Using changes in auction maturity sectors to help identify the impact of QE on gilt yields

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Using the information contained in economic news and data releases, financial markets have widely anticipated recent Monetary Policy Committee announcements about the amount of assets the Bank of England intends to purchase as part of its quantitative easing (QE) policy. This makes it increasingly difficult to identify the impact of QE on gilt yields. This article uses three 'natural experiments' associated with operational changes to the distribution of gilt purchases — in March 2009, August 2009 and February 2012 — to help overcome this identification problem. It finds that the 'local supply' channel, which can be identified using these events, can explain around half of the total impact of QE on gilt yields. The estimates of this effect are broadly similar across the three events; so the strength of this channel of QE does not appear to have changed significantly since gilt purchases were introduced in early 2009.

In March 2009, the Bank of England announced that it would begin a programme of large-scale asset purchases financed using central bank money; a policy widely referred to as quantitative easing (QE). By May 2012 the Bank's purchases totalled £325 billion, almost exclusively in UK government bonds (gilts). The aim of asset purchases is conceptually the same as a cut in Bank Rate: to stimulate nominal spending in order to meet the 2% inflation target in the medium term.

There are a number of channels through which asset purchases might affect spending and inflation.[2] The first leg of many of these channels is the impact of asset purchases on gilt yields: purchases by the Bank increase the price of gilts and therefore lower their yields. But identifying this impact on yields has become increasingly difficult as financial markets have begun to anticipate future purchases. This article uses a novel approach to isolate part of the impact of QE on gilt yields, by using 'natural experiments' associated with operational changes that contained news about the distribution of future gilt purchases.

Given that financial markets are forward looking, the majority of the impact of asset purchases on gilt yields is likely to occur when expectations of purchases are formed — rather than when the purchases are actually made.[3] Therefore changes in gilt yields will be observed when there is 'news' that changes expectations about future purchases.

When QE was first introduced, the policy was unfamiliar to financial market participants. So it is likely that their expectations of the size of asset purchases were formed primarily from Monetary Policy Committee (MPC) announcements about the planned amount of QE purchases. Therefore these initial announcements contained significant news and so could be used to estimate the effect of QE on gilt yields.

Over time, however, gilt market participants have learned how the MPC's QE decisions depend on the United Kingdom's economic outlook. Expectations of gilt purchases are therefore increasingly formed when economic news and data are released, that is, in advance of the MPC announcement itself. Subsequent MPC announcements have thus contained less news about gilt purchases, making it harder to identify the impact of QE on gilt yields from the immediate market reaction to these announcements. Just as with changes in Bank Rate, expectations of policy changes which are already widely anticipated will have little market impact when they are actually announced.

(2) For a more detailed discussion see the previous *Quarterly Bulletin* article by Joyce, Tong and Woods (2011).
(3) Forthcoming work by Daines, Joyce and Tong (2012) finds that there may have been some impact on yields at the time of purchases during the early stages of QE purchases in 2009. But the majority of the impact was observed when purchases were announced.

This article tries to overcome this identification problem by using the reaction of gilt yields to market notices which contained operational changes to the distribution of gilt purchases that were largely unanticipated. These notices are unlikely to have changed the total amount of gilt purchases market participants were expecting the Bank to make in the future. But the notices did have implications for how these expected purchases were likely to be spread across different groups of gilts. Therefore these events can be used to determine how each gilt's yield changes given a change in the amount of that gilt that is expected to be purchased. Although this does not capture all of the effects of QE on gilt yields, it can help to identify a part of the effect. Furthermore, because the timings of these notices (in March 2009, August 2009 and February 2012) span the period of QE purchases, they can also be used to determine if the strength of this effect has changed over time.

The first section of this article outlines the channels through which asset purchases affect gilt yields, and discusses which of these can be identified using these natural experiments. The second section explains how the news in the operational market notices can be quantified. The third section uses a regression approach to investigate the link between this measure of news and the change in yields, to help quantify this part of the impact of QE. The fourth section puts the results into context by comparing them to other work on QE for the United Kingdom and the United States. The final section concludes.

Channels from QE to gilt yields

This section outlines the links between QE and gilt yields, and then explains which of these channels can be identified using the operational market notice events. The link between QE and gilt yields is usually explained by the following effects:

- *Local supply*: if some investors do not view gilts of different maturities as perfect substitutes (for example, some investors will strongly prefer to hold longer-maturity assets to match their long-dated liabilities) then central bank purchases expected in a specific maturity range can reduce the remaining supply of gilts expected to be available to private sector participants, driving up prices and lowering yields in that part of the yield curve.[1]

- *Duration*:[2] if the marginal investor in the market dislikes the risk associated with holding long-maturity assets, then market prices will contain a 'term premium' which will, in part, compensate the holder for bearing this 'duration risk'. Purchases of long-maturity assets, such as long-dated gilts, by the central bank will reduce the aggregate amount of this duration risk remaining in the private market. This reduces the compensation required for investors to hold the remaining bonds. As a result each gilt's term premium will

fall, with the extent of the fall increasing with the maturity of the gilt.

- *Interest rate signalling*: QE announcements may convey information about the central bank's view of the economy and so the likely future path of Bank Rate. This news about the path of short-term interest rates would be expected to have a larger impact on shorter-maturity gilts than longer-maturity gilts.

- *Liquidity*: the presence of the central bank in the gilt market as a buyer may provide a 'backstop' which improves market functioning and increases liquidity. This reduces the cost of trading bonds, and so will reduce the 'illiquidity premium' demanded to compensate investors for holding the remaining bonds.

As noted, the market notices contained news about the way expected purchases would be distributed across different gilts. This would have changed expectations of both the local supply of gilts and the aggregate amount of duration risk remaining in the private market. It is unlikely, however, that the market notices would have signalled anything about the path of Bank Rate; and given the size and depth of the gilt market, it is also unlikely that overall market liquidity would have changed greatly. This suggests the market notices might be useful in helping to identify local supply and duration effects.

But while it is possible to estimate the local supply effects, it is not possible to identify the duration effects. The difficulty is that market notices were released on the same day as MPC announcements about the total planned amount of asset purchases. It is possible to take this into account when estimating the local supply effects. But these announcements may also have been interpreted as signalling a change to the expected path of Bank Rate, for instance that interest rates would remain lower for a longer period. Such signalling effects cannot be distinguished from the effect of the announcements on duration risk. This is because both of these effects vary monotonically depending on the maturity of the gilt: duration risk effects are smoothly increasing with maturity and interest rate signalling effects are smoothly decreasing with maturity. So it is difficult to distinguish the variation due to each effect. Fortunately, it is possible to control for the *joint* effect of these channels, so the market notice announcements can still be used to isolate the local supply effects.

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(1) In theory, these differences may be short-lived if other market participants without such preferences are able to exploit arbitrage opportunities across bonds of different maturities. But if there are some constraints on arbitrageurs' ability to bear risk, then these differences can persist.
(2) Duration is a measure of the remaining maturity of a bond which also takes into account the time profile of coupon payments associated with the bond. For a theoretical model incorporating this channel, see Vayanos and Vila (2009).

Analysing changes in the distribution of gilt purchases

The three natural experiments used in this article are the result of operational changes to the Bank's gilt purchases. Gilt purchases are implemented through a series of 'reverse auctions' where bidders offer gilts for the Bank to purchase, specifying the amount and price at which they are willing to sell.[1] Separate auctions are held for different groups of gilts depending on their remaining maturity. These groupings or 'auction maturity sectors' are specified in advance, and have only been changed infrequently, and for operational reasons. **Table A** summarises all the changes to the auction maturity sectors to date, and the box on page 132 outlines the rationale for these choices.

Table A Changes in auction maturity sectors[a]

Market Notice	Auction details
11 February 2009	February *Inflation Report* and associated press conference give strong indication that gilt purchases financed using central bank money are likely. But no details on the quantity or distribution of purchases.
5 March 2009	Gilt purchases financed from central bank money are announced. Purchases split between **two** auction maturity sectors for gilts with remaining maturities of: (i) 5–10 years (ii) 10–25 years.
6 August 2009	Purchases split between **three** auction maturity sectors for gilts with remaining maturities of: (i) 3–10 years (ii) 10–25 years (iii) 25 years and greater.
9 February 2012	Purchases split between **three** auction maturity sectors for gilts with remaining maturities of: (i) 3–7 years (ii) 7–15 years (iii) 15 years and greater.

(a) A gilt with remaining maturity exactly on the boundary of these ranges is classified in the higher sector. For instance, for the 5 March 2009 Market Notice a gilt with exactly 10 years' remaining maturity would be included in the 10–25 year maturity sector.

The August 2009 and February 2012 events are directly comparable as both involved a change to the auction maturity sectors. March 2009 is slightly different because this is when the auction maturity sectors were first defined. But as this event contained considerable news about how gilt purchases would be distributed, it provides a useful comparison to the other two events.

Quantifying the news in operational market notices

To assess the reaction of gilt yields to changes in the auction maturity sectors, it is necessary to calculate a measure of the news contained in the market notices. For each gilt, this is the difference between expected purchases before and after the market notice.

The first step is to estimate expectations of total future QE purchases, before and after the market notice. The former is

taken from the mean response to the Reuters survey of private sector economists conducted *before* the market notice.[2] But all of the market notices were on the same day as MPC announcements about the planned amount of gilt purchases. And these MPC announcements affected market expectations of the total future amount of QE, particularly in the period after QE was first introduced. To account for these changes, total expected purchases after the market notice are estimated using the mean response to the Reuters survey conducted *after* the market notice. **Table B** summarises the surveys used.

Table B Market expectation of amount of gilt purchases expected in the future, mean response to Reuters survey[a][b]

£ billions

Date of MPC announcement and Market Notice	5 March 2009[c]	6 August 2009	9 February 2012
Expected before	0 (n.a.)	27 (30 July 2009)	86 (1 February 2012)
Expected after	142 (1 April 2009)	62 (6 August 2009)	92 (9 February 2012)
Total QE 'surprise'	142	35	6

Source: Thomson Reuters.

(a) The Reuters poll asks respondents about the amount of gilt purchases they expect the Bank of England to make in total. The figures above subtract from this the amount of gilts already purchased, but not those which have been announced but are yet to be purchased. Surveys on the same day were snap polls conducted after the MPC announcement and market notice.
(b) Date of Reuters survey in brackets.
(c) There was no Reuters survey prior to the March announcement. Therefore, total QE expectations are assumed to have been zero prior to the February *Inflation Report*, with the total change in expectations over this entire period given by the April Reuters survey.

The second step is to estimate how market participants would have expected these total purchases to be distributed across each of the gilts. The distribution of the total purchases expected before the market notice will depend on the previous auction maturity sectors. The distribution of the total expected after will depend on the new auction maturity sectors announced in the market notice.

Total purchases by the Bank have been split evenly *between* the maturity sectors. But how these purchases are spread *within* each sector is not known until the purchases are actually made, because it depends on the market offers received in the auctions. In each auction, purchases of each gilt seem equally likely. Therefore this article assumes that agents start from the expectation that *within* each maturity sector, an equal amount of each individual gilt will be purchased.

This means that expected purchases of each gilt will depend on the number of other gilts in the same sector. For instance,

(1) In each auction the Bank offers to purchase a fixed total value of gilts. The preferred bids chosen to fulfil this total value are selected based on the attractiveness of offers for each gilt relative to market yields, as published by the Debt Management Office, at the close of the auction. For more details of the auction process see www.bankofengland.co.uk/markets/Documents/marketnotice120301con.pdf.
(2) This method was first outlined in Joyce *et al* (2011). The Reuters poll of economists regularly surveys a panel of about 50 City economists on their future Bank Rate expectations. During the period of QE purchases, Reuters also included a question in its poll on the total amount of gilt purchases respondents expected. Although this does not cover Gilt-edged Market Makers, market intelligence suggests that the responses to this survey provide a good proxy for market expectations of QE.

The rationale behind the changes in gilt auction maturity sectors

The primary objective of the Bank's QE gilt auction programme is to purchase the total amount of gilts announced by the MPC in their policy meetings. But the design has also taken into account the implications for the operation and functioning of the gilt market.[1] One particular operational concern was that the Bank should not own large proportions of individual gilts or specific parts of the yield curve, in order to avoid undue disruption to market liquidity. As a result, it has been necessary to review the design of the operations over time, in light of the Bank's increased gilt holdings and changing conditions in the gilt market. This has motivated two changes in the auction maturity sectors over the period of QE purchases.[2]

In March 2009, the Bank announced it would initially buy conventional gilts with a residual maturity of 5–25 years. These purchases would be split into two auction maturity sectors: 5–10 years and 10–25 years.

As the size of the gilt purchase programme increased, the Bank began to accumulate a large percentage of the 'free float' (total outstanding issuance less government holdings of gilts) in the 5–25 year sector. In order to increase the amount of purchases further without disrupting this sector of the gilt market, in August 2009 the Bank decided to extend the purchase range to include all gilts with a residual maturity of three years and greater. These purchases would be split into three auction maturity sectors: 3–10 years, 10–25 years and 25 years and greater. This led to a significant increase in the amount of gilts in private ownership within the purchase range, as shown in **Table 1**.

Table 1 Private sector gilt holdings within QE purchase range

| Date	Purchase range	Face value of gilts remaining in private sector (£ billions)	Percentage of free float remaining in private sector
5 March 2009	5–25 years	192	99[a]
6 August 2009 (before Market Notice)	5–25 years	129	54
6 August 2009 (after Market Notice)	3 years and greater	283	72
9 February 2012	3 years and greater	411	66

Sources: Bank of England, Debt Management Office and Bank calculations.

(a) Even prior to gilt purchases for the purposes of QE, the Bank held a small amount of gilts as a result of its open market operations.

The initial £200 billion QE programme was completed in January 2010, but in October 2011 the MPC announced a further £75 billion of purchases, and this was extended by

£50 billion in February 2012. New issuance by the Debt Management Office (DMO) since 2010 meant that in February 2012 there was still a large amount of privately held gilts with maturities of greater than three years (**Table 1**). But the distribution of these gilts across the existing maturity sectors was somewhat uneven (**Chart A**). Although the relative scarcity of gilts in the 10–25 year sector had not yet reached levels likely to disrupt the functioning of the gilt market in this sector, the Bank acted pre-emptively to avoid these issues arising in the future. In February 2012 the Bank changed the auction maturity sectors: purchases would now be split into three sectors of 3–7 years, 7–15 years and 15 years and greater. **Chart A** shows the impact of that change on the distribution of private sector gilt holdings across each of the maturity sectors.

Chart A Privately held gilts, by maturity, based on auction maturity sectors used before and after 9 February 2012 Market Notice
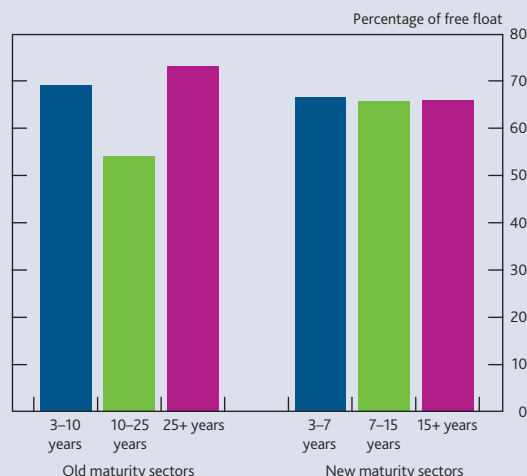
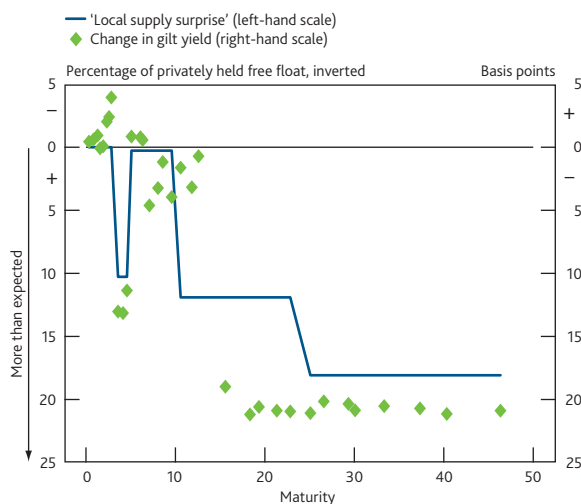Sources: Bank of England, DMO and Bank calculations.

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(1) For more details about the operational design of the Bank's gilt purchases, see Fisher (2010).
(2) The Bank has also taken other measures to avoid undue pressure on specific gilts. Since the start of gilt purchases, the Bank has avoided buying gilts with an outstanding issue size below £4 billion. In July 2009, the Bank announced it would not buy individual gilts where its holdings were in excess of 70% of the free float. In order to alleviate that pressure further, in August 2009 the Bank also announced it was offering to lend gilts via the DMO.

**Chart 1** Relationship between local supply surprise and two-day change in gilt yields, February 2012
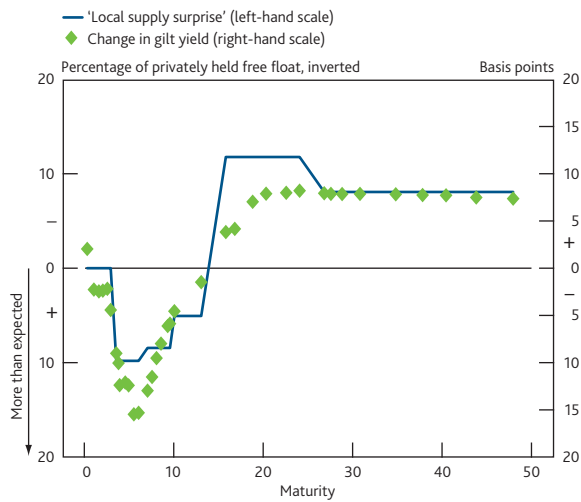
Sources: Bank of England, DMO, Thomson Reuters and Bank calculations.

Chart 2 Relationship between local supply surprise and two-day change in gilt yields, August 2009

Sources: Bank of England, DMO, Thomson Reuters and Bank calculations.

Chart 3 Relationship between local supply surprise and two-day change in gilt yields, March 2009
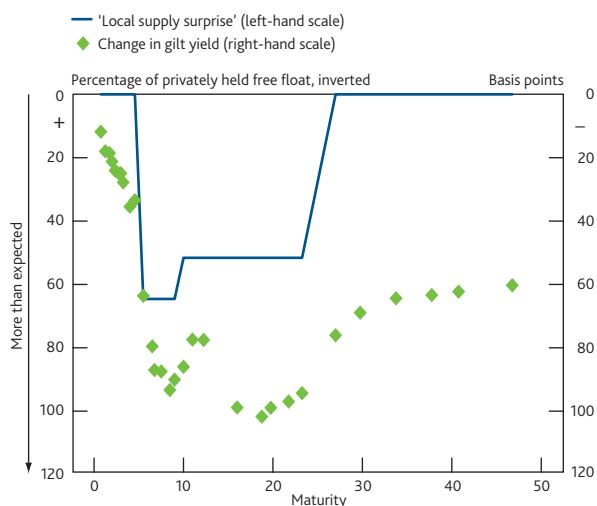
Sources: Bank of England, DMO, Thomson Reuters and Bank calculations.

when a maturity sector is extended to include a larger number of gilts, purchases are expected to be spread more thinly across each of the gilts. It is, therefore, possible to estimate how the total amount of purchases is expected to be split across each of the gilts. The difference between the expected purchases of each gilt before and after the market notice is a measure of the news contained in the market notice.

The final step is to take into account how much the change in expected purchases affected the supply of gilts remaining in the market. Therefore the size of the change in expected purchases is measured relative to the amount of gilts of similar maturity remaining in the private sector.

The resulting measure is referred to as the 'local supply surprise'. The box on page 134 describes its construction in more detail using the February 2012 Market Notice as an example.

The relationship between the change in expected future purchases and gilt yields

Chart 1 plots the 'local supply surprise' (blue line) against the change in gilt yields (green diamonds) following the February 2012 Market Notice. **Charts 2** and **3** plot the equivalent series for the August 2009 and March 2009 Market Notices respectively. As in Joyce *et al* (2011) a two-day window is used to measure the change in gilt yields;[1] and the change in yields for the March 2009 announcement is combined with the change following the February 2009 *Inflation Report* so as to capture the full impact of the introduction of QE.[2]

In all three instances, the pattern of changes in gilt yields matches the local supply surprise. This supports the view that local supply effects are one of the channels through which QE affects gilt yields. That said, the relationship shown in the charts is not perfect, so it is likely other channels also play a part. For instance, in March 2009 there was a significant reduction in gilt yields at longer maturities even though none of the purchases were initially conducted in this part of the yield curve.

A regression approach

Drawing inferences directly from the charts implicitly assumes that changing the distribution of asset purchases affects gilt

(1) Defined as the yield to maturity at close of business one day after the announcement minus the yield to maturity at close of business the day before.
(2) As it is assumed total QE expectations were 0 before the February *Inflation Report*, the change in yields following the *Inflation Report* are combined with the reaction to the March announcement to give the total change in yields associated with the initial QE announcements. In addition, the Reuters interest rate poll suggests the February *Inflation Report* also led markets to anticipate a further 25 basis point cut in Bank Rate. In order to isolate the change in gilt yields due to just QE, an adjustment is made to remove this effect: instantaneous forward rates are reduced on a sliding scale by 25 basis points at zero years to 0 basis points at five years, and the corresponding impact on yields to maturity is calculated from this.

Estimating the local supply surprise for February 2012

Table 1 shows how the local supply surprise variable was calculated for February 2012.

Expected purchases prior to the market notice

The mean of the Reuters survey prior to the February announcement was for an additional £86 billion of purchases. Under the pre-existing operational procedures there were three auction maturity sectors: 3–10 years, 10–25 years and greater than 25 years. Therefore the expected purchases for each sector were £86 billion/3 = £28.7 billion. Taking the 3–10 year sector as an example: there were twelve eligible gilts,[1] so assuming purchases were expected to be evenly spread across the bonds, expected purchases per bond were £28.7 billion/12 = £2.4 billion.

Expected purchases after the market notice

After the February announcement, the mean of the Reuters survey increased to £92 billion (additional purchases relative to what had been announced *prior* to 9 February). Under the new procedures, there were still three auction maturity sectors, but now for maturities of: 3–7 years, 7–15 years and greater than 15 years. Expected purchases per bond can be calculated in a similar manner to above. For instance, for the 3–7 year maturity sector: there were seven eligible gilts, so expected purchases per bond were (£92 billion/3)/7 = £4.4 billion.

The change in expected purchases

For each gilt the difference is taken between expected purchases before and after the market notice. For instance, for the 2% 2016 gilt: £4.4 billion–£2.4 billion = £2.0 billion. Because purchases were assumed to be uniform within each sector, this results in six groups for which the change is identical. For instance the change in expected purchases for all the gilts in the 15–25 maturity group is -£1.5 billion.

Relative to the outstanding private stock of gilts in each group

The change in expected purchases is aggregated across each of the gilts within these subgroups.[2] This is then divided by the 'privately held free float' of gilts (total issuance minus Bank of England and government holdings) remaining within this range. The remaining amounts of ineligible bonds[3] are excluded from this calculation. As expectations are forward looking, the outstanding amount of each bond is adjusted to account for expected Debt Management Office (DMO) issuance.[4] As an example, the outstanding stock of gilts in the 3–7 year group is £142 billion. The change in expected purchases for this group is £2 billion*7 = £14 billion. Therefore the change in expected purchases relative to the privately held free float (the 'local supply surprise') is £14 billion/£142 billion = 10%.

Table 1 Local supply surprise calculation, February 2012

Gilt	Years to maturity	Average expected purchases per bond (£ billions)			Privately held free float (£ billions)	Change, as proportion of privately held free float in sector (per cent)
		Before	After	Change		
5¼% 2012	0.3	0.0	0.0	0.0	22	0
9% 2012	0.5	0.0	0.0	0.0	0	0
4½% 2013	1.1	0.0	0.0	0.0	24	0
8% 2013	1.6	0.0	0.0	0.0	4	0
2¼% 2014	2.1	0.0	0.0	0.0	26	0
5% 2014	2.6	0.0	0.0	0.0	19	0
2¾% 2015	3.0	0.0	0.0	0.0	24	0
4¾% 2015	3.6	2.4	4.4	2.0	22	10
8% 2015	3.8	2.4	4.4	2.0	5	10
2% 2016	4.0	2.4	4.4	2.0	35	10
4% 2016	4.6	2.4	4.4	2.0	28	10
1¾% 2017	5.0	2.4	4.4	2.0	28	10
8¾% 2017	5.5	2.4	4.4	2.0	6	10
5% 2018	6.1	2.4	4.4	2.0	18	10
4½% 2019	7.1	2.4	4.4	2.0	19	8
3¾% 2019	7.6	2.4	4.4	2.0	25	8
4¾% 2020	8.1	2.4	4.4	2.0	20	8
3¾% 2020	8.6	2.4	4.4	2.0	25	8
8% 2021(a)	9.3	0.0	0.0	0.0	8	8
3¾% 2021	9.6	2.4	4.4	2.0	28	8
4% 2022	10.1	3.6	4.4	0.8	16	5
5% 2025	13.1	3.6	4.4	0.8	16	5
4¼% 2027	15.8	3.6	2.0	-1.5	13	-12
6% 2028	16.8	3.6	2.0	-1.5	7	-12
4¾% 2030	18.8	3.6	2.0	-1.5	14	-12
4¼% 2032	20.3	3.6	2.0	-1.5	14	-12
4½% 2034	22.6	3.6	2.0	-1.5	15	-12
4¼% 2036	24.1	3.6	2.0	-1.5	15	-12
4¾% 2038	26.8	3.2	2.0	-1.1	13	-8
4¼% 2039	27.6	3.2	2.0	-1.1	15	-8
4¼% 2040	28.8	3.2	2.0	-1.1	21	-8
4½% 2042	30.8	3.2	2.0	-1.1	13	-8
4¼% 2046	34.8	3.2	2.0	-1.1	14	-8
4¼% 2049	37.8	3.2	2.0	-1.1	15	-8
3¾% 2052	40.4	3.2	2.0	-1.1	7	-8
4¼% 2055	43.8	3.2	2.0	-1.1	14	-8
4% 2060	48.0	3.2	2.0	-1.1	14	-8
Total	–	86	92	6	624	–

Sources: Bank of England, DMO, Thomson Reuters and Bank calculations.

(a) Gilt ineligible for purchase.

(1) The 8% 2021 gilt was excluded as the Bank already holds more than 70% of the free float (total outstanding issuance less government holdings). The auctions also excluded gilts issued by the DMO within the past week or to be issued in the next week. However, these gilts are not excluded from the calculations, as they can still be purchased in auctions after this one-week window. For more details of eligibility criteria for February 2012, see the Market Notice available at www.bankofengland.co.uk/markets/Documents/apf/marketnotice120209.pdf.
(2) The change in expected purchases could be divided by the privately held free float on a gilt-by-gilt basis. However, there is likely to be some substitutability between gilts of similar maturities. Therefore this measure is designed to capture the change in purchases for each sector of the yield curve. The groupings used are those defined naturally by the change in the maturity sectors.
(3) See footnote (1) above.
(4) The privately held free float is adjusted to incorporate announced DMO issuance for the next six months. The pattern of issuance across the sectors is assumed to be the same as the previous year. Within each sector, new issuance is proportional to the amount of each gilt currently in issue.

yields through only the local supply channel. But there will be other channels in operation so a regression can be used to estimate the strength of the local supply effects while controlling for these other effects.

Methodology

For each of the three market notices, a separate regression is estimated to explain how the yield of each gilt changed following the operational announcement. The dependent variable is the change in gilt yields in the two-day window after each announcement (Δy_n, for all conventional gilts in issue, n). The first explanatory variable included is the local supply surprise (Δq_n), measured as discussed above. To account for the other channels, a constant term (α) and the duration of each bond (d_n) are also included. Equation **(1)** is the preferred specification:[1]

$$\Delta y_n = \alpha + \beta \Delta q_n + \gamma d_n + \varepsilon_n \qquad (1)$$

The coefficient on the local supply surprise (β) is the primary focus. If the local supply of a gilt does matter, then this would be consistent with a significantly negative value for this coefficient — such that an unexpected decrease in the available supply of a gilt (an increase in expected purchases) is associated with a rise in the price and fall in the yield of that gilt.

The constant term and the duration of each bond are included in the regression to control for systematic changes across the yield curve that are not directly related to the local supply of gilts. Including the duration of each bond will control for any effects which vary depending on the maturity of the bond.

Results

Table C reports the results of estimating the preferred specification for each of the market notice announcements. In all three instances, the local supply coefficients are negative and significantly different from 0 at the 5% level. This is consistent with the local supply channel operating.

Table C Yield change regression results[a]

Independent variables		2009		2012
		5 March	6 August	9 February
Constant	α	-17.2 (0.00)	1.8 (0.24)	-3.9 (0.01)
Local supply surprise	Δq_n	-0.81 (0.00)	-0.74 (0.04)	-0.80 (0.00)
Bond duration	d_n	-2.8 (0.00)	-0.6 (0.18)	0.2 (0.09)
R-squared		0.94	0.80	0.91
Observations		30	34	36

(a) Dependent variable: change in gilt yields in the two-day window after each announcement. P-values for heteroskedasticity and autocorrelation consistent standard errors shown in parentheses.

The estimated local supply surprise coefficients are of a similar order of magnitude for all three events, and the hypothesis that the coefficients are the same cannot be rejected at the 5% level (**Table D**). So the strength of the local supply channel of QE does not appear to have changed significantly since gilt purchases were introduced in early 2009.

Table D Tests of equality of local supply surprise coefficients to February 2012 estimate[a]

	2009	
	5 March	6 August
t-statistic	0.10	-0.27
p-value	0.92	0.78
Significantly different at 5% level?	No	No

(a) Test of hypothesis that $\beta_{\text{Feb. 2012}} = \beta_t$, for t = Mar. 2009, Aug. 2009. Based on White standard errors.

There are quite large differences between the constant and duration coefficients across the different events. The constant picks up any effects not captured by the other variables included in the regression. The absolute value of the constant is greatest for March 2009. This is not surprising since there was more news about the total amount of QE in March 2009, and so the size of these other effects was likely to be greater. But since the size of the news was different across the events, this does not necessarily tell us anything about the strength of the other channels. As discussed above, it is difficult to interpret the size of the bond duration coefficient because it captures both duration risk and interest rate signalling effects, and so the estimated coefficient could conflate these two effects.

Robustness checks

The regressions above were re-run to check whether the results are robust, rather than specific to the particular data used and specification chosen. In general, the findings appear to be similar across a range of different data and specifications.

For instance, increasing the length of the window over which the change in gilt yields is measured does not greatly affect the local supply surprise coefficient estimates. Using a three-day rather than a two-day window gives very similar results. And although the one-day window estimates do differ markedly (**Table E**), there appear to be good reasons for choosing a longer window. The choice of the two-day window in Joyce *et al* (2011) was originally motivated because it is believed it took markets more than a day to evaluate the news associated with the announcement of this unconventional monetary policy tool. And further work by Daines, Joyce and

(1) A number of alternative specifications were tested allowing for more complicated non-linear relationships with duration. But the functional form chosen did not significantly affect the coefficients on the local supply variable. Therefore, the simple linear specification was chosen. The preferred specification also assumes that the strength of the local supply effects are the same for gilts of all maturities (the β coefficient does not vary with maturity). Due to the relatively small sample sizes the regressions are not re-estimated with a maturity-varying coefficient.

Tong (2012), using intraday data and comparing movements in international yields, supports the use of a two-day window for the March 2009 event; the further falls in gilt yields the day after seem to suggest that the market was still digesting the consequences of the announcement.

Table E Local supply surprise coefficient using different event windows to measure the gilt yield reaction

Event window	2009		2012
	5 March	6 August	9 February
One-day	0.02	-0.76	-0.37
Two-day	**-0.81**	**-0.74**	**-0.80**
Three-day	-0.85	-0.86	-0.82

There is also a risk that the total change in QE expectations, taken from the Reuters survey, is mismeasured, and so not an accurate representation of the change in market expectations associated with each MPC announcement. The surveys were not always conducted immediately before and after the market notice announcements, and, as with any survey, it is subject to sampling error. But it does not appear that the results are driven by the precise number taken from the survey. Changing the total QE surprise for each event by £10 billion in either direction has only a small impact on the estimated coefficients.

Therefore, only a large mismeasurement of the change in total QE expectations would greatly affect the results. There is probably most uncertainty over the total change in QE expectations for March 2009. As there was no Reuters survey prior to the March announcement, an assumption must be made about expectations before this date. The solution used in this article is to group together the March 2009 announcement with the February 2009 *Inflation Report*. It is assumed that expectations of QE were formed only from these two events, and so it is assumed that no gilt purchases were expected prior to the February 2009 *Inflation Report*. This seems reasonable since the Bank had not publicly discussed gilt purchases prior to this date. However, an asset purchase facility for private sector assets had already been established and the possibility of QE had been discussed by some market analysts; so it is possible the change in expectations is overestimated. If, for instance, £50 billion of purchases were already expected prior to the February *Inflation Report*, then the estimated coefficient for March 2009 would be -1.24; consistent with a considerably larger local supply effect than the -0.81 central estimate.

Putting the results in context

Forthcoming Bank analysis by Daines, Joyce and Tong (2012) also finds evidence that the reaction of gilt yields to MPC announcements about QE is consistent with local supply (and duration) effects. This article complements that work by

attempting to quantify the size of the local supply channel. To put these estimates in context, the total contribution of the local supply surprise variable can be compared to the total change in gilt yields attributed to QE.

For March 2009, the contribution can be estimated by multiplying the local supply surprise variable by the corresponding coefficient estimate from **Table C**. This suggests that the local supply effect accounted for 46 basis points of the total 93 basis point decline in 5–25 year maturity gilt yields. The March 2009 event should provide a good approximation of the overall importance of the local supply channel because this event contained such a large amount of news about the total amount of QE.[1]

An alternative way to test the importance of the local supply effect is by computing the relative importance of each regressor (Kruskal (1987)). The advantage of this test is that it can be applied to all three events, even where there was little news about the total amount of QE. This test finds that 42%–62% of the variation of the change in yields can be explained by the local supply channel, with the duration of each bond accounting for around 31%–38% (**Table F**).

Table F Relative importance of the local supply surprise and bond duration regressors[a]

Per cent

Event window	2009		2012
	5 March	6 August	9 February
Total variation explained (R-squared)	94	80	92
of which, local supply surprise	62	42	61
of which, bond duration	32	38	31

(a) Based on the relative importance of regressor test (Kruskal (1987)).

These results are similar to estimates of the relative importance of the local supply channel for the first round of large-scale asset purchases in the United States. D'Amico *et al* (2012) find that around two thirds of the fall in US government bond yields could be explained by the local supply channel, albeit using a different methodology. For the second round of US large-scale asset purchases, they find that local supply effects played a larger role, and explained most of the decline in yields.[2]

(1) This exercise involves averaging the local supply surprise and the change in yields over a range of maturities. The exercise is informative for March 2009 because the changes over this range are all in the same direction. But a similar exercise is not appropriate for the other two events, because this would involve averaging over a range for part of which the local supply surprise is zero or even in opposite directions.
(2) US$300 billion of US government bonds were purchased in the first round of US purchases, commencing in March 2009 and completed in October 2009. A large amount of agency debt and agency mortgage-backed securities was also purchased. US$600 billion of US government bonds were purchased in the second round of purchases, announced in November 2010 and completed in June 2011. D'Amico *et al* (2012) suggest the larger role for local supply in the second round reflects the more modest impact on aggregate duration of these purchases.

The above analysis suggests that the local supply channel is an important mechanism which may explain around half of the impact of QE on gilt yields. Therefore the natural experiments approach is useful for identifying a considerable portion of the effect of QE, and so some weight can be attached to the results which suggest that the strength of this channel has not changed since 2009.

The other channels from QE to gilt yields have not been separately identified, so it is not possible to draw conclusions about how they may have changed. Furthermore, the impact on gilt yields is only the first leg of the transmission to spending and inflation. Therefore, even though the strength of the local supply channel does not appear to have changed, the analysis in this article cannot necessarily be used to draw conclusions about the wider economic effects of QE.

Conclusion

Estimating the impact of QE on gilt yields has become increasingly difficult as MPC announcements about the amount of assets the Bank intends to purchase are now widely anticipated by financial market participants, based on economic news and data releases. To overcome this problem, this article uses a novel way of identifying part of the impact of QE on gilt yields, using natural experiments associated with changes in the auction maturity sectors used for gilt purchases.

The reaction of gilt yields to these market notices closely matches the news they contained about the way in which future purchases were expected to be distributed across gilts of different maturities. This is consistent with an important role for the local supply channel. The regression estimates in this article suggest this channel can account for around half of the reduction in gilt yields due to QE, so the approach used in this article is useful for identifying a considerable portion of the impact of QE on gilt yields.

The estimated strength of the local supply channel is broadly similar across the three market notice events. These events span the period of QE purchases, so the strength of this particular channel does not appear to have changed significantly since QE was introduced in early 2009.

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