexit	0.0111	-0.0178	-0.0740	-0.0559	**-0.630*** **	**-0.793** **	**-0.609*** **	**-1.246*** **
	(0.0775)	(0.0728)	(0.0733)	(0.0574)	(0.225)	(0.330)	(0.215)	(0.343)
treatedDirect * **QE**covid	0.0339	0.0386	0.0534	0.0436	0.339	-0.353	0.813**	0.371
	(0.0722)	(0.0548)	(0.0546)	(0.0330)	(0.324)	(0.477)	(0.337)	(0.450)
Bond Controls	YES	YES	YES	YES	YES	YES	YES	YES
Firm Controls	YES	NO	YES	NO	YES	NO	YES	NO
treatedDirect	YES	YES	YES	YES	YES	YES	YES	YES
QE	YES	YES	YES	YES	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES	YES	YES	YES	YES
Time FE	YES	YES	YES	YES	YES	YES	YES	YES
Observations	206	393	178	320	206	393	178	320
R-squared	0.130	0.060	0.086	0.047	0.446	0.142	0.596	0.141

Bond-level analysis on bond issuance during QE. QEbrexit and QEcovid are indicator variables that become one after the introduction of the third QE wave in August 2016 and forth one in March 2020 respectively. treatedDirect is an indicator variable that become one if the bond is CBPS eligible and zero otherwise. Bond-level controls are bond rating, maturity and log of value. Firm-level controls are size as log of total assets, current to total assets for models (1-4), long term to total debt, current to total liabilities and dividends. The latter is an indicator variable that equals 1 if the company pays dividends and 0 otherwise. Robust standard errors are clustered at the firm level and reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 13: Placebo tests - DiD direct effect of QE on corporate cost of borrowing and issuance amount 2000-2016

VARIABLES	(1)	(2)	(5)	(6)
	Yield at issuance		Issuance	
	2000-2016	2000-2016	2000-2016	2000-2016
treatedDirect * **QE**	-0.0664	0.00304	0.0473	-0.188
	(0.0657)	(0.0281)	(0.397)	(0.497)
treatedDirect * **QE**2	0.0593	-0.0348	0.613	**1.361*** **
	(0.0691)	(0.0477)	(0.375)	(0.508)
Bond Controls	YES	YES	YES	YES
Firm Controls	YES	NO	YES	NO
treatedDirect	YES	YES	YES	YES
QE	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES
Time FE	YES	YES	YES	YES
Observations	210	383	210	383
R-squared	0.178	0.084	0.233	0.122

Bond-level analysis on bond issuance during QE. QE and QE2 are indicator variables that become one after the introduction of the first QE wave in March 2009 and second one in October 2011 respectively. treatedDirect is an indicator variable that become one if the bond is CBPS eligible and zero otherwise. Bond-level controls are bond rating, maturity and log of value. Firm-level controls are size as log of total assets, current to total assets for models (1-4), long term to total debt, current to total liabilities and dividends. The latter is an indicator variable that equals 1 if the company pays dividends and 0 otherwise. Robust standard errors are clustered at the firm level and reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 14: DiD direct effect of QE on firm total issuance

VARIABLES	(1) Total Issuance 2000-2021	(2) Total Issuance 2000-2021	(3) Total Issuance 2009-2021	(4) Total Issuance 2009-2021	(5) Total Issuance 2013-2021	(6) Total Issuance 2013-2021
treatedDirect * QEbrexit	-2.673e+07 (1.679e+07)	-2.894e+07* (1.690e+07)	-4.073e+07 (3.241e+07)	-4.099e+07 (3.215e+07)	-7.702e+07 (6.277e+07)	-7.782e+07 (6.320e+07)
treatedDirect * QEcovid	1.416e+08 (1.068e+08)	1.418e+08 (1.076e+08)	1.359e+08 (1.051e+08)	1.364e+08 (1.057e+08)	1.289e+08 (1.038e+08)	1.284e+08 (1.037e+08)
Controls	YES	YES	YES	YES	YES	YES
treatedDirect	YES	YES	YES	YES	YES	YES
QE	YES	YES	YES	YES	YES	YES
GDP	YES	YES	YES	YES	YES	YES
Gilts Yield	NO	YES	NO	YES	NO	YES
Firm FE	YES	YES	YES	YES	YES	YES
Observations	618	618	460	460	319	319
R-squared	0.097	0.106	0.115	0.117	0.164	0.165

Firm-level analysis on bond total issuance during QE. QEbrexit and QEcovid are indicator variables that become one after the introduction of the third QE wave in August 2016 and forth one in March 2020 respectively. treatedDirect is an indicator variable that becomes one if the bond is classified as CBPS eligible and zero otherwise. Firm controls are size as log of total assets, market cap, current to total assets, long term to total debt, current to total liabilities and dividends. The latter is an indicator variable that equals 1 if the company pays dividends and 0 otherwise. Robust standard errors are clustered at the firm level and reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

This suggests that relying on the QE effects on the secondary market yields to draw conclusions about the impact on the cost of borrowing can be misleading. Interestingly, Table 12 models (4-8) consistently report negative and robust coefficients across different model specifications for QE Brexit. This suggests that issuers of the eligible bonds chose to go for smaller bond issuances (i.e., smaller amounts issued per issuance), following CBPS purchases in the Brexit wave. This could be compensating for pre-Brexit larger issuances. To confirm this hypothesis, we run the same model for the first two QE waves, QE1 from March 2009 and QE2 from October 2011. The results are presented in Table 13. The DiD estimates for yields at origination do not show any evidence of an impact on bond issuance. The second QE wave shows much larger issuances, which could justify the negative diff-in-diff coefficient we find for QE Brexit. Finally, we test the same model with firm total issuance as the dependent variable to assess if any change in the total issuance by firms issuing eligible bonds can be found. Table 14 shows no robust evidence of any effect on bond issuance caused by CBPS purchases, which is expected due to the small magnitude of the effect compared to the total asset purchases under QE, as mentioned earlier.

6. Conclusions

QE impact can transmit to the real economy via several channels, most channels go through assets prices and yields. The asset purchases by central banks increase the prices and reduce the yields of the targeted assets. This impact then spreads to other assets, through signalling, liquidity and portfolio rebalancing effects, especially close alternatives to the targeted assets. Unlike similar programmes in other countries, UK QE focused on purchasing gilts, and at a later stage a relatively smaller amount of eligible corporate bonds, under the Corporate Bond Purchase Scheme (CBPS). Due to this design, UK QE purchases can have two effects on bond (secondary) markets, a *direct* effect and an *indirect* effect. The first refers to the impact of purchases under CBPS on prices and yields of targeted corporate bonds, whereas the second refers to portfolio rebalancing and liquidity effects of gilt purchases on those prices and yields. The reduction in yields in the secondary market may translate into a lower cost of borrowing and more issuance in the primary market, possibly leading to higher investment spending and output (i.e., real effects).

While earlier papers have investigated the impact of QE on secondary market, in this paper, we investigated the real economy impacts of UK QE operations via primary and secondary bond markets. We achieved this by inspecting the impact of the purchases on secondary market yields, cost of borrowing and issuance in the primary market, and examining whether the issuing companies used the additional funding arising from increased issuance to fund real investments. Using a difference-in-difference (DiD) exercise, we found that investment-grade long-maturity bond issuance increased as a result of the lower cost of borrowing caused by QE. However, our results showed that companies directed the additional funds towards share buybacks and reducing bank borrowing rather than real investment. Our analysis also isolated the marginal impact of corporate bond purchases under CBPS (i.e., the *direct* effect) from the total effect of QE on the bonds market based on bond eligibility. We find that the yields of eligible bonds fell by 40-60bps relative to ineligible bonds. However, this did not pass through to the cost of borrowing and issuance in the primary market. There could be some plausible explanations for the lack of evidence in the primary market: (i) the increase in leverage due to earlier waves (insolvency risk) could have wiped out the benefits coming from the secondary market for any new issuances; (ii) the relatively small size of the corporate bond programmes relative to gilt purchases might have made their effects insignificant in the primary market. We are not attempting to answer why primary market rates didn't reflect secondary market. However, no change in the rates is consistent with what we observe in terms of no increase in issuance by issuers of eligible bonds.

A number of policy implications can be drawn from our analysis. First, lower yields in the secondary market may not translate into a lower cost of borrowing. Hence, relying on the QE effects on the secondary market yields to draw conclusions about the impact on the cost of borrowing can be misleading. Second, even if lower secondary market yields are reflected in the cost of borrowing, incentivising more bond issuance in the primary market, this doesn't guarantee attaining real effects. This is because issuers, in a low-yields environment, might find it more lucrative to use the cheaper funding to reduce the cost of debt (by restructuring it), distribute more dividends, or buy back shares rather than spending on real investment. Lastly, our analysis suggests that direct interventions are likely needed to attain the favourable real effects.

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Appendix

Table 15: Firm and bond level model of corporate bond issuance pre-Brexit

a) Firm level

	(1)	(2)
VARIABLES	Issuance	
QE	**9.835e+06***** (3.506e+06)	516,417 (4.851e+06)
Firm Controls	YES	YES
GDP	YES	YES
Gilt Yields	NO	YES
Firm FE	YES	YES
QE * CONTROLS	YES	YES
Observations	1,848	
Observations	440	440
R-squared	0.080	0.090

b) bond level

	(1)	(2)	(3)	(4)
VARIABLES	Issuance		Yields	
QE	**159.7*** (54.62)	**1,719**** (658.1)	-0.00964 (0.0133)	-0.680 (3.175)
Maturity	2.134** (1.072)	0.730 (0.671)	-0.000154 (0.000188)	-0.0264 (0.0386)
Rating	15.44 (13.33)	-93.88** (41.82)	0.00575* (0.00343)	0.0346 (0.168)
Firm Controls	NO	YES	NO	YES
GDP	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES
Broker FE	YES	YES	YES	YES
QE * CONTROLS	YES	YES	YES	YES
Observations	2,229	152	2,236	152
R-squared	0.460	0.996	0.227	0.230

Firm-level and bond-level analysis of bond issuance are shown in panel (a) and (b) respectively. The period covers the first two QE waves and ends before the QE Brexit in August 2016. QE is an indicator variables that becomes one after the introduction of the QE wave in March 2009. Firm controls are size measured as log of total assets, leverage, current intangible debt, dividends and profitability measured as the ratio between earnings before interest and tax (EBIT) and total assets. Dividend is an indicator variable that equals 1 if the company pays dividends and 0 otherwise. Robust standard errors are clustered at the firm level and reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 16: Risk and Maturity decomposition of bond issuance amount

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Issuance - Investment Grade					Issuance - Non Investment Grade				
VARIABLES	all	lowest 50%	highest 50%	lowest 75%	highest 25%	all	lowest 50%	highest 50%	lowest 75% -	highest 25%
QE	**346.4*** (88.73)	-326.8* (190.5)	-106.1 (91.47)	**-315.3**** (150.5)	-28.24 (23.69)	32.43 (32.66)	-10.25 (37.76)	50.38** (25.11)	12.99 (24.73)	14.33 (0)
Observations	1,501	370	448	624	232	1,594	542	631	1,019	240
R-squared	0.382	0.943	0.955	0.938	0.989	0.768	0.968	0.994	0.971	0.996

Bond-level analysis of amount of bond issuance during the QE period. QE is an indicator variables that becomes one after the introduction of the QE wave in March 2009. Robust standard errors are clustered at the firm level and reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 17: DiD direct effect of QE on market yields 2013-2021

VARIABLES	(1) Yield	(2) Yield	(3) Yield	(4) Yield
treatedDirect * **QE**brexit	-0.00510*** (0.00131)	-0.00468*** (0.00130)	-0.00454*** (0.000977)	-0.00406*** (0.000970)
treatedDirect * **QE**covid	-0.00137 (0.000915)	-0.00126 (0.000917)	-0.00131* (0.000713)	-0.00118 (0.000729)
Controls	YES	YES	YES	YES
treatedDirect	YES	YES	YES	YES
QE	YES	YES	YES	YES
QE * Controls	YES	YES	YES	YES
Firm FE	NO	NO	YES	YES
Time FE	NO	YES	NO	YES
Observations	120,888	120,888	120,888	120,888
R-squared	0.417	0.433	0.665	0.676

Bond-level analysis of the secondary market yields from Jan 2013 to end of 2021. QEbrexit and QEcovid are indicator variables that become one after the introduction of the third QE wave in August 2016 and forth one in March 2020 respectively. treatedDirect is an indicator variable that becomes one if the bond is CBPS eligible and zero otherwise. Controls are bond rating, maturity, liquidity measured as HQLA eligible and face value. Robust standard errors are clustered at the firm level and reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 18: DiD direct effect of QE on corporate cost of borrowing and issuance amount (ST vs LT)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	Yield at issuance				Issuance			
	2009-2021	2009-2021	2013-2021	2013-2021	2009-2021	2009-2021	2013-2021	2013-2021
treatedDirect * **QE**brexit_ST	-0.0197	0.0958***	-0.00498	0.0561**	-0.702*	-0.445	-0.927*	-0.923**
	(0.0585)	(0.0301)	(0.0630)	(0.0265)	(0.373)	(0.265)	(0.512)	(0.349)
treatedDirect * **QE**covid_ST	0.00807	-0.0288	-0.0707	-0.0617	-0.629**	-0.818**	**-0.632*** **	**-1.256*** **
	(0.0754)	(0.0794)	(0.0757)	(0.0644)	(0.267)	(0.332)	(0.196)	(0.282)
treatedDirect * **QE**brexit_LT	-0.00490	0.0522	0.0155	0.0494	0.490	-0.583	**1.153*** **	0.430
	(0.0490)	(0.0552)	(0.0535)	(0.0376)	(0.394)	(0.662)	(0.264)	(0.588)
treatedDirect * **QE**covid_LT	0.202*	0.0686	**0.139*** **	0.0608*	-0.193	0.688	-0.0971	0.410
	(0.115)	(0.0759)	(0.0468)	(0.0327)	(0.309)	(0.506)	(0.598)	(0.524)
Bond Controls	YES	YES	YES	YES	YES	YES	YES	YES
Firm Controls	YES	NO	YES	NO	YES	NO	YES	NO
treatedDirect	YES	YES	YES	YES	YES	YES	YES	YES
QE	YES	YES	YES	YES	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES	YES	YES	YES	YES
Time FE	YES	YES	YES	YES	YES	YES	YES	YES
Observations	206	393	178	320	206	393	178	320
R-squared	0.130	0.060	0.086	0.047	0.446	0.142	0.596	0.141

Bond-level analysis on bond issuance during QE. QEbrexit_ST and QEcovid_ST are indicator variables that become one after the introduction of the third QE wave in August 2016 and forth one in March 2020 respectively and return to 0 six months later. QEbrexit_LT and QEcovid_LT are indicator variables that become one six months after the introduction of the third QE wave in August 2016 and forth one in March 2020 respectively. treatedDirect is an indicator variable that become one if the bond is CBPS eligible and zero otherwise. Bond-level controls are bond rating, maturity and log of value. Firm-level controls are size as log of total assets, current to total assets for models (1-4), long term to total debt, current to total liabilities and dividends. The latter is an indicator variable that equals 1 if the company pays dividends and 0 otherwise. Robust standard errors are clustered at the firm level and reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1.