Heterogeneous Effects of QE on Corporate Bonds and Firm Outcomes[1]

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Last updated: August 31, 2021

Abstract

Following the Global Financial Crisis, several central banks turned to quantitative easing to lower long-term interest rates. This reduced yields of treasuries and other safe assets. However, little evidence exists if QE influenced real outcomes. Using the universe of US corporate bond trades matched to public firm financial data, we study the heterogeneous response of corporate bond yields to QE announcements and their association to subsequent firm-level real outcomes. We find significant reductions in bond yields, particularly for QE1. These shocks were pronounced for investment grade-only firms. Following the announcement of MBS purchases, firms in the construction industry experienced large reductions in bond yields. However, there is limited covariance between these shocks to firm borrowing costs and subsequent real outcomes. In line with theory and the existing literature, we find that the aggregate 2009Q1 borrowing cost shocks to have a statistically and economically significant association with increased investment in the subsequent quarter. Although extremely preliminary work, this is suggestive evidence of QE having limited impacts on US public firms, but—as will be extensively discussed—requires significantly more work to further establish.

In a November 4, 2010 Washington Post opinion article, then Federal Reserve Chairmen Ben Bernanke wrote, reflecting on Quantitative Easing (QE): "it eased financial conditions in the past and, so far, looks to be effective again … long-term interest rates fell when investors began to anticipate the most recent action. Easier financial conditions will promote economic growth. For example … lower corporate bond rates will encourage investment." Our goal in this paper is to explore whether QE lowered corporate bond yields, and if this led to subsequent increased investment or changes in other firm-level outcomes.

The causal effect of QE on US firm-level outcomes is an unidentified parameter. One cannot randomize QE across the US economy in parallel universes. Thus, we aim to provide suggestive evidence on this important research topic by narrowing our focus on the following question: did QE differentially affect US public firms borrowing costs and did this lead to changes in credit uptake, investment, and other real activity? Moreover, how do these results varying across the

[1]For helpful comments and discussions we want to thank David Arsenau, Andy Atkeson, Lee Ohanian, Tyler Muir, David Rappoport, Alexandros Vardoulakis, David Vestin, Pierre-Olivier Weill, participants of Andy & Pierre's reading group, participants of Gary Hansen & Lee's reading group, as well as participants of the Stockholm University IMDb group. For generous funding we thank the UCLA Ziman Center for Real Estate's Rosalinde and Arthur Gilbert Program in Real Estate, Finance and Urban Economics. Emmanuel Bekee Aluo and Lu Cheng provided excellent research assistance. We thank David Lindsay for sharing their TRACE-cleaning R code. All mistakes are our own.

specifics of the QE announcements, e.g. treasury v.s. MBS purchases. If MBS's were more influential, did the first QE activities stimulate real estate-related industries more?

The Federal Reserve's QE policies have been extensively reviewed in the literature, for example in Joyce, Miles, Scott, and Vayanos (2012). We nevertheless provide some motivating remarks. The Federal Reserve's primary policy tool is influencing the federal funds rate. In the aftermath of the Financial Crisis of 2007–2008, monetary policy was constrained by a low interest rate environment. In response, central banks turned to unconventional monetary intervention, including large-scale asset purchases (LSAP)—also known as QE. The Federal Reserve enacted three rounds of QE starting in November 2008. Initially holding about $800 billion dollars of treasury securities from open-market operations, their balance sheet expanded to hold $2.5 trillion dollars of treasury securities and $1.7 trillion dollars of mortgage-backed securities by the end of QE3 in October 2014. Given the immense scale and the Federal Reserve's legal mandates of maximizing employment, maintaining stable prices, and enabling moderate long-term interest rates, important questions remain on firm-level outcomes (e.g. employment) associated with these significant monetary policy actions.

Portfolio rebalancing is the primary channel through which the literature considers QE effects on firms. The theory asserts investors will shift away from treasuries—whose returns have declined—toward other long-term safe assets, e.g. investment grade corporate bonds. This in turn can spill over to lower-grade corporate bonds as rebalancing continues.

Thus, to begin, we add—through an event study framework—rich heterogeneity to our understanding of the effects of QE on firm borrowing costs by working with the universe of US corporate bond trade level data. We establish causality by assuming in high-frequency window around important QE-related announcements that this news is the relevant information being incorporated into corporate bond yields. First, we established that aggregate traded volumes and yields did not change much on the same day of each QE event. Therefore we expand the event window and use more disaggregated data. At the bond-level, we find significant reductions in yields across QE1 event dates, which is robust across maturity and investment and high-yield bonds. The effect is stronger for longer durations. When we aggregate to the firm-level, we find—as expected from theory—reduction in yields for firms with only investment grade outstanding, while firms with high-yield debt had much variable responses. Riskier firms with shorter durations seem to be more affected by the Federal funds target and other measures on earlier QE1 dates. At the industry-level, we find suggestive evidence that the borrowing cost of construction firms in the corporate bond market was reduced following the MBS purchase announcement. Finance and insurance industry was not as a group affected by the same announcement, but saw reduced yields on following QE1 event days.

On the later QE2 dates, we find more muted effects at both the bond and firm level, which is similar to previous findings; those have been rationalized by later announcements already being priced in by the market (Thornton, 2017). The directions of the effects are mixed. However, for investment-grade bonds the net effect across QE2 events is that yields are reduced, and again stronger for longer durations. We attribute the concentrated effect to investment grade to the safety channel, but also a reduced risk of default since the effect increases with duration.

We then explore whether reduced borrowing costs is associated with increased subsequent

real activity of firms by performing a series of univariate regressions of real outcomes on the firm-quarter QE shocks, which we restrict to QE1 given their more clear effects in the event study. This is similar to Di Maggio, Kermani, and Palmer (2020), which found stronger effects of QE on consumer mortgage refinancing in QE1 relative to later QE rounds. Following Gürkaynak, Sack, and Swanson (2005) and Wong (2019), we aggregate the firm-level QE shocks from the event study within quarter. Using quarterly financial data from Compustat, we form outcomes of investment, loan uptake, total debt, dividend payments, liquidity measures, and sales. In these simple regressions, we find broadly muted positive covariance between reduced borrowing costs and increased real activity. Surprisingly, in line with theory, we do find the aggregate 2009Q1 borrowing cost shocks to have a statistically and economically significant association with increased investment. Specifically, we find for a 100 basis point reduction in borrowing costs—induced by the 2009Q1 QE announcements—there is an associated increase in 2009Q2 investment of $57MM over a within quarter average of $116MM. Obviously, without an identification strategy, we are not finding any causal results. Also, the strongest results are for contemporaneous outcomes. For example, a yield reduction of 100 basis points following QE-events in 2008Q4 is associated with higher total debt of $328 million in the same quarter. Because the QE event days in 2008Q4 were in late November and December, we do not believe firm debt was affected by QE to that extent; if anything, the yield reduction was higher for firms with higher levels of debt. Other outcomes have negative estimated coefficients, matching our priors, but of very low statistical and economic significance. Loan uptake is estimated to be higher on average for firms with greater yield reductions, so is total debt, dividends, liquidity, investment, and sales in the four quarters following the two first quarters of QE.

Although extremely preliminary work, this is suggestive evidence of QE having limited impacts on US public firms, but—as will be extensively discussed—requires significantly more work to further establish. We aim to not only enrich the event study and regressions with further heterogeneity, but, primarily, we move forward focusing on extending this work to study the QE events of 2020. We believe we have an identification of the causal effect of QE on firm-level outcomes given the Federal Reserve purchased specific corporate bonds, which follows methods in Foley-Fisher, Ramcharan, and Yu (2016). There are still of course valid general equilibrium critiques, but we hope these results can at least shed light on this economically significant policy.

This paper contributes to two strands of literature. The first and much more extensive literature studies the effects of QE on asset prices. Numerous papers have established, often through an event study framework, the causal effect of QE on long-term treasury yields, including—to only name a few—Gagnon, Raskin, Remache, and Sack (2010), Vissing-Jorgensen and Krishnamurthy (2011), and Joyce et al. (2012). These papers have also found similar results for corporate bond yields at an aggregate credit rating-level. Thornton (2017), for one, asks more rigorous questions of these data to raise concern if these effects are sustained and statistically significant. We extend this literature—through the use of trade level data—by studying heterogeneous effects of QE on corporate bond yields, by e.g. firm, industry, and finer maturity and credit ratings.

Second, we contribute to a much smaller literature that studies the real effects of US QE on non-financial firms. Foley-Fisher et al. (2016) is the only paper to our knowledge that explores this topic—albeit limited to one aspect of QE, the Maturity Extension Program (MEP). They

find LSAP of treasury securities leads to more financially constrained firms issuing more long-term debt, expanding employment, and increasing investment. We expand upon these results by studying QE1 and QE2.

There are several papers studying real effects in adjacent areas. Ottonello and Winberry (2020) finds conventional monetary policy stimulative of investment by less indebted firms with a high distance-to-default. Similarly, we find that investment increases by unconventional monetary policy, and that safer-firm yields are more affected than high-yield firms. Todorov (2020) studies the European Central Bank's purchase of corporate bond debt during its QE program. They find the policy had large positive impact on borrowing costs of the applicable bonds (i.e. bond yields dropping 30 basis points on average after announcements); led to significant liquidity improvements; and, in particular, caused affected firms to issue more debt, which was mostly used to increase dividends with limited real effects. We do not find significant results that agree with Todorov, but the directions are the same for corresponding outcomes.

Our paper is organized as follows: Section 1 details the data and empirical methodology. Section 2 presents empirical results on the causal effect of QE on firm- and bond-level yields. Section 3 studies the association between these QE-induced shocks to firm cost of capital and subsequent real outcomes. Section 4 concludes.

1 Data and Methodology

1.1 The selection of QE event dates

The goal of the event study is to capture the movement of asset prices as news of QE is priced in. We follow the literature to identify these "QE event dates", on which the Federal Reserve made an announcement or released minutes with novel information related to QE.

Specifically, we follow Thornton (2017) for a comprehensive list of QE event dates. The literature acknowledges later event dates are less well suited to an event study methodology given the news was expected by the market. Thus, we focus on the earlier event dates related to QE1 and QE2. We have the same five QE1 event dates as Vissing-Jorgensen and Krishnamurthy (2011) and Gagnon et al. (2010). We aimed to use six dates for QE2 and one date for the MEP that were common across the three papers. However, as will be discussed further, we are less certain of the identification assumptions in the later event study dates. As Vissing-Jorgensen and Krishnamurthy (2011), we use Factiva to confirm and identify the time QE announcements. To analyze the content of QE events, we use FOMC statements and transcribed speeches.

1.2 The event study of corporate bonds

Our first main data source is the corporate bond trade-level Academic Trade Reporting and Compliance Engine (TRACE) for calendar years 2008–2011, inclusive, to study the effects of QE on corporate bond yields. TRACE covers over 99% of corporate debt traded in over-the-counter markets FINRA (2021). The initial data contains 53,620,667 trades. We follow Dick-Nielsen and Poulsen (2019) to remove missing data; fix cancellations, corrections, and reversals; and, drop agency transactions and inter-dealer transactions. We follow Rossi (2014) to drop trades with

outlier prices. Finally, we remove noisy pricing data from infrequently traded bonds by calculating each bond's median number of trades per day and dropping the bonds in the bottom three-fourths of this distribution. In the appendix, we report results using trade data without dropping illiquid bonds. The cleaned data contains 30,673,105 trades with information on execution time, grade, maturity date, price, coupon, and volume.

For the large majority of the trades in TRACE, the yield is missing. Therefore we compute them using bond information and traded price, see the Appendix section A.2. The computed yields have high agreement with the minority of trades with non-missing yields.

Following the methodology pioneered by Cook and Hahn (1989), we measure shocks to corporate bonds using a high-frequency, event-study approach. The key identifying assumption is that the only news affecting corporate bond yields in this window is the QE news. Due to low liquidity in corporate bond markets, we present a four-day event study, i.e. the pre-period is the previous two trading days and the post period is the current trading day after the event time to the end of the subsequent trading day. We also present results in the appendix using a narrow window (i.e. previous trading day compared to the current trading day after the event time) and a wide window (i.e. the previous five trading days compared to the current trading day after the event time and the subsequent four trading days).

Specifically, we take the within-firm difference between the volume-weighted average yield of each firm's trades before and after the QE news. We also study the same effect within bond instead of within firm. Mathematically, for each sample day t, window size Δ, firm j (or bond b), and its associated trades i with volume $V_{i,j,t}$ and yield to maturity $YTM_{i,j,t}$, we form the firm (or bond) effect $T_{j,t}$ by

$$\begin{aligned} T_{j,t} &\coloneqq \overline{YTM}_{j,t+\Delta} - \overline{YTM}_{j,t-\Delta}, \text{ where} \\ \overline{YTM}_{j,t\pm\Delta} &\coloneqq \frac{1}{\sum_i V_{i,j,t\pm\Delta}} \sum_i YTM_{i,t,t\pm\Delta} \times V_{i,j,t\pm\Delta}. \end{aligned}$$

To isolate changes to corporate yields over the risk-free rate of return, we also subtract out of the firm effect $T_{j,t}$ (or bond effect $T_{b,t}$) the change in the relevant treasury yield over the same window. We obtain the intraday yield of the 5, 10, and 30 year treasury from FirstRate Data.

In addition to forming this causal variable of interest using the TRACE data, we also extract several conditioning variables. We directly use the bond-level grade variable for Investment or High Yield. To aggregate this to the firm level, we label a firm High Yield if it has at least one High Yield bond within our four-year sample.

TRACE also provides each bond's maturity date, which we directly use at the bond-level to form the days to maturity from the event date. At the firm level, we take the volume-weighted average days to maturity over all the trades associated with each firm. If this average days to maturity is under five years, we label the firm a "Short" maturity firm. If the average days to maturity is at least five years and under ten years, we label the firm an "Intermediate" maturity firm. The remaining firms with average days to maturity of tens years or more are labeled "Long" maturity firms.

In the event study tables, we provide tests of statistical significance of the corporate bond yield changes, focusing on the total change for QE1 and QE2 at both the firm and bond level. Follow-

ing Vissing-Jorgensen and Krishnamurthy (2011), we test whether changes on QE announcement days differ from changes on other days. We regress the daily changes in firm- or bond-level yields for the four-year sample on three dummies for whether there were QE1 or QE2 announcements on this day. We report standard errors robust for heteroskedasticity to test the null whether the coefficients on the QE dummies are zero, which would suggest these event days are not significantly different than the other days in the sample.

1.3 The real effects of QE on firms

We use the Compustat North America database to obtain quarterly statements of public U.S. firms. The original data, which covers 2008Q2–2013Q2, contains 15,826 firms and 234,882 observations, of which 8007 firms and 167,442 firms are observed both before 2009Q1 and after 2012Q3. We require this to get full coverage over the time period of interest.

Several firms have gaps in the outcomes of interest. We apply linear interpolation to gaps up to 2 consecutive quarters long, and drop firms from the sample if they show gaps longer than so. The variables are sales, total debt, total tangible assets, total intangible assets, total assets, and liquidity. See in Table 15 in the appendix how we define these from Compustat codes. E.g., 1576 firms are dropped because they have too long gaps in sales. That is also the first variable we test if a gap is too long and about 83% of all firms that are dropped are at this first step (i.e., other variables might also have long gaps for the already dropped firm, but we do not investigate if so). At the end of this step we have 6113 firms, 128,373 observations, and 1,829 observations have interpolated values (1.4%).

We also match on firm credit ratings for 30% of the firms in our panel. Lastly, we drop end-quarters and end up with a balanced panel for 6113 firms, for 103,921 observations covering 2008Q4–2012Q4.

After studying the response of corporate bond yields and spreads, we now turn to the real outcomes of firms.

In a quarter τ with a QE event, we define the treatment $T_{j,\tau}$ of firm j as

$$T_{j,\tau} := \sum_{\forall \text{QE events in } \tau} T_{j,t}. \tag{1}$$

These shocks are in the style of Gürkaynak et al. (2005), but firm-specific. As in Wong (2019), we aggregate up by quarter without weighting the shock by the number of days into the quarter of the shock. We choose this because we want to look what happens to the firm several quarters ahead for the real effects.

Firms that do not have outstanding bonds (only relevant for the analysis of real outcomes) or are not traded in the window have $T_{j,\tau} = 0$. We start with this decision to capture the heterogeneity in the broader public firm sample versus restricting ourselves to just the sample of firm's whose corporate bonds trade within the event windows. In future iterations of this working paper, we will report results with and without this broader sample of firm's whose bonds do not trade in the window or do not have traded corporate bonds.

For each QE quarter τ, we regress future real outcomes in quarter $\tau + \Delta$ on the firm-specific treatment $T_{j,\tau}$ in τ.

$$\text{real outcome}_{j,\tau+\Delta} = \gamma_\tau \times T_{j,\tau} + \epsilon_{j,\tau+\Delta}. \tag{2}$$

The estimates are presented in Tables 13 and 14 in Section 3.

2 Results: Event Study

This section presents the results from studying changes in corporate bond yields following important QE announcements. We establish causality by assuming in high-frequency window around important QE-related announcements that this news is the relevant information being incorporated into corporate bond yields. We aim to add to our understanding of the causal effect of QE on firm borrowing costs by exploring additional heterogeneity in the results that is offered by working with the trade level data. First, we show the hour-by-hour trade patterns on QE event days.

2.1 Intraday yields and trading volumes during QE1, QE2, and MEP dates

To get an idea of the overall behavior in the corporate bond market on QE event days, we calculate the average traded yield in every hour of each day and present them in Figures 1 and 2. Overall, we see no consistent responses of corporate bond yields to announcements. Then we turn to volumes traded (Figures 3 and 4), where we find no unusual behavior. Unlike Vissing-Jorgensen and Krishnamurthy (2011) – who document spikes in trading volumes following several QE events in the U.S. treasury market – volumes follow regular camel-shaped intraday patterns in the corporate bond market on QE event days.

Summary: We find no indications of immediate responses in the corporate bond market following QE events, unlike in the treasury market.

2.2 Event study, QE1

Corporate bonds are not interchangeable: changes in average traded yields (or the lack thereof) could be due to the composition of bonds being traded. Also, the corporate bond market is generally much more illiquid than the treasury market and market participants need time to process the information from QE events before making trading decisions; the latter a point made by Toloui (2019). Therefore we from now on study changes to yields in a wider window, consisting of the 2 days before an event, the day of the event, and the following day (i.e., wider than in e.g. Vissing-Jorgensen and Krishnamurthy 2011).

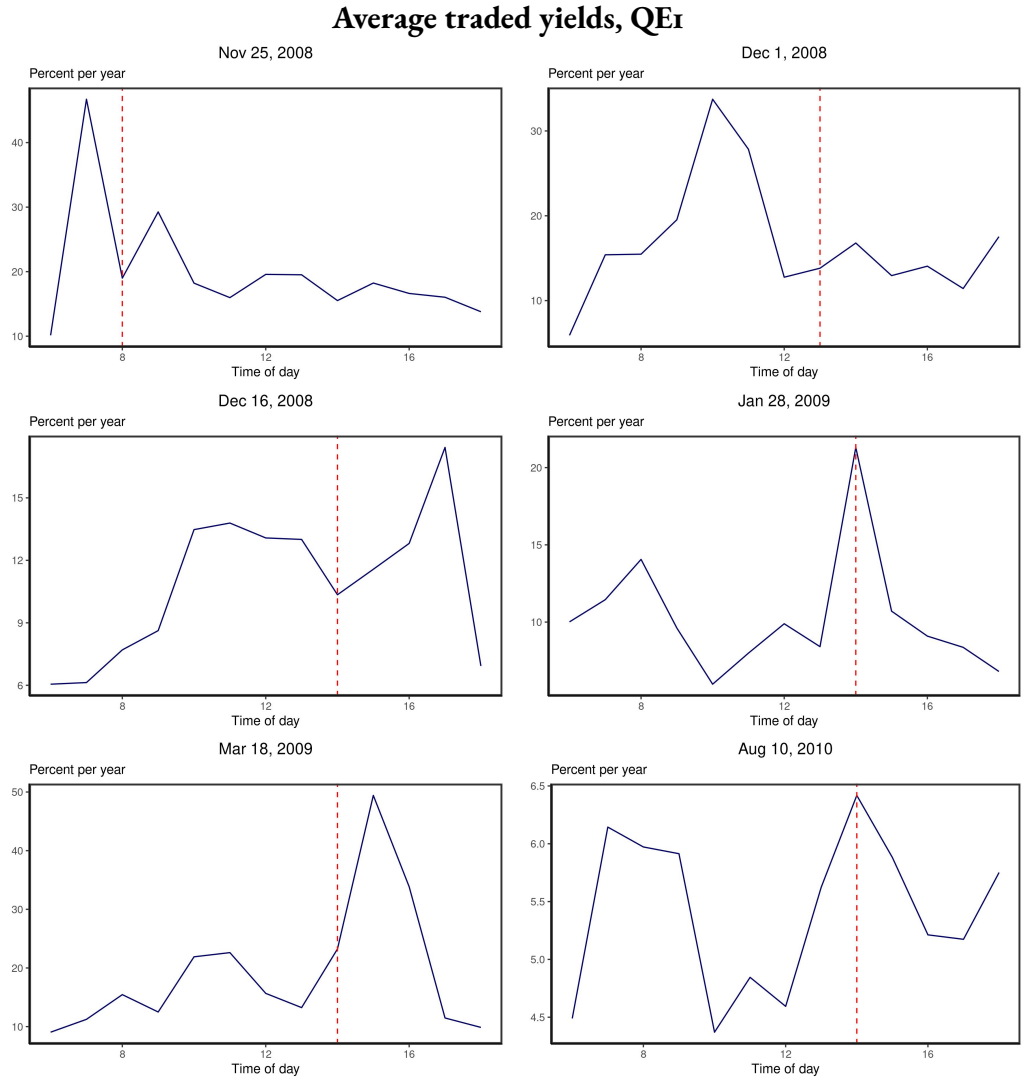

Figure 1: This figure presents the hourly average yields traded on QE event days during QE1. The vertical, dashed, red line indicates the hour before an announcement.

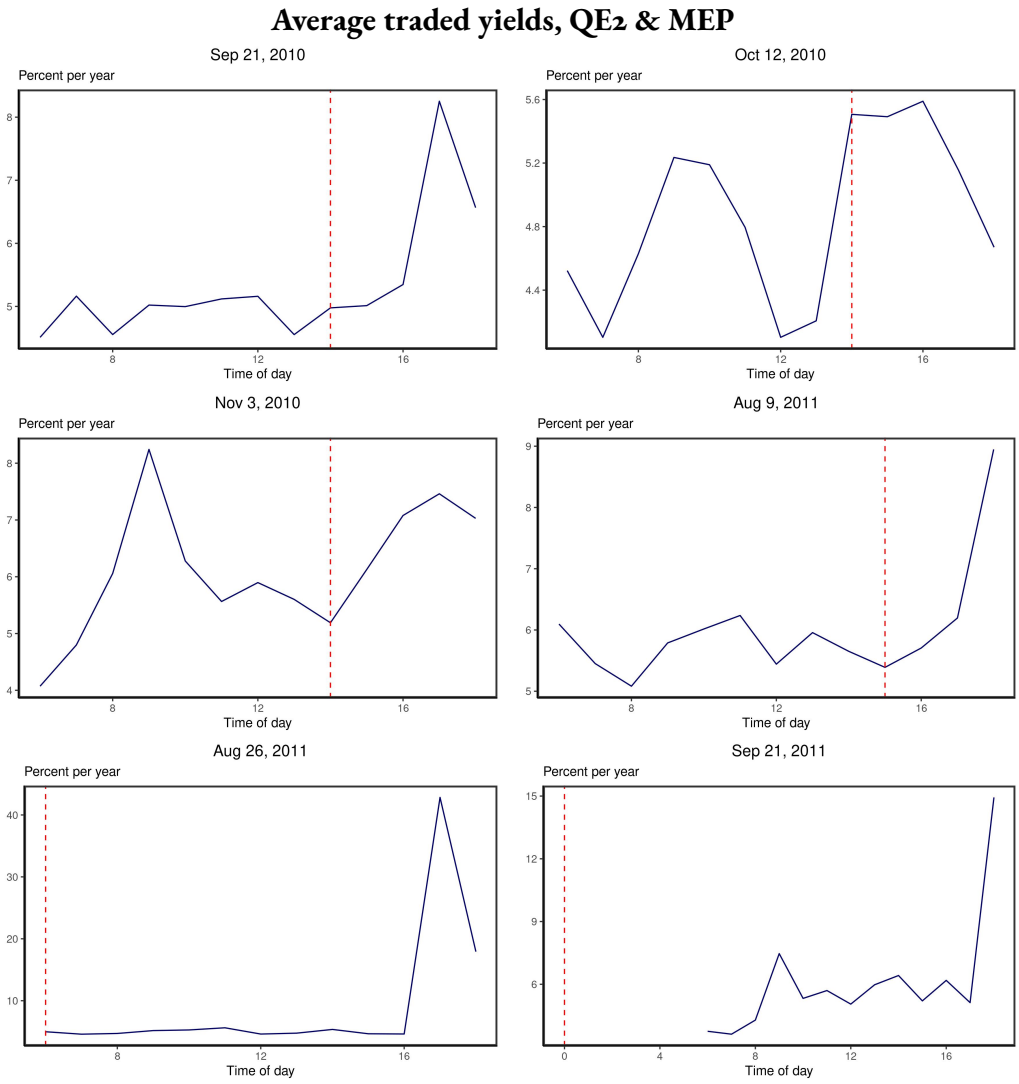

Figure 2: This figure presents the hourly volumes traded on QE event days during QE2 and the MEP. The vertical, dashed, red line indicates the hour before an announcement.

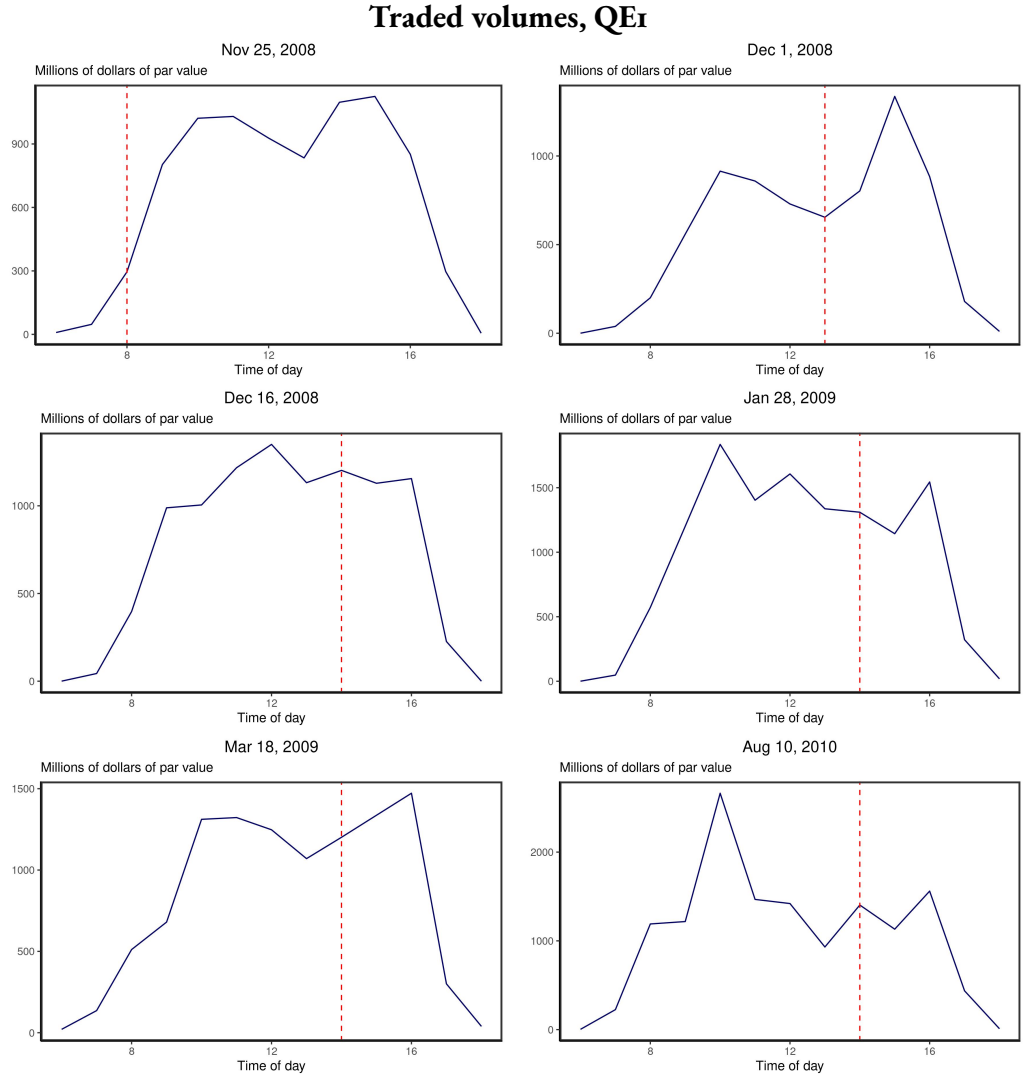

Figure 3: This figure presents the hourly volumes traded on QE event days during QE1. The vertical, dashed, red line indicates the hour before an announcement.

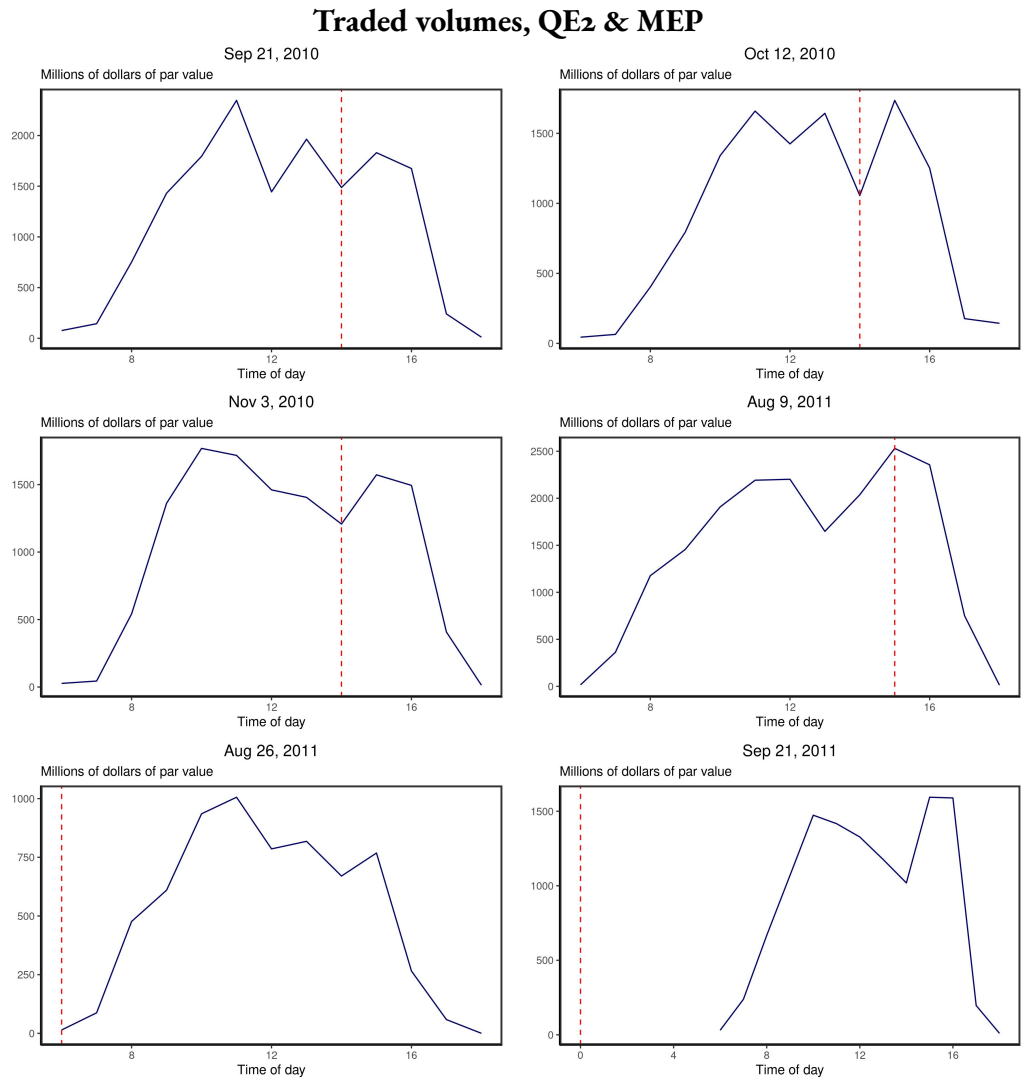

Figure 4: This figure presents the hourly average volumes traded on QE event days during QE2 and the MEP. The vertical, dashed, red line indicates the hour before an announcement.

Table 1: Summary statistics for selected and unselected firms in QE1 event study.

Statistic	Selected	Unselected	All
Number of trades	4,674,210	17,460	4,691,670
Percent investment grade	34.750	29.510	34.150
Average trades per day	29.920	0.940	26.590
Average volume per day	15,002,760	1,419,503	13,434,952
Volume-weighted average price	90.050	79.390	88.830
Volume-weighted average coupon	6.100	6.900	6.190
Volume-weighted average yield in basis points	0.000	0.000	0.000
Volume-weighted average years to maturity	9.007	11.300	9.300

In Table 1, we present summary statistics on the trades of firms used in the analysis and those excluded because they were not observed to be traded on any QE event of the particular QE program. In particular, we take as the unselected firms those with bonds traded in the year prior to the earliest event date. The trades of the excluded firms make up less than 0.3% of the total number of trades and the bonds are much less frequently traded. They differ in other characteristics too: they are in general most often high yield and of longer maturity. They are also significantly cheaper in the pre-event period which suggests they have a higher risk premium.

Because the excluded firms are few and illiquid, we don't believe it biases our results in a way to produce a false negative result of QE's effect on corporate yields. Though it is possible that any conclusions about the causal effects of QE apply less to firms with illiquid bonds, whose borrowing costs through corporate bonds are difficult to influence using QE.

In Table 2 and 3, we compute for QE1 the firm-level change in bond yields and spreads using the firm-aggregation method in Section 1.2.

Across the QE1 events, we identify three trends: first, firms with only investment grade bonds outstanding see lowered yields across all events (Column "All, I", Table 2), even on January 28, 2009 when treasuries increased (albeit by the smallest amount in the column).

Second, for firms with at least one high-yield bond, the results are mixed (Column "All, H", Table 2). In most cases, firm spreads increased on average (Table 3). But following November 25 and December 16, 2008, yields and spreads were lowered across the board.

Taken together, our first and second observation suggest that the safety channel of QE is mostly at work. Agents with a preference for safe assets substitute from treasuries to the next tier of safe bonds when treasury yields fall. Similarly, this could be repricing in anticipation of agents rebalancing portfolios. Given the reasoning of curvature of the marginal cost of investment in Ottonello and Winberry (2020), and their finding that lower-risk firms respond more to decreasing short interest rates, the same reasoning would apply for decreasing long rates.

Third, the yield response is increasing in duration; longer bonds have consistently more negative changes than intermediate bonds which in turn have more negative changes than the shortest (except on one occasion, compare columns "Short, All', "Inter, All", "Long, all" in Table 2). If this would be due to the signaling channel, the market is pricing in low yields for many years to follow. We will return to this interpretation when studying bond-level yields.

Table 2: Changes in Corporate Yields at the Firm Level on QE1 Event Dates by Grade and Maturities with Normal Window and Illiquid Bonds Removed

Event date	All, All	All, H	All, I	Short, All	Inter, All	Long, All	Short, H	Short, I	Inter, H	Inter, I	Long, H	Long, I
2008-11-25	-67.6	-106	-12.7	-42	-55.5	-142	-68.3	-12.1	-75.2	-9.05	-276	-17.9
2008-12-01	82.3	151	-7.64	86.1	109	18.5	184	-8.33	173	-29.3	15.8	21.1
2008-12-16	-59	-72.1	-39.3	-118	-16.1	-26.4	-184	-32.4	-0.367	-48.9	-14.4	-38.9
2009-01-28	46.9	80.4	-5.31	81.2	39.1	-3.08	148	-11	59.3	-6.16	-10.9	4.77
2009-03-18	69.6	135	-46.2	176	14.4	-44.8	321	-42.3	38.9	-47.8	-39.5	-51.4
Total	72.1	189	-111	184	91.3	-198	400	-106	195	-141	-325	-82.3
Total s.e.	28.9	47.8	7.64	46.5	24.8	24.8	81.4	6.08	36.3	8.17	47.8	12

Table 3: Changes in Corporate Yield Spreads at the Firm Level on QE1 Event Dates by Grade and Maturities with Normal Window and Illiquid Bonds Removed

	Gov. bonds			Corporate bonds											
Event date	5 year	10 year	30 year	All, All	All, H	All, I	Short, All	Inter, All	Long, All	Short, H	Short, I	Inter, H	Inter, I	Long, H	Long, I
2008-11-25	-2.06	-16.4	-10.8	-65.3	-104	-10.1	-39.4	-53.1	-140	-66.1	-9.15	-72.8	-6.53	-274	-15.8
2008-12-01	-28.2	-23.3	-24.8	114	183	24	118	141	49.7	216	23.4	205	2.64	47.1	52.2
2008-12-16	-18.3	-27.1	-27.1	-34.7	-48.3	-14.4	-93.3	7.64	-1.53	-160	-7.5	22.2	-22.9	11.7	-15.4
2009-01-28	1.87	1.12	2.57	42.6	76.3	-9.78	76.4	35.1	-6.71	143	-16	55.2	-10.1	-13.9	0.454
2009-03-18	-19.1	-23.4	-10.7	96.1	162	-19.2	203	41	-18.4	347	-15.8	64.9	-19.7	-13.3	-24.9

Table 4: Changes in Corporate Yields at the Bond Level on QE1 Event Dates by Grade and Maturities with Normal Window and Illiquid Bonds Removed

Event date	<2, I	<2, H	<2, All	2–5, I	2–5, H	2–5, All	5–10, I	5–10, H	5–10, All	10–30, I	10–30, H	10–30, All	>30, I	>30, H	>30, All
2008-11-25	-68.7	453	67.9	-24.1	-134	-67.2	-10.3	-36	-21.2	-12.2	-152	-55.5	-18.2	-352	-161
2008-12-01	6.6	-474	-100	-12.4	-58	-28.4	-17.5	124	36.7	-17.8	14.3	-7.97	46.8	-95.8	-24.5
2008-12-16	-10.2	-2.27e+03	-596	-40.3	-109	-66.9	-50.9	-76.7	-62.4	-38.2	-95.6	-56.4	-4.9	-116	-71.7
2009-01-28	-10.5	-363	-106	-10.9	-29.9	-18.6	-11	-10.8	-10.9	0.0212	-12.9	-4.07	-4.94	-18.7	-10.8
2009-03-18	-48.1	-29	-42.7	-46.9	-40.7	-44.3	-43.7	-43.1	-43.4	-49.6	-59.4	-52.7	-24.8	-274	-124
Total	-131	-2.69e+03	-778	-135	-372	-225	-134	-42.7	-101	-118	-305	-177	-5.94	-857	-393
Total s.e.	12.4	415	103	6.5	18.1	8.83	7.68	31.1	15	8.03	26.4	10.7	11.3	54.9	25.7

Table 5: Changes in Corporate Yield Spreads at the Bond Level on QE1 Event Dates by Grade and Maturities with Normal Window and Illiquid Bonds Removed

	Gov. bonds			Corporate bonds														
Event date	5 year	10 year	30 year	<2, I	<2, H	<2, All	2–5, I	2–5, H	2–5, All	5–10, I	5–10, H	5–10, All	10–30, I	10–30, H	10–30, All	>30, I	>30, H	>30, All
2008-11-25	-2.06	-16.4	-10.8	-66	455	70.3	-21.5	-132	-64.8	-7.04	-33.5	-18.3	-9.56	-149	-53	-12.8	-348	-156
2008-12-01	-28.2	-23.3	-24.8	38.2	-442	-68.8	19.2	-26.2	3.28	14	156	68.2	13.1	45.5	23	77.2	-65.6	5.82
2008-12-16	-18.3	-27.1	-27.1	13.9	-2.25e+03	-572	-16	-85.2	-42.8	-26.4	-53.6	-38.5	-15.1	-72.6	-33.4	22.8	-87.4	-43.3
2009-01-28	1.87	1.12	2.57	-15.2	-367	-111	-15.1	-34.2	-22.9	-15	-14.8	-14.9	-3.52	-16.8	-7.71	-6.91	-20.3	-12.6
2009-03-18	-19.1	-23.4	-10.7	-21.5	-4.99	-16.8	-19.6	-13.4	-17	-16.9	-16.6	-16.8	-24.2	-33.9	-27.3	2.17	-252	-99.4

Alternatively, the fall could be attributed to the default risk channel. The risk of the debtor to not repay is lowered, and thus the risk premium is reduced. If the risk reduction is long-term, this would affect longer bonds more. This is supported by the shrinking spreads in Table 3.

By studying changes in CDS rates, Vissing-Jorgensen and Krishnamurthy (2011) find that the default risk channel and the signalling channel fully explains the change to Baa bonds; however, they did not find the increasing response in duration. That could be because they use a more narrow set of durations [2] and Barclay indexes.

To explain the default risk channel, we summarize the policy announcements made on in late 2008 on November 25 and December 16. November 25 was the first announcement to create TALF and the plan to purchase assets such as GSE-backed MBSs and GSE agency debt. Treasuries were not mentioned and neither were changes to the Federal funds target (Reserve, 2008b). On December 16, the Board of Governors decided to lower the Federal fund target rate from 1.00 percent to a range of 0–0.25 percent, to lower the discount rate by from 1.25 to 0.50 percent and the interest rate on excess reserves to 0.25 percent, down from 1.00 percent (Reserve, 2008a). These policy events also explain why short-term bonds responded the most on this date, but also throws doubt how much this was specifically a QE event, or a more conventional monetary policy announcement.

Surprisingly, at the announcement of the first treasury purchases on March 18, high-yield firm yields increased on net. The Bernanke speech at the Greater Austin Chamber of Commerce (December 1) and the FOMC statement of January 28 did not announce any changes to policy but communicated that the FOMC was considering the purchase of treasuries. These events saw if anything increasing yields for high-yield firms.

To explore further we turn to the disaggregated bond trades in Tables 4 and 5. Observe that (1) investment-grade bonds respond in general after most QE events. (2) But also high-yield bonds react overall, if noisier. This is in contrast to high-yield firms (a firm with at least one issued high-yield bond). In the aggregation, we weight by volume traded. Thus, the difference should be driven by bigger trades of bonds that have increasing yields. (3) We observe a hump-shape in the response w.r.t. duration. The less-than 2 year bonds and 2–5 year bonds are lowered by more than the 5–10 year bonds. Also 10–30 and more-than 30 year bonds move further down, but not as much as the shortest bonds. Again, this is different from the firm-level results, suggesting that trades of bigger volumes are traded at higher yields, pulling up the averages.

Summary: Three observations regarding QE1 stand out.

1. The safest firms (investment-grade only bonds outstanding) see consistently reduced bond yields. This is consistent with the safety channel and investors rebalancing from treasuries to other safe assets.

2. Other firms see reduced yields and spreads on dates when the Fed funds rate was reduced or TAFL and MBS purchases were announced; on other dates, responses are mixed. This suggests that short rates and risk-reduction has more impact on less safe firms than the influence of long rates.

[2] They categorize the durations as "intermediate (around 4 years) and long (around 10 years)"

3. At the bond level, yields fall consistently across durations and quality. The longer the duration of a bond, the greater the reduction. This is consistent with an overall reduction in risk of default.

For future work, we need to think more about the aggregation from bond yields to firm-level yields.

2.3 Event study, QE2 and MEP

We group the Maturity Extension Program (MEP) announcemenet on September 21, 2011, together with QE2 events.

In Table 6 we present the summary statistics for the firms used in our analysis of QE2. The share of trades excluded is slightly higher than in Table 1, but less than 1% and the total number of trades per QE event is higher overall. The excluded firms' bonds are again illiquid, but of short maturity which in part can explain that they are on average cheaper.

Tables 7, 8, 9, and 10 present the event study results for QE2 events. Overall we note that changes to yields are of lesser magnitude than during QE1, and the standard errors are smaller. Over the seven QE events, yields increase on net by 21.1 basis points (Column 'All, All", Table 7), compared to increasing by 72.1 over all QE1 events (Column "All, All", Table 2). Results for high-yield firms are mixed in signs when comparing across events, while investment grade are more consistently negative even if they don't match the changes to treasuries. E.g., on October 12, 2010, treasury yields rise while investment grade fall; for August 9, 2011, treasuries fall and investment grade rise (see Table 8). It is only on August 10 and November 3, 2010 when corporate bonds react in the same direction as treasuries.

As in QE1, the response with respect to increasing duration is falling on net. On the short- and intermediate-duration side, investment grade fall while high yield increase, for long bonds it is high yield that on net fall.

In Table 9, presenting the results on the bond level, we see that the duration effect ends after 30 years; for all durations, the yield change is smaller as we move further out. For 10–30 year bonds, the co-movement between high-yield and investment grade is strong, while for all the shorter bonds, it is investment grade that reacts downwards.

Table 6: Summary statistics for selected and unselected firms in QE2 event study.

Statistic	Selected	Unselected	All
Number of trades	11,497,984	100,484	11,598,468
Percent investment grade	16.600	32.390	18.000
Average trades per day	27.050	2.790	24.870
Average volume per day	13,350,584	1,823,197	12,306,712
Volume-weighted average price	101.7	92.210	100.9
Volume-weighted average coupon	6.360	6.270	6.350
Volume-weighted average yield in basis points	0.000	0.000	0.000
Volume-weighted average years to maturity	8.435	5.000	8.100

Table 7: Changes in Corporate Yields at the Firm Level on QE2 Event Dates by Grade and Maturities with Normal Window and Illiquid Bonds Removed

Event date	All, All	All, H	All, I	Short, All	Inter, All	Long, All	Short, H	Short, I	Inter, H	Inter, I	Long, H	Long, I
2010-08-10	-41.2	-52.5	-2.97	-118	2.7	15.6	-155	7.55	5.31	-9.16	28.2	-9.77
2010-09-21	13.2	18.3	-6.55	45.3	-1.51	-11.1	59	-0.755	0.964	-15	-13.2	-5.37
2010-10-12	-10	-10.8	-7.08	-21.3	2.39	-15	-24.9	-7.98	5.97	-19.3	-23.4	4.51
2010-11-03	-10.9	-12.4	-4.43	-13.7	-11	-5.9	-14.9	-9.3	-11.9	-5.07	-9.05	2.96
2011-08-09	3.72	3.02	7.55	-15.8	20.7	0.298	-23.5	14	23.9	-9.35	-3.55	14.8
2011-08-26	8.43	11.6	-9.54	34.7	-1.52	-17.2	48.5	-22.6	-1.89	1.84	-21.9	-0.544
2011-09-21	57.9	69.3	-0.454	135	16.2	8.8	167	1.29	18.4	0.301	12.4	-4.76
Total	21.1	26.5	-23.5	45.8	28	-24.5	55.7	-17.8	40.7	-55.8	-30.4	1.83
Total s.e.	10.6	13	1.98	27.1	3.83	4.32	34.6	4.22	4.24	2.69	6.57	2.84

Table 8: Changes in Corporate Yield Spreads at the Firm Level on QE2 Event Dates by Grade and Maturities with Normal Window and Illiquid Bonds Removed

	Gov. bonds			Corporate bonds											
Event date	5 year	10 year	30 year	All, All	All, H	All, I	Short, All	Inter, All	Long, All	Short, H	Short, I	Inter, H	Inter, I	Long, H	Long, I
2010-08-10	-3.38	-6.93	-4.2	-35.2	-46.4	2.71	-112	8.75	21.1	-149	14.4	11.5	-3.62	34.4	-5.38
2010-09-21	-9.84	-13.2	-10.5	25.1	30.2	5.2	57.1	10.5	0.685	70.7	11.2	13	-2.94	-1.11	5.7
2010-10-12	3.36	5.99	8.42	-14.7	-15.4	-11.9	-26	-2.36	-19.6	-29.5	-12.8	1.24	-24.2	-28	-0.13
2010-11-03	-7.4	-8.79	-0.159	-0.629	-2.2	5.87	-3.43	-0.726	4.27	-4.65	0.946	-1.6	4.77	0.885	13.8
2011-08-09	-13.4	-19.1	-6.39	24.8	24.2	28	5.08	41.8	21.5	-2.8	35.8	45.3	8.56	17.7	35.5
2011-08-26	-1.45	0.546	0.901	9.75	13	-8.3	36.1	-0.167	-16.1	49.9	-21.4	-0.53	3.14	-20.8	0.612
2011-09-21	-2.5	-11.6	-20	60.5	71.9	2.06	137	18.8	11.5	169	3.87	21.1	2.79	15.2	-2.32

Table 9: Changes in Corporate Yields at the Bond Level on QE2 Event Dates by Grade and Maturities with Normal Window and Illiquid Bonds Removed

Event date	<2, I	<2, H	<2, All	2–5, I	2–5, H	2–5, All	5–10, I	5–10, H	5–10, All	10–30, I	10–30, H	10–30, All	>30, I	>30, H	>30, All
2010-08-10	1.97	24.2	9.76	0.0424	0.344	0.215	-4.84	2.15	-0.75	-1.33	-1.61	-1.44	-0.666	1.71	0.522
2010-09-21	-1.6	119	41	-7.67	-10.4	-9.3	-11.5	-6.61	-8.54	-6.62	-12	-8.9	-5.32	-7.07	-6.34
2010-10-12	0.141	43.3	15.2	0.651	-1.96	-0.885	3.67	-0.837	0.888	3.9	0.892	2.58	0.399	-4.46	-2.36
2010-11-03	8.68	125	49.9	-8.24	-12.8	-11	-12.1	-12.3	-12.2	-0.355	-36.5	-16.5	-0.656	4.17	2.21
2011-08-09	20.3	25	22.4	13.5	31.6	25.1	-1.69	16.6	11	6.28	13.1	9.39	16.4	24.1	20.7
2011-08-26	-8.83	-24.9	-16.1	-11.4	-9.38	-10.1	-4.01	-5.89	-5.32	-5.45	-5.67	-5.55	-0.393	-6.41	-3.73
2011-09-21	8.28	86	44.6	12.7	19.4	17	5.45	12.9	10.6	3.33	3.14	3.24	-1.21	9.19	4.37
Total	28.9	398	167	-0.354	16.8	11	-25.1	6.08	-4.27	-0.24	-38.6	-17.2	8.54	21.2	15.3
Total s.e.	3.26	19.4	8.19	3.51	5.9	4.97	2.37	3.71	3.15	1.7	5.51	3.03	2.43	3.87	3.12

Table 10: Changes in Corporate Yield Spreads at the Bond Level on QE2 Event Dates by Grade and Maturities with Normal Window and Illiquid Bonds Removed

	Gov. bonds			Corporate bonds													
Event date	5 year	10 year	30 year	<2, I	<2, H	<2, All	2–5, I	2–5, H	2–5, All	5–10, I	5–10, H	5–10, All	10–30, I	10–30, H	10–30, All	>30, I	>30, H	>30, All
2010-08-10	-3.38	-6.93	-4.2	8.1	30.2	15.8	6.33	6.16	6.24	0.642	8.22	5.08	4.62	4.38	4.52	4.39	6.71	5.55
2010-09-21	-9.84	-13.2	-10.5	10.6	131	53	4.5	1.6	2.79	0.603	5.33	3.47	4.9	-0.0162	2.82	6.15	5.33	5.67
2010-10-12	3.36	5.99	8.42	-4.43	38.6	10.6	-4.03	-6.67	-5.58	-1.01	-5.55	-3.82	-0.723	-3.78	-2.06	-3.78	-9.07	-6.77
2010-11-03	-7.4	-8.79	-0.159	19.5	135	60.5	2.14	-2.55	-0.683	-1.63	-1.93	-1.82	10.1	-26.4	-6.23	10.1	13.9	12.4
2011-08-09	-13.4	-19.1	-6.39	41.4	47	44	35.8	53.1	46.9	19.6	37.6	32.1	28.1	34.9	31.2	36.7	46.3	42
2011-08-26	-1.45	0.546	0.901	-7.63	-23.3	-14.8	-10	-8.07	-8.77	-2.98	-4.67	-4.16	-4.32	-4.3	-4.31	0.618	-5.57	-2.82
2011-09-21	-2.5	-11.6	-20	10.9	88.5	47.2	15.2	21.9	19.5	8.07	15.6	13.3	5.85	5.78	5.82	1.44	12.6	7.42

It seems however implausible that this could be due to the signalling channel, even 10–30 years is very long into the future. The shape rather suggest that the risk of default is decreasing.

Unlike QE1, during QE2, yields don't fall consistently at the bond level. Only on September 21, 2010 and August 26, 2011 did it happen. Also, spreads shrank on these dates (see Table 10).

Particular for the Maturity Extension Program, the FOMC announced that they would sell treasuries of remaining maturity less than 3 years, and buy treasuries of longer duration, between 6–30 years. The rebalancing channel and a preference for safe assets would imply that investment-grade, of matching maturities would see reduced yields relative short bonds (especially of maturities less than 3 years). This holds for each "All" category in Table 9, row 2011-09-21. Investment-grade bonds of remaining maturity greater than 30 years also follow this trend.

Summary: Less clear patterns emerge after QE2 events, and different levels of aggregation contradict each other. The observations are summarized as follows.

1. As previously established by the literature, QE2 was less effective to reduce yields compared to QE1. Effects are overall mixed.

2. Investment-only firms see reduced yields on net. This is consistent with the safety channel.

3. Yield changes decrease with durations $\leq$ 30 years. Bonds of maturities greater than 30 years break the trend.

4. Only on 9/21, 2010 and 8/26, 2011 do yields consistently fall at the bond level. This does not agree with firm-level results. Spreads only fall consistently on 8/26, 2011 at the bond level.

2.4 Heterogeneity by industry

The asset classes purchases by the Federal Reserve can be grouped as GSE-backed MBS's, other GSE obligations, and treasuries. The former classes are found to lower mortgage rates (Hancock and Passmore, 2011). Given that the statement of November 25 was specific about attempting to increase available credit for purchases of homes (Reserve, 2008b), we ask if there is any differential effect to mortgage-related sectors and their cost of borrowing. Because of the possibility to contrast between mortgage-specific QE and treasury-only, we focus on QE1. This is also motivated by the smaller, mixed effect of QE2.

Only by utilizing firm-specific assets is it possible to study effects to different industries. To our knowledge, this has not been done in previous studies.

The results are presented per QE event in Table 11. Using the two-digit NAICS code list, we observe 21 industries and one NA (Compustat does not have a NAICS code for these firms). Of these, we believe that Construction (23) and Finance and Insurance (code 52) would be the most exposed to mortgage rates and mortgage lending. The right-most column "Total" is the net effect across QE events, weighted by number trades per day.

On November 25, yields for firm in Construction showed a huge response (–14 percentage points, see Table 11). Only Professional, Scientific, and Technological Services reacted more (code

Table 11: Changes in Corporate Yields at the Firm Level on QE1 Event Dates by Industry with Normal Window and Illiquid Bonds Removed

Industry	2008-11-25	2008-12-01	2008-12-16	2009-01-28	2009-03-18	Total
11	NA	51.7	25.9	170	55.3	94.5
21	−14.7	60.6	−64.3	10.5	−47.6	−13
22	−27.1	12.5	−17.5	−16.9	−49.2	−20.2
23	−1,400	−598	8.88	NA	NA	−663
31	−27.1	43.6	−10.4	−215	598	88.6
32	10.1	34.5	−45.4	−1.46	−103	−21
33	−92.5	5.43	21.8	202	−60.7	15.1
42	132	31.8	−159	−11.4	−26.5	−9.37
44	−138	−2.81	−12.2	−1.75	21.5	−27.2
45	−41.8	−34.6	−32.9	−30.3	−93.3	−46.6
48	13.0	−23.6	−65.6	−32.6	−189	−64.5
49	−129	0.296	−80.1	10.9	5.86	−38.5
51	80.1	168	−26.6	−14.2	−45.7	32.6
52	3.78	−36.2	−33.4	−2.37	−44.5	−22.3
53	3.6	66.3	48.2	−9.01	−15.9	14.4
54	−2,550	534	−197	212	710	−366
56	440	3,860	127	135	−2,560	401
62	−31.6	65.9	−42	−26.8	−10.1	−10.8
71	−51.9	NA	−2,240	NA	NA	−1,510
72	139	28.9	10.6	−11.9	−33.5	30.4
99	13.8	−34.9	24.4	−59.8	4.25	−10.5
NA	−118	144	−88.1	86.6	211	48.8

54), but that industry is generally very volatile across QE events (so is Arts, Entertainment, and Recreation, code 71).

Also on December 1, 2008—a day of generally little reactions—does the construction sector yields fall.

However, Finance and Insurance (code 52) is flat on the first event, while falling on the following QE events. The opportunity to offload toxic MBS's from their balance sheets to the Federal Reserve's did not lower their borrowing costs. Real Estate Rental and Leasing (code 53) has mixed reactions and on net yields increase in the QE-event windows.

It is clear that the results are generally noisy, and we attribute this to the small overlap between TRACE and Compustat data, and the issue of general illiquidity in the corporate bond market.

We do not see any overall trend in the net changes of all QE1 events. Two industries are impacted quite a lot. Those are codes 54 and 71, Professional, Scientific, and Technical Services, and Arts, Entertainment, and Recreation. We see no channel other than through general equilibrium demand that could explain this. Rather, we note that the effects are driven by outliers. Also code 56 (Administrative and Support and Waste Management and Remediation Services) responds

very strongly on one date, but the effect is cancelled out by an even greater shift in yields before.

Summary: We distill our conclusions of the industry-level analysis to.

1. The industry-level results are noisy.
2. Construction saw big yield reductions following the QE announcement concerning MBS purchases
3. Finance and insurance was little affected by MBS purchases, but yields were reduced after later QE1 events.

3 Results: Real Effects

To explore the real effects of quantitative easing through the portfolio rebalancing channel, we investigate whether the causal effect of QE on firm's cost of credit is associated with firm-level outcomes. The event study results showed more clear repricing for the QE1 event dates relative to the later dates and thus we focus on QE1 for the study of real effects, which is in line with the literature acknowledging that later event dates were often anticipated (Thornton, 2017).

Table 12 reports sample characteristics for the real effects sample. For the sample period considered in these data (i.e. fourth quarter 2008 through first quarter 2020), we have approximately thirty-seven thousand firm-quarters with six thousand unique firms per quarter. There is wide variation in the range of values for these outcome variables. We specifically see in the latter two panels–at the onset of the economic contraction–reduced average loan uptake, total debt, liquidity, investments, and sales. The treatment variable is centered near zero given these tables have the full Compustat panel wherein only a few hundred firms had corporate bonds traded in the event windows.

Table 13 and 14 report results of regression specification (2) for outcomes within quarter and at the four subsequent quarters after Q4 2008 and Q1 2009, respectively. Again, the treatment variable, as defined in (1), is the firm level sum of the relevant quarter's QE shocks. We report the univariate coefficients and standard errors using six outcomes: loan uptake, total debt, dividends, liquidity, investment, and sales. Coefficients significant at the five percent level are emboldened.

Beginning with studying the results broadly across the two tables, we see the large majority of the estimates are negative, that is, the QE induced reduction in cost of borrowing is associated with higher real outcomes: loan uptake, total debt on balance sheets, dividends, cash and short-term investments, change in total assets, and total revenue. However, very few of the coefficients are significant and, moreover, the confidence intervals are much larger than the magnitude of the coefficients. Although limited by the size of the confidence intervals, we do see that the magnitudes of the coefficients tend toward zero at longer horizons, which would fit a prior of general equilibrium effects increasing limiting the identification of the relationship of interest. Moreover, finding limited real effects of monetary policy fits previous studies of QE; for example, Foley-Fisher et al. (2016) found non-zero results only for investment and total employees.

To interpret the economic magnitude of the coefficients, we recall the treatment is the sum of the percentage point change in yield across the quarter's QE event dates while the outcomes

2008.4–2010.1	Mean	N	Min	p25	Median	p75	Max
loan uptake	99.1	36,678	-125,964	-5.29	0	0.615	2,488,290
total debt	3,714	36,678	0	0.554	56	638	3,262,844
dividends	26.8	36,678	0	0	0	2.34	10,856
liquidity	1,287	36,678	-0.0719	4.71	33.4	178	490,948
investments	26.9	36,678	-41,816	-5.82	-0.009	8.72	69,963
sales	952	36,678	-25,623	5.45	48.7	322	128,572
2008.4							
treatment	-0.212	6,113	-10,867	0	0	0	13,987
loan uptake	-94.2	6,113	-106,639	-5.66	0	1.62	182,695
total debt	3,605	6,113	0	0.736	63.4	660	870,470
dividends	35.3	6,113	0	0	0	3.29	6,834
liquidity	1,240	6,113	-0.0719	4.48	28.1	152	368,149
investments	-89.7	6,113	-38,256	-26.8	-1.09	1.94	29,486
sales	922	6,113	-25,623	5.4	48.1	328	105,715
2009.1							
treatment	-1.24	6,113	-5,030	0	0	0	12,431
loan uptake	-3.65	6,113	-125,964	-8.4	0	0.2	240,355
total debt	3,601	6,113	0	0.667	60	637	909,511
dividends	21.6	6,113	0	0	0	1.93	10,856
liquidity	1,201	6,113	-0.002	4.11	29.1	156	409,326
investments	-83.7	6,113	-41,816	-20	-1.02	0.382	32,876
sales	862	6,113	-127	5	44.4	307	108,747

Table 12: All monetary amounts are in Millions USD. Treatment (basis points) is the sum of the shocks for all QE event dates in the quarter.

Following 2008.4	(1) loan uptake	(2) total debt	(3) divid.	(4) liquid.	(5) invest.	(6) sales
t+0	-0.256	**-3.28**	-0.0121	-1.04	**0.147**	**-0.928**
	(0.22)	(1.37)	(0.0111)	(0.552)	(0.0686)	(0.183)
t+1	-0.019	-0.45	-0.00196	0.0115	-0.0151	0.221
	(0.22)	(1.37)	(0.0111)	(0.553)	(0.0686)	(0.184)
t+2	0.0107	-0.43	-0.00101	-0.0826	-0.0166	0.021
	(0.22)	(1.37)	(0.0111)	(0.553)	(0.0686)	(0.184)
t+3	-0.0193	-0.753	-0.00334	-0.113	0.016	-0.185
	(0.22)	(1.37)	(0.0111)	(0.553)	(0.0686)	(0.184)
t+4	-0.00237	-0.306	-0.00742	-0.046	-0.00368	-0.019
	(0.22)	(1.37)	(0.0111)	(0.553)	(0.0686)	(0.184)

Table 13: Estimated coefficient from univariate regressions of six outcomes at various horizons on within 2008Q4 summed treatment. Coefficients significant at the five percent level are emboldened.

are in millions USD. Thus, the coefficients are the unit of millions of dollars per one percentage point change to the firm's cost of borrowing.

We next study the coefficients in detail beginning with the within-quarter results. For the Q4 2008 within quarter results, total debt, investment, and sales are significant at the five percent level. Liquidity is significant at the ten percent level. Similarly, for the Q1 2009 within quarter results, total debt and liquidity are significant at the five percent level. However, we are hesitant to confirm the direction of causality for the within-quarter results. For example, it seems more plausible that firm investment decisions were influenced at horizons of several months as opposed to late November and early December 2008 QE events causally influencing the quarter's investment. The estimated magnitude of these coefficients are economically significant. For example, we find a one percentage point reduction in cost of borrowing, induced by the three Q4 2008 QE events, is associated with a $328MM increase in total debt, in relation to a $3,605MM firm-level average for Q4 2008. The economic magnitude is even larger for total debt in Q1 2009.

As aforementioned, the coefficients with outcomes at future horizons tend toward zero. However, for Q1 2009, we find significant results for investment and revenue. For a one percentage point reduction in the cost of borrowing from the two Q1 2009 QE event dates, we find total sales increased by about $49MM while investment increased by about $57MM. In particular, investment is highly significant. The strongest result of increased investment in the subsequent quarter after the monetary policy induced reduction in firm cost of credit has also been observed in Ottonello and Winberry (2020), for traditional monetary policy, and in Foley-Fisher et al. (2016), for the MEP in particular. This connects further with the more broadly observed empirical fact of investment being one of the most responsive components of GDP to monetary shocks, which has been the basis of much study of the investment channel. In future iterations of this paper, we hope to add a rich set of controls to study how financial constraints and frictions (e.g. degree of leverage, distance to default, etc.) determine this investment response to monetary shocks.

Following 2009.1	(1) loan uptake	(2) total debt	(3) divid.	(4) liquid.	(5) invest.	(6) sales
t+0	-0.391	**-5.03**	-0.0193	**-1.60**	-0.0954	-0.303
	(0.29)	(1.93)	(0.0121)	(0.754)	(0.0748)	(0.227)
t+1	-0.191	-1.43	-0.000335	-0.242	**-0.571**	**-0.489**
	(0.29)	(1.94)	(0.0121)	(0.755)	(0.0745)	(0.227)
t+2	-0.113	-0.103	-5.69×10^{-5}	-0.0617	-0.00846	-0.0305
	(0.29)	(1.94)	(0.0121)	(0.755)	(0.0748)	(0.227)
t+3	-0.00656	0.42	0.000133	-0.032	-0.0102	-0.0401
	(0.29)	(1.94)	(0.0121)	(0.755)	(0.0749)	(0.227)
t+4	-0.0869	-0.196	-0.00692	-0.0897	0.0276	-0.126
	(0.29)	(1.94)	(0.0121)	(0.755)	(0.0749)	(0.227)

Table 14: Estimated coefficient from univariate regressions of six outcomes at various horizons on within 2009Q1 summed treatment. Coefficients significant at the five percent level are emboldened.

In addition to the numerous previously mentioned limitations, we add the following. First, we have begun this study with simple univariate regressions which obviously gives no notion of causality nor controlling for obvious confounding variables. Similarly, we will in the next iteration use heteroskedastic robust standard errors and no longer ignore correlations across firms, but instead follow the literature by clustering standard errors at the industry level. Next, given the size of the panel data, we find confidence intervals that limit the ability to bound the results. For example, many of the coefficients have confidence intervals including economic magnitudes of both positive and negative hundreds of millions of dollars per percentage point shock to a firm's cost of borrowing.

Lastly, it is important to reiterate that these results are capturing the heterogeneous association between the QE-induced shock to firm's cost of borrowing. It is of course of interest to learn how the economy evolves in a world with and without QE to inform policy decisions. However, we are not able to run an experiment to study potential outcomes in a world with and without QE policy.

Summary: We distill our conclusions of the real effects to:

1. there is broadly limited association between QE1-induced firm cost of borrowing shocks and subsequent real outcomes;

2. there is a statistically and economically significant estimate of a one percentage point reduction in the cost of borrowing being associated with an increase of about $57MM in investment; however,

3. we are hesitant to draw conclusions from such a limited exploration of the data.

4 Conclusion

We plan to enrich the event study and real effects investigation to move this paper closer to a publication-worthy working paper.

We aim to extend this paper by performing a similar exercise for the QE actions taken by the Fed in early 2020 with the onset of the COVID-19 pandemic. We believe there is stronger identification treated firms given the direct purchase of corporate bonds by the Fed. Studying these outcomes at a one year horizon is only just recently available.

We further hope to enrich our event study results with further controlling variables to segment the effects by channels (e.g. default risk) and additional statistical tests for more rigorous inference. Moreover, we hope to study the real effects with a richer set of regression specifications as well as a difference-in-difference analysis. We are considering a synthetic control strategy to fit a QE-induced borrowing cost effect to firms who do not have corporate bonds traded in the event windows.

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Appendix

A.1 Details on Compustat data

Table 15: This table presents the Compustat variables we use to define our real outcome variables.

Definition	Compustat codes	Description
Total debt	`dlcq, dlttq`	`Debt in current liabilities + long-term debt Total`
Total tangible assets	`ppentq, actq`	`Property, plants, equipment Total net + Current assets`
Total intangible assets	`intanq`	
Sales	`saleq`	O&W
Liquidity	`cheq`	`Cash and short-term investments`
Dividends	`dvy, dvpy`	`Cash Dividends, Dividends - Preferred/Preference`
Total assets		Sum of tangible and intangible assets
Total investment		Change in total assets
Loan uptake		Change in total debt

A.2 Computing the missing yields

TRACE does not provide a yield to maturity (YTM) for most bond trades. We use the present-value PV formula for annual coupon C bond with T years to maturity with closed-form formula

$$PV = \frac{C}{YTM}\left[1 - \frac{1}{(1+YTM)^T}\right] + \frac{F}{(1+YTM)^T}. \tag{3}$$

To calculate the yield for each bond trade with face value F and price P, we numerically solve this equation using the fixed-point equation

$$YTM = \frac{C}{P}\left[1 - \frac{1}{(1+YTM)^T}\right] + \frac{F \times YTM}{P \times (1+YTM)^T}. \tag{4}$$

The agreement is high with the few trades with reported yields. Because not all corporate bonds in TRACE are plain vanilla, this method will be erroneous for those but we believe this only adds noise and no specific bias to our results.

A.3 Additional tables, event study

For completeness we include here the event study tables when using a more narrow window, a wider window, including and excluding illiquid bonds. We also include the industry-specific yield changes for QE2.

Table 16: Changes in Corporate Yields at the Firm Level on QE2 Event Dates by Industry with Normal Window and Illiquid Bonds Removed

Industry	2010-08-10	2010-09-21	2010-10-12	2010-11-03	2011-08-09	2011-08-26	2011-09-21	Total
11	034	−30.5	−12.3	−12.9	27.5	14.3	65.6	12.2
21	11.4	8.75	17.8	−1.36	6.5	−2.38	27.1	9.42
22	−19.4	18.0	3.33	16.4	−32.6	−10.5	012	−1.41
23	NA	NA	NA	NA	44.4	019	13.2	25.5
31	5.8	19.1	−8.55	−8.96	5.36	16.7	−1.79	4.09
32	4.31	−14.7	−1.9	−15.5	13.2	−16.7	7.56	−3.38
33	−9.9	−17.3	−2.12	−2.71	014	−3.27	10.6	−0.974
42	1.02	9.79	7.95	−13.8	18.6	−5.71	16.0	4.56
44	−30.5	22.3	38.5	0.796	11.4	−13.7	34.2	9.59
45	−5.53	−8.39	−3.16	−15	−1.83	−7.25	16.5	−2.85
48	8.46	5.78	16.9	−8.19	106	−29.8	033	17.4
49	015	−6.24	−18.2	−25.2	−68.6	−15.2	−7.31	−14.1
51	13.6	−20.9	−5.38	−9.6	16.5	−5.23	18.1	1.5
52	−2.8	4.89	2.21	7.34	12.1	−28.6	13.4	0.999
53	−5.35	−3.16	17.9	−6.47	23.9	−03	8.59	5.14
54	−24.9	5.72	28.4	24.6	−13.4	−7.99	−32	−2.8
56	NA	26.6	9.06	−12.2	−24.3	−4.73	1.38	−3.55
62	6.14	−12.6	24.5	−28.2	46.7	−27.1	019	4.58
71	60.5	22.1	NA	NA	120	−45.8	71.5	45.6
72	13.2	−8.07	−28.4	25.5	20.5	−15.5	6.66	1.5
81	NA	NA	NA	NA	11.7	18.3	−13.4	5.51
99	41.3	−8.96	93.6	14.9	28.2	−36.3	28.2	023
NA	−97.9	35.7	−30.8	−24	−9.73	35.8	118	7.07

Table 17: Changes in Corporate Yields at the Firm Level on QE1 Event Dates by Grade and Maturities with Normal Window

Event date	All, All	All, H	All, I	Short, All	Inter, All	Long, All	Short, H	Short, I	Inter, H	Inter, I	Long, H	Long, I
2008-11-25	-6.08	1.46	-25.4	-3.7	55.1	-106	5.44	-25.7	72.8	-11	-146	-37.8
2008-12-01	13.5	18.6	3.08	-49.8	56.7	46.2	-84.1	14.4	78.1	-10.1	79.9	-0.036
2008-12-16	-83	-106	-30.5	-182	-32.7	-29.5	-265	-17.4	-34.6	-25.6	-17.2	-49.1
2009-01-28	-102	-141	-0.411	-197	-94	4.52	-278	-0.488	-113	-21.6	-2.8	17.5
2009-03-18	-90.9	-112	-32.8	-148	6.26	-173	-197	-28.8	15.7	-24.5	-225	-50.4
Total	-268	-339	-86	-580	-8.63	-258	-819	-58	18.8	-92.8	-311	-120
Total s.e.	21.3	29	6.88	34	25.5	35.2	48.8	7.3	32	2.99	48.7	12.4

Table 18: Changes in Corporate Yields at the Firm Level on QE2 Event Dates by Grade and Maturities with Normal Window

Event date	All, All	All, H	All, I	Short, All	Inter, All	Long, All	Short, H	Short, I	Inter, H	Inter, I	Long, H	Long, I
2010-08-10	-15.1	-16.7	-6.47	-46.4	0.0425	2.94	-52.3	-15.9	-1.22	8.86	7.56	-12.4
2010-09-21	17.1	20.3	-2.01	-7.31	9.26	65.5	-8.9	1.79	9.2	9.77	86.3	-16.8
2010-10-12	-10.7	-13.4	5.84	-35.7	21.6	-34	-40.6	-7.22	24.3	3.12	-45.4	27.3
2010-11-03	19.3	20.2	13.7	-38	2.56	123	-43.1	-7.06	1.69	10.5	143	36.8
2011-08-09	20.3	20.2	20.9	13.7	25.3	19.3	16.4	-6.39	26.2	10	12	56.5
2011-08-26	3.39	4.22	-3.27	23.4	-4.41	-12.6	27.1	5.46	-4.99	6.61	-10.2	-27.4
2011-09-21	32.6	36.5	0.535	59.3	19.7	14.6	68.2	9.33	21.6	-10.8	17.8	-5.32
Total	66.8	71.2	29.3	-30.9	74	178	-33.2	-20	76.8	38	211	58.6
Total s.e.	6.15	6.87	3.49	13.6	4.1	18.5	15.5	3.06	4.56	2.67	22.2	11.1

Table 19: Changes in Corporate Yields at the Firm Level on QE1 Event Dates by Grade and Maturities with Narrow Window and Illiquid Bonds Removed

Event date	All, All	All, H	All, I	Short, All	Inter, All	Long, All	Short, H	Short, I	Inter, H	Inter, I	Long, H	Long, I
2008-11-25	-62.7	-96	-18.4	-95.5	-47.9	-23.7	-177	-9.23	-60.2	-22.4	-14.7	-31.4
2008-12-01	13	27	-1.47	104	-93.9	3.23	256	-8.18	-138	-15.8	-37.4	35.7
2008-12-16	89.5	166	-10.1	174	65.3	-42.2	338	1.93	106	-24	-80	-15.3
2009-01-28	117	203	-5.56	-31.8	316	19.1	-54.7	-3.31	486	-10.2	40.8	-3.21
2009-03-18	326	550	-37.3	675	66.2	50.1	1.21e+03	-37.6	104	-24.1	137	-55.6
Total	483	849	-72.8	826	305	6.51	1.57e+03	-56.4	498	-96.5	45.3	-69.8
Total s.e.	58.5	97.4	5.68	122	63.6	14.5	217	6.15	96.3	2.44	33.5	13.6

Table 20: Changes in Corporate Yields at the Firm Level on QE2 Event Dates by Grade and Maturities with Narrow Window and Illiquid Bonds Removed

Event date	All, All	All, H	All, I	Short, All	Inter, All	Long, All	Short, H	Short, I	Inter, H	Inter, I	Long, H	Long, I
2010-08-10	-44.3	-53.6	-10.8	-114	-6.78	5.03	-148	28.7	1.77	-44.5	14.4	-14.6
2010-09-21	74.1	91.2	7.42	212	-0.342	-11	270	13.2	-2.3	13	-14.2	-3.3
2010-10-12	-1.88	-4.84	11.5	-25.5	13.4	11.9	-33.8	11.4	16.6	-9.35	7.23	25.5
2010-11-03	19.4	22.7	5.61	52.3	2	2.8	67.3	0.196	0.83	9.12	0.708	9.34
2011-08-09	-27.1	-30.3	-6.72	-88.1	11	-13.2	-104	-5.96	12.3	-3.5	-14	-10.3
2011-08-26	-43.2	-49.8	-6.71	-122	2.71	-11	-146	-14.9	2.71	2.74	-12.9	-4.58
2011-09-21	29.4	34.5	2.72	74.7	1.25	4.22	94	-4.41	0.88	4.6	1.35	13.5
Total	6.55	9.85	3.02	-10.5	23.3	-11.1	-1.74	28.2	32.8	-27.9	-17.4	15.5
Total s.e.	15.2	18.3	2.97	42.8	2.41	3.47	53.8	5.14	2.44	6.78	4	5.03

Table 21: Changes in Corporate Yields at the Firm Level on QE1 Event Dates by Grade and Maturities with Wide Window and Illiquid Bonds Removed

Event date	All, All	All, H	All, I	Short, All	Inter, All	Long, All	Short, H	Short, I	Inter, H	Inter, I	Long, H	Long, I
2008-11-25	51.9	92.5	-10.9	54	116	-75.1	90	9.45	178	-33.2	-127	-20.1
2008-12-01	42.2	92.1	-32.4	12.1	137	-89.3	46.7	-29.4	212	-40.5	-152	-28
2008-12-16	-4.32	30.9	-60	110	-81.7	-59.2	233	-65.4	-91.9	-61	-67	-50
2009-01-28	9.81	18.3	-4.38	39	-15.4	5.64	71.2	-10.3	-15.4	-15.4	-4.89	18.7
2009-03-18	11.7	33.4	-29.6	130	-92	-24.2	230	-43.6	-121	-19	-27.6	-19.3
Total	111	267	-137	345	64.1	-242	672	-139	162	-169	-378	-98.7
Total s.e.	9.49	14.4	8.72	19.8	43.3	15.5	36.2	11.6	61.6	7.34	25.2	9.94

Table 22: Changes in Corporate Yields at the Firm Level on QE2 Event Dates by Grade and Maturities with Wide Window and Illiquid Bonds Removed

Event date	All, All	All, H	All, I	Short, All	Inter, All	Long, All	Short, H	Short, I	Inter, H	Inter, I	Long, H	Long, I
2010-08-10	-18.4	-22.5	-4.88	-56.3	0.738	12.3	-72.4	-4.88	2.88	-8.76	18.4	-0.506
2010-09-21	21.6	28.1	-2.95	45.5	-0.741	22.5	59.9	-1.76	-0.0262	-4.68	32.1	-2.85
2010-10-12	43.6	54.9	0.0391	178	-4.83	-94.1	229	4.75	-4.03	-9.34	-132	3.14
2010-11-03	-9.57	-10.4	-5.88	-90.6	-11	133	-112	-9.42	-11.8	-6.34	175	-0.0693
2011-08-09	42.5	49.6	5.45	63.1	43.7	-2.9	77.6	6.51	48.1	7.76	-3.71	0.163
2011-08-26	48.1	58.4	-7.2	140	-7.06	-2.38	178	-12	-7.04	-7.26	-3.73	2.26
2011-09-21	72.7	84.9	6.93	145	34.8	12	178	10.8	37.8	11.2	17.1	-8.9
Total	200	243	-8.48	425	55.6	80.2	538	-6.02	65.9	-17.5	103	-6.76
Total s.e.	11.5	13.6	1.95	36.2	7.67	23.2	45.6	2.98	8.26	2.93	31.3	1.4