Finance and Economics Discussion Series
Divisions of Research & Statistics and Monetary Affairs
Federal Reserve Board, Washington, D.C.

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2016-025

Please cite this paper as:
Foley-Fisher, Nathan, Rodney Ramcharan, and Edison Yu (2016). "The impact of unconventional monetary policy on firm financing constraints: Evidence from the maturity extension program," Finance and Economics Discussion Series 2016-025. Washington: Board of Governors of the Federal Reserve System, http://dx.doi.org/10.17016/FEDS.2016.025.

The impact of unconventional monetary policy on firm financing constraints: Evidence from the maturity extension program

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February 2016

Abstract

This paper investigates the impact of unconventional monetary policy on firm financial constraints. It focuses on the Federal Reserve's maturity extension program (MEP), intended to lower longer-term rates and flatten the yield curve by reducing the supply of long-term government debt. Consistent with those models that emphasize bond market segmentation and limits to arbitrage, around the MEP's announcement, stock prices rose most sharply for those firms that are more dependent on longer-term debt. These firms also issued more long-term debt during the MEP and expanded employment and investment. These responses are most pronounced for those firms that are larger and older, and hence less likely to be financially constrained. There is also evidence of "reach for yield" behavior among some institutional investors, as the demand for riskier corporate debt also rose during the MEP. Our results suggest that unconventional monetary policy might have helped to relax financial constraints for some types of firms in part by inducing gap-filling behavior and affecting the pricing of risk in the bond market.

JEL: E52, G23, G32

Key words: unconventional monetary policy, firm-financial constraints, bond markets.

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1. Introduction

To help overcome the zero lower bound constraint after the 2008-2009 financial crisis, the Federal Reserve and other central banks have implemented a number of unconventional policies, including a series of large-scale asset purchases or quantitative easing (QE). These policies are in part intended to work around the zero lower bound constraint by directly buying assets, such as U.S. Treasury bonds and mortgage-backed securities, in order to offset disruptions in private sector intermediation and relax firms' external finance constraints in the aftermath of the crisis (Cahill et al., 2013; Gertler and Karadi, 2011; Krishnamurthy and Vissing-Jorgensen, 2011; and Shleifer and Vishny, 2011).[2]

This paper develops a number of empirical tests to understand how unconventional monetary policy might shape firms' financial constraints. We focus mainly on the Federal Reserve's attempt to flatten the yield curve through the maturity extension program (MEP), announced on Sept. 21, 2011. The explicit intention behind the MEP was to reduce the supply of long-term Treasury securities and put downward pressure on longer-term interest rates, especially on those assets considered close substitutes for long-term Treasury securities. Under the plan, lower borrowing costs and increased credit availability would relieve possibly binding financial constraints on firms and households. To that end, the MEP committed the Federal Reserve to sell about $400 billion in shorter-term Treasury securities and use the proceeds to buy longer-term Treasury securities. The Federal Reserve extended the program in June 2012 through December 2012 for an additional $267 billion. In this paper, we examine how stock prices, debt issuance, and firms' investment and hiring activities reacted to the MEP.

Our empirical tests of the MEP's impact are motivated by those theories that emphasize partial segmentation in bond markets, limits to arbitrage, and the role of nonfinancial corporations in responding to shocks in the supply of government debt (Greenwood, Hanson, and Stein, 2010; Vayanos and Vila, 2009). Partial segmentation in bond markets can arise when some natural buyers of bonds, such as insurance firms and pension funds, prefer investing at specific maturities; life insurers, for example, mainly invest in longer-term bonds to match the duration of their liabilities.[3] These models also observe that time-varying risk premia would respond to an unexpected decline in the supply of longer-term government debt, through limited capital relative to the size of the shock or high levels of risk aversion, ultimately affecting interest rates.

With inelastic demand and limits to arbitrage, the argument in Greenwood, Hanson, and Stein (2010) predicts that nonfinancial corporations would fill in the supply gaps for longer-term debt created

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[2] See Chodorow-Reich (2013) for evidence on how the crisis might have affected financial constraints at bank-dependent firms. Di Maggio and Kacperczyk (2014) study the impact of low interest rates on reach for yield behavior in the mutual fund industry. Benmelech, Meisenzahl, and Ramcharan (2014) and Ramcharan, Verani, and Van den Heuvel (forthcoming) study the impact of financial sector distress during the crisis on households. DiMaggio, Kermani, and Ramcharan (2014) and Keys et. al (2014) study how monetary policy after the crisis might have affected household level financial constraints.

[3] The average maturity of corporate bond holdings in the life insurance industry is about 11 years, roughly unchanged since 2004 (NAIC 2014).

by government supply shocks like the MEP.[4] This channel would be especially strong for those firms with a preference for using longer-term debt to meet their financing needs or those with the financial flexibility to adjust the maturity of their debt issuances easily. Moreover, if these firms faced financial constraints after the crisis, then filling the supply gaps created by the MEP might also allow them to take better advantage of growth opportunities, leading to increased investment and employment. In contrast, if arbitrageurs operate freely at different maturities along the yield curve, then any policy-induced reduction in longer-term yields might be evanescent, leaving little impact on corporate debt issuances and real outcomes.

Table 1 shows that the decline in the supply of longer-term government debt envisaged by the MEP was large relative to the size of the Treasury market, and we find evidence consistent with the gap-filling hypothesis in Greenwood, Hanson, and Stein (2010). Our first set of tests exploits cross-sectional differences in the stock price response to the MEP's announcement. These tests suggest that market participants likely expected the MEP to lower financing costs and relax financial constraints primarily for those firms that traditionally rely on longer-maturity debt. That is, for those nonfinancial firms that traditionally relied on longer-term debt finance, their abnormal stock returns on the day after the MEP's announcement rose sharply. An increase of one standard deviation in the long-term debt ratio of a firm is associated with a 0.26 percentage point higher abnormal return, which is about 93% in annualized terms. These results are robust to a variety of controls and persist even when using higher-frequency intraday data around the announcement.

The next set of tests examines the response of firms to the MEP using a difference-in-difference methodology. There is evidence that firms with a greater preference for relying on longer-term debt issued more longer-term debt during the MEP to fill the "gap" created by the Fed's purchases of longer-term assets. An increase of one standard deviation in the long-term debt ratio is associated with about a 8% faster growth in the stock of long-term debt during the MEP's implementation. As a falsification test, the coefficient estimate for the growth in short-term debt is not statistically significant, giving us some confidence that the effect of the MEP program operates through longer-term borrowing. And consistent with the gap-filling motive, as well as the evidence in Badoer and James (forthcoming), we find that firms with more financial flexibility might have more easily adjusted their financing plans to take advantage of the MEP.

Beyond inducing gap-filling bond issuances by nonfinancial firms, low nominal interest rates or the expectation that low rates might persist can also create incentives for certain types of creditors to take added risk in an effort to reach for yield, affecting risk premia and the demand for longer-dated high-yielding debt (Morris and Shin, 2012; Borio and Zhu, 2012; and Hanson and Stein, forthcoming). That is, a monetary policy shock such as the MEP might be associated with changes in the risk premium over and above any change in the actuarially fair long-term interest rate implied by the expectations theory of the yield curve.

We test this "reach for yield" channel using a discontinuity in the capital regulations that govern the insurance industry (Becker and Ivashina, forthcoming). Insurers are the main buyers of corporate

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[4] Apart from the MEP, Badoer and James (forthcoming) provide evidence that gap-filling behavior in response to Treasury supply shocks might be an important determinant of long-term corporate issuances.

debt in the United States, accounting for about 60% of all institutional investors' corporate bond holdings. Their bond holdings are also subject to risk-adjusted capital requirements. These requirements are based on bond ratings, and they increase exponentially as the credit quality worsens. For bonds rated AAA through A-, the capital requirement is identical, but this requirement rises sharply for bonds below the A- threshold. Among AAA through A- bonds, we show that during the period of the MEP's implementation, risk premia fell disproportionately for the higher-yielding A- bonds, reflecting in part an increase demand for higher-yielding debt that also economize on regulatory capital requirements. We also find evidence that those insurers more dependent on income earned from Treasury securities before the MEP, and thus more likely to be affected by the prospect of persistently low longer-term Treasury yields, increased their relative purchases of higher yielding A- securities during the MEP's implementation.

Finally, we investigate the MEP's impact on a range of firm decisions. The difference-in-difference approach suggests that firms more dependent on longer-term debt may have been able to take advantage of the more benign financing conditions to increase investment and employment during the MEP relative to other periods. During the MEP's implementation, an increase of one standard deviation in long-term debt dependence is associated with a 1.4 percentage point increase in employment growth during the MEP. The effects are similar for the growth in plant and equipment expenditures. And again consistent with the prediction in Greenwood, Hanson, and Stein (2010), these magnitudes appear somewhat larger for firms with more financial flexibility.

Our analysis contributes to the literature in three ways. First, we provide new evidence that nonfinancial corporations, especially those that are larger and older and thus less likely to be financially constrained, might systematically provide liquidity in response to shocks in the supply of government debt. Second, our results also inform the broader literature on the impact of external finance constraints on stock returns—see, for example, Lamont, Polk and Saa-Requejo (2001), Whited and Wu (2006). Third, this paper adds to the debate on the effects of unconventional policies such as the MEP. Some have argued, for example, that these policies might have little real impact, as economic growth in a post-crisis economy might be shaped more by the pace of reallocation across geography and industries (King, 2013). Unconventional policies are then more likely instead to fuel asset price bubbles, excessive risk-taking, and future instability (Rajan, 2013; Stein, 2014). Several recent papers already provide important evidence documenting the effects of these policies, primarily around their announcement dates, on a range of asset prices.[5] But we are able to probe further and build upon economic theory to identify key mechanisms through which the MEP might relax financial constraints and affect economic decisions at firms.

The remainder of the paper is structured as follows: Section 2 describes the maturity extension program and the basic empirical tests. Section 3 provides a summary of data used in the paper. Section 4 presents empirical results using firm- and bond-level data. Section 5 concludes.

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[5] See, for example, Cahil et al., 2013; Gagnon et al., 2011; Hamilton and Wu, 2012; Swanson and Williams (forthcoming), and Wright, 2012.

2. The Maturity Extension Program and the Basic Hypotheses

The Federal Reserve announced the maturity extension program (MEP) at 2:23 p.m. EST on Sept. 21, 2011, in its Federal Open Market Committee (FOMC) statement. The Federal Reserve announced that it would sell or redeem a total of $400 billion of shorter-term Treasury securities and use the proceeds to buy longer-term Treasury securities, thereby extending the average maturity of the securities in the Federal Reserve's portfolio. With the short-term interest rate near the zero lower bound, the program's intention was to lower long-term interest rates, and ultimately the cost of longer-term credit for households and firms.[6] The September 2011 announcement indicated a program end date of June 2012. But in June 2012, the MEP was renewed; the Fed announced plans to swap another $200 billion in short-term Treasuries for longer-maturity debt. The MEP was officially discontinued at the end of 2012.

The MEP was large relative to the size of the Treasury market. Table 1 shows the maturity structure of the Federal Reserve Bank of New York purchases of Treasuries under the MEP. The bottom panel of the table also shows the stock of outstanding Treasuries at various maturities at the end of 2011. For bonds of duration roughly eight years or longer, projected MEP purchases equal about 18 percent of the outstanding stock Treasuries in 2011. To help visualize the potential impact of these purchases on bond prices, panel A of Figure 1 plots the daily yields of 30-year and one-year Treasury bonds around the announcement of MEP. The solid line is the yield on the 30-year Treasury and the dashed line is the one-year yield. The 30-year yield started to drop when the Fed announced the MEP on Sept. 21, 2011, but the more significant drop occurred on Sept. 22, 2011. Consistent with the economic magnitudes in Table 1, the drop of 25 basis points on Sept. 22 alone was a two standard deviation change, and the 30-year yield dropped by 42 basis points over the two-day period.

Intraday movements in yields show the MEP's impact more clearly. Panel B of Figure 1 plots the cumulative change in the 30-year Treasury yield over Sept. 21 and 22, observed at 30-minute intervals. Yields began dropping right after the announcement at 2:30 p.m. on Sept. 21. But consistent with the fact that market participants might have taken time to process the announcement's implications, as well as the fact that the Federal Reserve Bank of New York's trading desk only began program implementation at 9:30 a.m. on Sept. 22, yields continued falling until the afternoon of Sept. 22. Panel C shows that the yield curve of Treasury bonds also tilted downward, consistent with the intention of the MEP. The solid line is the yield curve of Treasury bonds on Sept. 20, 2011. The dashed and dotted lines are the yield curves for Sept. 21 and Sept. 22, 2011, respectively.

Models that emphasize bond market segmentation and limited arbitrage suggest that the MEP might affect the term spread and the pattern of corporate debt issuances (Greenwood, Hanson, and Stein, 2010; Vayanos and Vila, 2009). If arbitrageurs are risk averse, and some natural buyers of corporate debt have relatively inelastic demand for longer-dated maturities, perhaps because they wish to match the maturities of their assets and liabilities, then targeted policies such as the MEP can flatten the yield curve. A key implication of these theories then is that those firms with a "preferred habitat" or

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[6] See the following link for details about the MEP: (www.federalreserve.gov/monetarypolicy/maturityextensionprogram-faqs.htm).

a preference for longer-term liabilities, or those able to adjust easily the maturity structure of their borrowings, are likely to benefit the most from the MEP's attempt to reduce the relative cost of longer-term external finance.

But unconventional policies such as the MEP can also affect the demand for debt and the risk premia that borrowers might face. The expectation that low rates might persist can induce certain types of creditors to take added risk in an effort to reach for yield, reducing risk premia (Guerrieri and Kondor, 2012; Hanson and Stein, forthcoming; and Stein, 2013). Investors, for example, with a focus on current income and a need to hold longer-term assets to match the duration of their liabilities, such as life insurance firms, could rebalance their portfolios in favor of both more duration and credit risk when they expect longer-term interest rates to remain low for an extended period.[7] In this case, bond market risk premia are likely to decline especially for those firms that issue longer-term debt.

Motivated by these ideas of limited arbitrage and segmentation at various points in the yield curve, we construct a number of tests to measure the MEP's impact. These tests build on the idea that in a cross-section of firms, the policy's impact should be the largest among those firms with a stronger preference for issuing longer-term maturities. In particular, if market participants absorbed the forward guidance associated with the MEP and believed in segmentation and limits to arbitrage, then stock prices of firms with a higher dependence on long-term debt should react more positively to the MEP's announcement. After all, because the MEP would be expected to relax financial constraints disproportionately for these types of firms in the aftermath of the financial crisis, they would now be better able to take advantage of growth opportunities.

The second battery of tests focuses on external finance. If the MEP disproportionately reduced the cost of external finance for these firms, we should see an increase in their debt issuances at the extensive margin during the program's implementation relative to other types of firms. We use a difference-in-difference framework to test these predictions. We also construct tests to gauge the impact of the MEP on the search for yield behavior among the natural buyers of long dated debt, and study its impact on bond market risk premia and the portfolios of insurance companies. A final set of tests is motivated by the idea that if the MEP did relax financial constraints disproportionately for those firms better able to fill the gap in longer-term debt, then these firms might more readily expand employment and investment during the program relative to other types of firms.

The MEP provides an especially useful context in which to investigate the effects of unconventional monetary policy on real economic outcomes. The relative calm around the MEP's announcement makes it somewhat easier to avoid conflating the effects of the MEP with wider developments in financial markets. The Fed's previous attempts at quantitative easing, such as QE 1, were announced and implemented in 2008 during the financial crisis—a period when financial markets were significantly dislocated and the economy was rapidly slowing. This makes it an especially difficult period for statistical inference. Panic selling and fire sales in asset markets, as well as general

[7] Morris and Shin (2012) develop a variation of this idea in the case of asset managers, noting that herding behavior can lead to a collapse in the risk premium after a central bank signals low future rates.

uncertainty in the wider economy, all likely occurred around the same time as these unconventional monetary policy announcements.

Compared with the other QE programs, the MEP's focus was on flattening the yield curve. Even though the goal of other QEs was also to stimulate the economy, the MEP had the largest proportion of its purchases of long-maturity securities. This precise focus on the yield curve affords us a "natural experiment" to study the differential impact of the program on firms with different debt maturity structures, making it somewhat easier to interpret the evidence relative to other monetary policy measures during the crisis. Indeed, because movements in the term spread generally reflect broader factors, such as expected business cycle movements or consumption smoothing motives, which might also shape firm behavior, distinguishing the direct impact of the term spread on firm behavior and asset prices from these broader factors can be even more difficult outside of the MEP (Estrella and Hardouvelis, 1991; Wheelock and Wohar, 2009).

To be sure, there are also challenges in interpreting the results using the MEP in our analysis. The motivation for the Federal Reserve's MEP announcement could have been an anticipation of future weakness in those sectors more dependent on longer-term credit. But this anticipatory bias is likely to lead to underestimates of the MEP's impact on asset prices and outcomes for these types of firms. In sum, our efforts to identify better the MEP's impact are aided by the policy's precise focus on the term spread, its well-defined implementation period, and the relative calm surrounding its announcement.

However, considerable care is still required when interpreting the evidence. Economic theory observes that the asset and liability side of a firm's balance sheet is jointly determined, and the asset side of a firm's balance sheet could independently shape how a firm might respond to the MEP. For instance, because firms might match the maturity of their liabilities with the maturity of their assets, those firms that issue longer-term debt might also operate longer-lived assets (Myers (1977). In this case, changes in the term structure brought about by the MEP could have an independent effect on future cash flow and firm value that is separate from the hypothesized external finance channel.

Also, because of contracting and information problems, a firm's maturity structure, as well as its choice between arm's-length and bank financing, can be closely related to the firm's credit rating, the quality of projects chosen by its management, and the information that its management might have about these projects compared to outsiders (Diamond, 1991; Flannery 1986). 8 But the credit rating of a firm or even the market's perception of the quality of a firm's projects could also be alternative channels through which the MEP might affect firm value. Concretely, a firm with projects that generate variable cash flow might both predominantly fund itself with longer-term debt to reduce the risk of inefficient liquidation. It might also expect an increase in demand and higher cash flow on account of a more accommodative monetary policy stance. Thus, any increase in firm value that coincides with the MEP's

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[8] This literature is large, and often points to a nonmonotonic relationship between the choice of maturity structure and these firm level observables. See also Hart and Moore,1994; Berglof and von Thadden,1994; the evidence in Barclay and Smith,1995; and Guedes and Opler, 1996; as well as the survey in Rajan, 2013 and more recent work by Crouzet, 2014.

announcement might stem from the expected increase in demand rather than the hypothesized relaxation in financial constraints.

This endogeneity concern guides our empirical research design. In many of our specifications, we use a large number of firm- and industry-level observables to control for various aspects of a firm's balance sheet. We also use high-frequency data to connect more directly our results to the MEP and a firm's dependence on longer-term debt. We document that those firms more dependent on longer-term debt were also more likely to issue debt during the MEP. And we exploit discontinuities in capital regulation among some of the natural buyers of this type of corporate debt to measure the impact of the MEP on risk premia and portfolio choices. We also provide evidence that those firms more affected by the MEP on account of their capital structure were also more likely to expand employment and investment during the program.

However, it is impossible to address fully this endogeneity concern using firm-level observational data. But by considering a wide range of alternative specifications and developing tests to identify the underlying mechanisms through which the MEP might affect firm outcomes, unobserved firm heterogeneity becomes a less attractive interpretation of the evidence, especially when taken together. That said, another concern stems from the fact that most public databases only coarsely measure the maturity structure of debt. To help address this measurement problem, we report results based on finer proxies for long-term debt dependence (Rauh and Sufi, 2010). In the next section, we describe the data in greater detail.

3. Data

We rely on the cross-firm variation in long-term debt dependence to construct tests of the MEP's impact. To measure this cross-firm variation, most of our baseline tests follow Greenwood, Hanson, and Stein (2010), and define long-term debt as debt with a maturity at issuance longer than one year. Since these tests depend on the variation across firms in their preference for longer-term maturities relative to shorter-term debt—see also Badoer and James (forthcoming)—the baseline measure of long-term debt dependence scales long-term debt by total debt. Also, since the MEP was primarily aimed at maturities greater than one year (Table 1), to match better theory and measurement, we conduct robustness checks using long-term debt dependence with the numerator defined as debt with remaining maturity in excess of three years.[9]

To reduce the risk of biased estimates stemming from the fact that the debt maturity structure of a firm might be correlated with a number of potentially relevant firm characteristics, we include many of the firm level controls common in the corporate finance literature (Badoer and James (forthcoming), Almeida et. al (2011), Gan (2007). Some of these controls include market capitalization, the product of the total number of outstanding common shares and the closing stock price at fiscal year end; total assets; the book-to-market ratio, defined as the ratio of book value of equity over market capitalization. We also include two measures of firm profitability: 1) net income growth is the log growth rate of a

[9] Unfortunately, debt reporting becomes increasingly unreliable in Compustat as maturities increase, and imputations based on longer maturities are less useful. Please see the data appendix for a discussion of these issues.

firm's net income; 2) the return on assets: net income divided by total assets; we also include operating income before depreciation and normalized by lagged total assets. Some specifications also include a firm's average Q to capture a firm's investment opportunity. Average Q is computed as the sum of market capitalization and total assets minus book equity, normalized by lagged total assets. Throughout, financial firms (SIC 6000-6999) are excluded from the sample.

The macroeconomics literature also notes that a firms' sensitivity to a monetary policy shock like the MEP might be related to a potentially broader set of relevant firm characteristics. For example, the capital intensity of a firm might shape its stock price reaction to the MEP, as more capital-intensive firms might be subject to less wage stickiness, and their stock returns might be less volatile in response to monetary shocks (Gorodnichenko and Weber (2013) and Barattieri, Basu, and Gottschalk (2014)). In sum, given that a firm's dependence on long-term debt financing is potentially endogenous, we purposefully include a large set of controls in order to gauge the robustness of these results.

Also, to limit any spurious associations induced by the crisis, we take the historical average of all the control variables through 2007. Some firm-level variables can vary significantly over time—see, for example, the discussion of capital structures in DeAngelo and Roll (2015)—and for robustness, we also try taking the average of the control variables through to Sept. 21, 2011, or just use the last available observation before 2007. All variables are winsorized at the 1% level to eliminate outliers. The data appendix describes the variables in greater detail.

Panel A of Table 2 reports summary statistics for two measures of long-term debt dependence and the key control variables. To make more transparent the challenges to casual inference, Panel B of Table 2 shows the simple and conditional correlations between the control variables and the baseline (one year cutoff) long-term debt dependence measure. There is some evidence that lower Q, more capital intensive and profitable firms tend to depend more on longer-term debt. In what follows then we are careful to include these and a number of other controls in our baseline specification.

4. Empirical Evidence

4.1. The MEP, Long-Term Debt Dependence, and Stock Returns

We first examine whether the MEP's attempt to relax financial constraints affected stock returns. That is, if market participants expected the MEP to relax financial constraints primarily for those firms that traditionally rely on longer maturity debt, allowing these firms to capitalize better on growth opportunities, then abnormal stock returns obtained around the MEP announcement date should be positively correlated with a firm's long-term debt dependence. But if market participants perceived that investors would quickly arbitrage away the MEP's attempt to reduce longer-term yields relative to shorter-term debt, leaving little impact on firm financial constraints, then there should be no statistically significant relationship between abnormal returns and a firm's debt maturity profile. These tests also rely on the fact that markets did not fully anticipate the MEP. If the MEP was anticipated, then these anticipation effects should attenuate the impact of the MEP announcement on stock returns.

Broader macroeconomic trends can also mask the impact of the MEP's announcement. Long-term yields began falling in the summer of 2011, driven in part by developments in Europe, and well ahead of the MEP's announcement. If market participants believed that these broader macro trends would likely account for most of the movements in yields and firms' financing costs, then the MEP's announcement would again be expected to have little impact on the abnormal returns of those firms more reliant on longer-term debt.

Table 3 examines the relationship between abnormal returns and long-term debt dependence. Column 1 presents the most parsimonious specification: A simple OLS regression of abnormal returns of firms on Sept. 22, 2011 on firms' long-term debt dependence. Abnormal stock returns are obtained from a standard one factor model (MacKinlay, 1997), and long-term debt dependence is defined as the ratio of debt with a maturity greater than one year to total debt; for each firm, this ratio is averaged through the history of the firm up through Dec. 31, 2006. Throughout, standard errors are clustered at the three-digit SIC level.

Consistent with the preferred habitat hypothesis, and some of the evidence in the literature on financial constraints and stock returns—see for example Whited and Wu (2006)—the coefficient estimate is positive and statistically significant. A one standard deviation increase in the long-term debt ratio of a firm is associated with a 0.26 percentage point higher abnormal return, which is about 93% in annualized term. To distinguish these results from purely sectoral effects, where some sectors are more affected by the announcement of the MEP than others, we include sector (SIC three-digit) fixed effects in the regression in column 2. The coefficient estimate is even bigger after controlling for sector fixed effects. We should note however that when replacing the baseline measure of long-term debt dependence with the ratio of long-term debt to assets, this coefficient is negative. Scaling long-term debt by assets is a less informative measure of a firm's preference for longer-term debt financing relative to its total debt financing, and these results are available from the authors.

A firm's capital structure closely relates to the nature of its assets and the industry in which the firm operates, and these results could be driven by unobserved balance sheet factors. For example, the stock price reaction to changes in the term spread might vary depending on the size of the firm or its relative "growth potential". To control for some of these characteristics, we compute the historical average of market capitalization and book-to-market ratio of firms. As before, we calculate the average through the whole history of each firm up until Dec. 31, 2006. Column 3 of Table 3 shows that the results are very similar.

We now include a veritable kitchen sink of firm-level observables to gauge the robustness of these results. Column 4 controls for firm leverage; the impact of leverage on abnormal returns is positive and the coefficient on long-term debt dependence remains significant. In addition to leverage, we add the total assets of a firm to measure better firm size. Column 5 also includes various measures of profitability; the firm's "investment opportunities"; dependence on external financing; short-term financing, and capital intensity. The coefficient on long-term debt dependence remains unchanged throughout.

In reacting to the MEP's announcement, market participants may have been influenced by more recent firm-level information than those observed pre-2007. As an additional robustness exercise, we use the last available observation of the control variables before Sept. 21, 2011 in column 6, instead of the historical average. And in column 7, the historical averages for all variables are computed using observations before the announcement of the MEP; we thus include the financial crisis. Across these various specifications, the impact of long-term debt dependence on abnormal returns the day after the MEP announcement remains positive and significant.

We have seen that the relationship between long-term debt dependence and abnormal stock returns is robust to most firm-level controls, but one competing explanation is that these firms are just more sensitive to monetary shocks more generally. As shown by Kuttner (2001), Bernanke and Kuttner (2005), and Gürkaynak et al. (2005), among others, stock prices react to unexpected monetary shocks. And to some extent, the MEP is an unexpected monetary shock, as measured by the changes in the prices of the federal fund futures. If our measure of long-term debt dependence captures the sensitivity of firms' response to monetary shock, these results could merely be a consequence of the differential effects of an unexpected monetary shock to short-term interest rates on firm value.

This interpretation is belied by the fact that the magnitude of the unexpected shock on the federal funds rate is small (about 0.8 basis points), and this shock occurred on Sept. 21, 2011, rather than on Sept. 22, 2011—the day the yield curve flattened the most. But to address more directly this concern, we include a control variable called "monetary shock sensitivity" in the regression. Following Gorodnichenko and Weber (2013), this monetary shock sensitivity variable is the slope coefficient estimates from firm-by-firm regressions of stock returns on unexpected monetary shocks over the period between 1980 and 2010. These slope coefficients capture the sensitivity of a particular firm's stock return to unexpected monetary shocks. The long-term debt dependence coefficient remains large and statistically significant (column 8).

Finally, our baseline measure of long-term debt—debt with a maturity greater than one year—has the widest coverage in public databases and is likely to have been the focus of investor attention as markets tried to parse the impact of the MEP on firms. Nevertheless, the MEP primarily affected yields at maturities longer than a year, and in column 9, we define long-term debt dependence as the ratio of debt with a maturity in excess of three years to total debt. The coefficient remains positive but unfortunately statistically insignificant. This can be a result of the noisy measure of debt with longer maturity cutoff than one year. We discuss this issue in the appendix.

4.1.1 Alternative Dates

While it seems unlikely that the results in Table 3 are driven by latent firm-level factors, they might be driven by events other than the MEP. In this subsection, we consider a number of additional tests to check whether the relationship between long-term dependence and abnormal returns is unique to Sept. 22, 2011 or also appear around dates unrelated to the MEP. Using the baseline specification in column 8 of Table 3 we first plot the long-term debt dependence coefficient estimate for a 10-day window around the Sept. 22, 2011 event date. The red line in Figure 2 plots the coefficient point estimate on each day in that window and the shaded area indicates the 95% confidence interval. The coefficient is statistically significant only on Sept. 22, 2011 at the 5% level. This gives us some confidence that the MEP affects firms on the day the yield curve flattens the most and that these results are not driven by other proximate events.

In addition to the placebo test previously described, we also report the regression results for a 10-day window around some other dates. The first set of these dates corresponds to the period around the MEP's announcement, namely around Sept. 22, but for the three years nearest our event: 2009, 2010, and 2012. The second set of dates is the two announcement dates for quantitative easing: Nov. 3, 2010 (QE2), and Sept. 13, 2012 (QE3). The reason that we exclude the announcement date of QE1 is that the Fed announced QE1 in 2008 during the financial crisis. Since the computed abnormal returns in our analysis are predicted residuals of a one-factor model using historical data one year in advance, the residuals are not reliably predicted during extreme market turbulence, and we exclude 2008 from the placebo test here.

Table 4 shows the results of these various placebo tests. In Panel A of Table 4, we run the same regression for the 10-day windows around the same time of year in 2009, 2010, and 2012. The exact date is either Sept. 20, 21, or 22, depending on weekends. No coefficient estimates are statistically significant at the 5% level. In Panel B, we include the announcement dates of QE2 and QE3 in addition to the previous results for the MEP. Out of all these dates, only the coefficient estimate for Sept. 22, 2011, is statistically significant at the 1% level. Two coefficient estimates are marginally significant at the 5% level. The coefficient estimate is marginally significant but negative on Nov. 8, 2010, three days after the announcement of QE2. One explanation for why we do not see significant announcement effects in the case of QE2 or QE3 is that those announcements might have been anticipated by financial markets.[10]

4.1.2 Intra-day Data

The positive association between abnormal returns on Sept. 22, 2011, and long-term debt dependence appears robust to a large number of firm-level controls, and there is little evidence of any such positive association on days unrelated to the MEP. However, using a finer temporal dimension based on intraday stock returns can further exclude alternative explanations and help reveal better how financial markets might process complex news. Panel B of Figure 1 already suggests that bond markets might have taken some time to react to the MEP. Given that the Fed announced the program at 2:23 p.m., Sept. 21, 2011, and the market closed at 4 p.m., if indeed investors needed time to digest the announcement, then the main hypothesis would predict that the relationship between abnormal returns and long-term debt dependence should become increasingly positive during early trading on Sept. 22, 2011.

To test this prediction, we use high frequency stock returns from the NYSE TAQ database. We compute 30-minute log returns for each stock between 9:30 a.m. and 4 p.m. on each day; for the 9:30 a.m. observations, we compute the return using the opening price of the day and the closing price of the previous trading day. We next obtain abnormal returns by using a one factor model-controlling for S&P 500 returns-over the base period 9:30 a.m. Aug. 22, 2011, through 4 p.m. Sept. 16, 2011, for each stock.[11] From this baseline factor model, we compute abnormal returns for every 30-minute interval for the trading days of Sept. 21 and Sept. 22, 2011. Finally, we regress cumulative abnormal returns during those two trading days on the long-term debt dependence variable along with all the control variables

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[10] See for example the press commentary ahead of QE3: http://www.washingtonsblog.com/2012/09/the-fed-is-expected-to-launch-qe3-next-week.html; as well as Krishnamurthy and Vissing-Jorgensen (2011).

[11] High-frequency data allow for the calculation of reliable correlations over a far shorter horizon that required by daily data. For example, Huang, Zhou and Zhu (2009) use equally spaced 30-minute returns over a range of time horizons from one week to one quarter.

from our baseline specification in column 8 of Table 3; industry fixed effects (SIC-3) are included and standard errors are clustered at the SIC-3 level.

Panel A of Figure 3 plots the coefficient estimates for long-term debt dependence and the corresponding 95% confidence intervals for each 30-minute interval over the two trading days. Consistent with the idea that market participants might have gradually begun to expect the MEP to relax financial constraints primarily for those firms that traditionally rely on longer maturity debt, the coefficient fluctuated around zero on Sept. 21 but then began rising when trading resumed on Sept. 22. The point estimate kept rising until around 11 a.m. on Sept. 22, before plateauing for the rest of the trading day. This pattern is consistent with the idea that investors might have only gradually digested news of the MEP, adjusting their valuations throughout the morning of Sept. 22.

Narrowing the frequency of analysis down to 30-minute time intervals helps to exclude a number of alternative explanations, but at this level of granularity we need to consider possible confounding effects due to major economic news and policy announcements on that day. To this end, we did a search on Bloomberg news and found three economic releases on Sept. 22. The Department of Labor released the U.S. jobless claims data at 8:30 a.m. The released number was at 423,000 for the week ended on Sept. 17, 2012, which was very similar to those of the previous few weeks with the four-week moving average at 421,000 and the number was also within the range of forecasts by economists (408,000 to 430,000). The Conference Board released its monthly Leading Economic Index for the U.S. at 10:00 a.m. The index increased 0.3% in August to 116.2, following a 0.6% increase in July and a 0.3% increase in June. The Federal Housing Finance Agency (FHFA) released its monthly House Price Index for July at 10 a.m. The index increased 0.8% for July, compared with 0.7% and 0.3% increases for June and May, respectively.

None of the aforementioned three is a major economic release and all the numbers were seen to be well within the range of expectations. The Conference Board index, for example, is computed using economic data that were already released in the previous month, and hence the released number was likely to have been already anticipated. Also, the jobless claims and the Conference Board index are both indicators of aggregate economic activity, which are already absorbed in our event study regressions through the S&P 500 factor. It is also unclear theoretically why the impact of these announcements on firm value should vary depending on the maturity structure debt.

The FHFA index release was also not a major surprise, with housing market conditions slowly improving. But given the importance of housing-related news after the crisis, we report estimates from the high-frequency event study regressions excluding observations from the construction industry (SIC 1500-1799).[12] Panel B of Figure 3 shows that the results are almost unchanged compared with those in Panel A. Finally, instead of using the ratio of debt with a maturity in excess of one year to total debt, as a further robustness check, we replicate the analysis in Panel A but use debt with a remaining maturity in excess of three years as the numerator in this alternative measure of long-term debt dependence. The coefficients are quantitatively similar, though somewhat less precisely estimated (Panel C of Fig. 3).

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[12] In all regressions, we already excluded firms in the real estate industry as a part of the financial sector.

4.2. The MEP, long-term debt dependence and corporate bonds

We have already seen evidence that upon the MEP's announcement, firm value increased disproportionately among those firms more dependent on longer-term debt. But a determined skeptic might nonetheless argue that the change in firm value does not reflect the causal impact of the policy on financial constraints and valuation but instead reflects latent news that also coincided with the MEP's announcement, or unobserved firm heterogeneity that correlate with long debt dependence. Even if the increase in firm value causally reflects the impact of the MEP's announcement on equity prices, the evidence is still silent on whether the MEP actually relaxed firm financial constraints in practice for those more dependent on longer-term debt and whether the policy influenced employment or investment decisions. We now develop these tests.

We begin with the idea that if the MEP affected the cost of longer-term external finance, then firms more reliant on this type of external finance would be more likely to issue longer-term debt during the MEP's implementation period relative to other periods. That is, to the extent that corporate bonds are close substitutes for longer-term Treasuries, the gap-filling hypothesis would predict that when Fed purchases reduce the supply of long-term Treasuries, firms with a preference for longer-term debt, or with the financial flexibility to adjust easily the maturities of their issuances, will increase the supply of longer-dated corporate bonds.

We also consider tests of the "reach for yield" hypothesis and bond risk premia. Low nominal interest rates, and the expectation that low rates might persist, can also create incentives for certain types of creditors to take added risk in an effort to reach for yield, affecting risk premia and the supply of credit. Investors, for example, with a focus on current income and a need to hold longer-term assets in order to match the duration of their liabilities, such as life insurance firms, could rebalance their bond portfolios in favor of more credit risk when longer-term interest rates are expected to remain low for an extended period.

4.2.1 Bond issuances

This subsection investigates the MEP's potential impact on bond issuances. The basic test uses a difference-in-difference estimation strategy to examine whether the stock of longer-duration debt rose faster during the MEP's implementation at firms with a preference for issuing this kind of debt. The data are observed annually from 2007 to 2013, and the dependent variable in column 1 of Table 5 Panel A is the growth in the stock of long-term debt—debt with maturity over one year—observed for the panel of firms. We create a dummy variable to capture the implementation of the MEP program; it equals one if a firm-year observation falls between Jan. 1, 2012 and Dec. 31, 2012, and zero otherwise.[13]

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[13] The reason that we use the 2012 calendar year for the post event period is twofold. First, the MEP was announced toward the end of 2011 and expired at the end of 2012. It might take some time for the firms to adjust their borrowing and investment, and the reported financials for 2011 may not fully reflect the effects of the MEP. Second, firms report financials on different dates of a year and many firms' fiscal years end in December. Using the 2012 calendar year thus likely includes the most updated financial information in 2012—the full year in which the MEP was in effect.

The key variable of interest is the interaction between this dummy variable and a firm's long-term debt dependence: If the MEP disproportionately increased bond issuances for firms more reliant on longer-term debt, then we would expect this coefficient to be positive. As always, we use the historical average before 2007 to avoid any potential endogenous firm responses to large scale asset purchases and the crisis. We use a full suite of firm controls in the regressions. These controls include the historical averages of the same variables as in column 8 of Table 3, all interacted with the MEP indicator variable; we also allow these variables to vary linearly over time in the panel to control for time-varying firm characteristics. Firm and year fixed effects are also included in all regressions.

We find evidence consistent with gap-filling behavior. The point estimate in column 1 of Table 5 suggests that a one standard deviation higher long-term debt ratio is associated with about an 8% faster growth in the stock of long-term debt during the MEP's implementation. The unconditional mean of the growth rate in the stock of long-term debt during the sample period is about 5%. As a falsification test, in column 2, the coefficient estimate for the growth in short-term debt is not statistically significant, giving us some confidence that the effect of the MEP operates through longer-term borrowing.

Building on Greenwood, Hanson, and Stein (2010) and the evidence in Badoer and James (forthcoming) we examine whether firm financial constraints help to shape the bond issuance response to the MEP. That is, the bonds of less financially constrained firms are likely to be the closest substitutes for US Treasuries (Graham, Leary and Roberts, 2014). And among those firms that rely more on longer-term debt, the ones that are also less financially constrained—those for instance that are large and have ready access to the bond market—should evince a greater supply elasticity, making use of their relatively greater financial flexibility in order to increase more rapidly their longer-term borrowings during the MEP relative to firms with less flexibility.

Panel B of Table 5 investigates this hypothesis. Our baseline measure of financial constraints come from Hadlock and Pierce (2010) which suggests that firm size and age are useful predictors of financial constraint levels[14]. The relationship between these two variables and Hadlock and Pierce (2010)'s indicators of financial constraints becomes flat at certain points, and those authors use a simple index to model this non-linearity, with a higher index value implying a more financially constrained firm. The size-age index suggests that financial constraints decline sharply as young and small firms mature and grow. The index also has the advantage that age and size are not easily adjustable in the short run, and are less likely to be endogenous.[15]

Using the same specification as in column 1 of Panel A, column 1 of Panel B restricts the sample to those firms below the 75th percentile of financial constraints age-size index. Column 2 repeats the exercise for those firms above the 75th percentile of the index—the more financially constrained

[14] Details of constructing the index are in the appendix.

[15] In contrast, common proxies such as cash holdings can be more difficult to interpret. To wit, while a large stock of liquid assets such as cash might relax external financial constraints, it might also be indicative of these very constraints, as a firm that expects to face limited access to external finance might accumulate cash.

sample. The differences across the two samples suggest that those firms that rely more on longer-term debt and that are less financially constrained may have been able to increase more rapidly their longer-term borrowings during the MEP. That is, in column 2 the point estimate on the interaction term between the MEP and long-term debt dependence is insignificant and about 22 percent smaller than the coefficient obtained in column 1, which itself is significant.

To examine further these differences, column 3 uses the full sample and introduces a series of interaction terms to the baseline specification. Specifically, column 3 interacts the MEP indicator variable with the age-size index; it also adds a triple interaction term, consisting of long-term debt dependence, the MEP indicator and the age-size index; the index itself is linearly absorbed in the firm fixed effect, and long-term debt dependence continues to be interacted with the MEP indicator variable. The coefficient on the interaction term between the MEP and long-term debt dependence remains positive, but the triple interaction term is negative, suggesting that the supply elasticity of long-term debt in response to the MEP might be larger among less constrained firms. Finally, in results available from the authors, we also replicate the sample splits using various other indicators of financial constraints, such as cash flow to assets, cash balances to assets, Tobin's Q and market capitalization.[16] We generally find a higher supply elasticity among the less financially constrained firms when using these alternative indicators.

Changes in a stock variable can imperfectly measure the response of firms at the extensive margin, and we now use data on corporate bond issuances from the Mergent FISD database to measure better the connection between the MEP and bond issuances. The database covers most corporate bond issuances, recording information about the issuer, offering date, maturity, and issuance amount. We use this information to study whether firms that are more reliant on longer-term debt are more likely to issue debt during the MEP. We measure the extensive margin by aggregating the issuance data up to the firm-calendar year level, merging the FISD data with the Compustat file by CUSIP and company names. This merge results in a match of 2,517 firm years, and it allows us to test whether the MEP is associated with a change in the probability that a firm issues a bond.

In column 1 of Table 6 Panel A, the dependent variable equals 1 if a firm issued a bond of any maturity in the calendar year and 0 otherwise.[17] The key variable of interest remains the interaction between the MEP implementation period indicator variable—equal to 1 for calendar year 2012 and 0 otherwise—and a firm's long-term debt dependence, as measured up through 2007; year fixed effects are the only other controls, and the sample period is 2007--2013. The evidence suggests that the MEP is associated with a higher probability of issuing a bond, especially for those firms more reliant on longer-term debt. In this most parsimonious specification, the point estimate in column 1 suggests that moving from a firm at the 25th to 75th percentile of long-term debt dependence is associated with a 0.013

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[16] The literature on firm financial constraints is large, and offers a diverse range of approaches to measuring financial constraints. See for example Faulkender and Petersen (2006); Farre-Mensa and Ljungqvist (2014); Fazzari, Hubbard and Petersen (1988); Hoshi, Kasyhap and Scharfstein (1991); Kaplan and Zingales (1997); Whited and Wu (2006).

[17] Corporate bonds usually have very long maturity. In our sample, over 90% of bonds issued have maturity of 30 years or longer.

increase in the probability of a bond issuance in 2012; the unconditional probability of a bond issuance is 0.31 over the sample period.

A firm's past decision to issue debt could potentially bias these estimates, and column 2 includes the one-year lag in the issuance decision as a control variable. The results remain unchanged in this autoregressive specification. Column 3 controls for time invariant firm unobservables using firm fixed effects, while column 4 retains firm fixed effects and interacts the full suite of firm-level controls with the MEP indicator variable in order to gauge further the robustness of these results; these controls are linearly absorbed in the firm fixed effects. Finally, Panel B of Table 6 examine whether these results vary depending on financial flexibility. The estimates are somewhat noisier and the impact of financial constraints in shaping the supply elasticity is inconclusive in these tests.

4.2.2 Reaching for yield

This subsection develops tests of the MEP's impact on "reach for yield" behavior using institutional features of the insurance industry. We have already seen evidence of gap-filling behavior by nonfinancial firms during the MEP, but some arguments observe that by engendering expectations of persistently low long-term rates, the MEP could provide incentives for certain types of creditors to take on added risk in an effort to reach for yield. This "reaching for yield" behavior can in turn shape risk premia and the supply of external finance. Insurers and the capital regulations that govern the industry provide an especially helpful context in which to investigate further this mechanism. Insurers are major buyers of corporate bonds, accounting for about 60% of all corporate bonds held by institutional investors. And there is already evidence that the industry as a whole might engage in reach for yield behavior (Becker and Ivashina, 2014).

The empirical tests in this subsection builds on the fact that insurance companies, like banks, are subject to risk-adjusted capital requirements on their investments. These requirements, which are coordinated through the National Association of Insurance Commissioners (NAIC), are based on the bond rating of the investment and increase sharply and discontinuously as the credit quality of the asset declines. For instance, regulations require that insurers maintain $0.30 of equity capital for each $100 invested in NAIC Category 1 bonds—those rated AAA through A-, excluding Treasuries. But for Category 2 bonds, those rated BBB+ to BBB-, the capital requirement triples.

Our empirical tests exploit this discontinuity in the regulatory capital requirement between Category 1 and Category 2 bonds. Among Category 1 bonds, those rated A- potentially afford the highest yield for the same capital requirement. Therefore, if the MEP and the associated forward guidance aimed at depressing longer-term rates also induced a greater "search for yield" among insurers, then the relative demand for A- debt should rise during the MEP, with a corresponding drop in the risk premia for A- bonds.[18]

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[18] We constructed NAIC bond credit ratings from the credit ratings assigned by the three major credit rating agencies and provided by Mergent's Fixed Income Securities Database (FISD). Following the NAIC procedure as applied by Becker and Ivashina (forthcoming), we use the median credit rating when all three ratings are available,

The results in Table 7 appear consistent with the reaching for yield hypothesis. For those firms that issued debt during the sample period, in Panel A of Table 7 we compute the risk premium associated with each bond at issuance: The spread between the bond's offering yield and the corresponding Treasury yield of the same duration. Using this risk premium as the dependent variable, in column 1 we restrict the sample to NAIC Category 1 bonds. To test for the impact of reach for yield behavior during the MEP, we then interact an indicator variable for A- bonds with the MEP dummy variable. The coefficient on the interaction term gives the difference-in-difference effect on the bond risk premium of an issue having an A- rating during the MEP period. We also include time and issuer (firm) fixed effects in addition to firm-level time-varying covariates from Table 5, along with key bond characteristics such as the maturity, rating, and issuance size.

The interaction coefficient is statistically and economically significant. Among Category 1 bonds, those rated A- were associated with a roughly 25% lower risk premium during the MEP period. Column 2 reports the same specification adding interaction terms between the MEP indicator variable and all the firm-level covariates, so that the coefficient on the interaction term reflects the discontinuity in ratings during the MEP holding firm-level fundamentals fixed. The results are unchanged.

However, rather than identifying reach for yield on account of the MEP and the attendant forward guidance committing to low long-term rates, these results might simply reflect a more general decline in credit spreads. For example, developments in Europe around this time might have reduced policy uncertainty, lowering all credit spreads in general, or perhaps especially for high-yielding debt. In column 3, we consider a sample of all Category 1 bonds plus BBB+ bonds—the highest-rated Category 2 bonds—and examine whether spreads on BBB+ bonds fell during the MEP relative to Category 1 bonds. We find no evidence that spreads on these higher-yielding bonds that also absorb more regulatory capital fell during the MEP's implementation. Even when broadening the sample to all Category 1 and Category 2 bonds, there is no evidence that spreads fell during the MEP for the highest-yielding bonds: BBB- (column 4). In contrast, even among this same sample, spreads fell significantly for A- debt (column 5), suggesting that this regulatory discontinuity in capital regulations might have allowed insurers to increase yield while conserving capital.

Consistent with the results in Panel A of Table 7, the aggregate evidence in Figure 4 suggests that the MEP might have also affected the quantity of A- debt purchased by the insurance industry. Figure 4 plots the share of A- rated debt in their Category 1 holdings for insurers. This share remained relatively flat the previous decade at around 5%. But it nearly triples between 2008 and 2011, and increases sharply in the period around the MEP before dropping in 2013, after the expiration of the MEP.

In search of more detailed evidence on quantities, Panel B of Table 7 links the MEP to insurer portfolio decisions. The logic of these tests builds on the idea that those insurers generally more dependent on income from Treasury securities would be more affected by the MEP's attempt to lower long-term Treasury yields for an extended period. These firms would in turn have a greater incentive to

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and the minimum credit rating when only two ratings are available.

reach for yield by tilting their bond portfolios towards riskier, higher yielding assets in response to the MEP and the prospect of persistently low long-term Treasury yields and the expected loss of income.

To implement this test, we collected data from insurance companies' annual statutory filings provided by SNL Financial on their bond holdings along with other income statement and balance sheet variables over the period 2004-2013. The dependent variable in column 1 Panel B of Table 7 is the fraction of A- debt in the insurer's bond portfolio. The key variable is the interaction between the MEP indicator and the ratio of income earned from Treasury securities to total earned income, where we average the ratio over the years before the crisis: 2004--2006. To limit the potential for biased estimates, we also control for a number of potentially relevant insurer characteristics. These include the log of the insurer's size, as measured by the total par value of all securities in the general account portfolio; the weighted average duration of the portfolio—up to a quadratic term; and the weighted average credit rating of the portfolio. These variables are observed annually and are also interacted with the MEP indicator. In addition, to control for persistence in portfolio allocation choices, we also interact the share of A- debt in the bond portfolio, averaged over 2004-2006, with the MEP indicator. Throughout, we also include year and insurer fixed effects and cluster standard errors at the insurer level.

The coefficient on the interaction term between the MEP and the pre-crisis ratio of income earned from Treasury securities is positive and significant. It suggests that during the MEP, a one standard deviation increase in the share of income derived from Treasuries is associated with a 1.25 percentage point or 0.23 standard deviation increase in the share of A- securities. To gauge further the robustness of these results, column 2 interacts the MEP with a number of pre-crisis observables; these variables are again linearly absorbed in the insurer fixed effect. The coefficient on the Treasuries interaction term remains significant and is little changed.[19]

We now focus on the extensive margin. The dependent variable in column 3 is the share of new A- securities divided by all new securities purchased in the same calendar year. The interaction between the Treasury-dependence variable and the MEP is significant and positive and larger than before. It suggests that a one standard deviation increase in the Treasury dependence variable is associated with a 2.46 percentage point or 0.45 standard deviation increase in the share of A- securities in total securities purchased in the calendar year. Column 4 includes the additional interaction terms with the other pre-crisis variables. The main result is little changed. When taken together, both the evidence on bond spreads and insurer bond holdings suggest that the MEP might have increased the demand for risker corporate debt.

[19] Ellul et al (forthcoming) show that insurer capital ratios along with accounting rules might have shaped insurer trading behavior during the financial crisis. Our results are also robust to including insurer pre-crisis capital ratios interacted with the MEP, and these results are available upon request. Also, Merrill et al (2014) suggest that insurer demand for riskier structured finance products before the financial crisis might have been driven by their issuance of guaranteed annuities. Our results are again robust to including a measure of annuities issuances before the crisis interacted with the MEP indicator.

4.3 Firm Outcomes

This subsection investigates the other dimensions through which the MEP might have affected firm behavior. In particular, we have seen that the MEP's impact on the yield curve might have shaped the cost and availability of credit disproportionately for those firms with a preference for longer-maturity borrowing. A key implication of these results then is that any relaxation in financial constraints for these firms might have also allowed them to take advantage of growth opportunities, leading to more investment and employment at firms more dependent on longer-term debt during the MEP (Adrian, Colla and Shin, 2013; Becker and Ivashina, forthcoming). Alternatively, absent good investment opportunities but amid continued economic and policy uncertainty in the aftermath of the crisis, firms could have also responded to the MEP induced decline in borrowing costs by holding more cash or repurchasing shares (Bates, Kahle, and Stulz, 2009).

We investigate these hypotheses using a similar difference-in-difference framework as before. The key variable of interest is the interaction between the MEP and a firm's long-term debt dependence measure, as measured before 2007. We continue to interact the full suite of other firm-level controls with the MEP indicator variable to measure more accurately the impact of long-term debt dependence on firm outcomes during the MEP. The panel structure also allows firm fixed effects to absorb firm level time invariant heterogeneity, along with year fixed effects. Time varying firm characteristics are also included as in the previous sections, and we cluster standard errors at the firm-year level.

Using the sample of public firm-year observations from 2007 to 2013, the dependent variable in Panel A column 1 of Table 8 is the growth in spending on plant, property, and equipment. The coefficient on the interaction term between the MEP and long-term debt dependence is positive and significant at the 5% level. The point estimate suggests that an increase of one standard deviation in long-term debt dependence is associated with a 2.1 percentage point increase in the growth in PPE expenditures during the MEP. The unconditional mean of the growth in PPE expenditures is about 4.7% during the sample period. In column 2, we use the growth in the number of employees as the dependent variable. We compute these from employee data reported in firms' annual reports. Again, we find significant evidence that those firms more dependent on longer-term debt may have expanded employment at a faster pace during the MEP. In this case, an increase of one standard deviation in long-term debt dependence is associated with a 1.4 percentage point increase in employment growth during the MEP. The unconditional mean of the growth in employment is about 1.9% during the sample period.

In Panel A column 3 of Table 8, the dependent variable is the growth in cash holdings. The interaction term between the MEP and long-term debt dependence is not significant, and there is little evidence of the precautionary motive. We also find no evidence that firms' more dependent on longer-term debt engaged in significantly higher levels of dividends and share buybacks during the MEP.[20] As a robustness check, Panel B of Table 8 uses the noisier but potentially more relevant measure of long-term debt dependence: the ratio of debt with a maturity greater than three years to total debt (observed before 2007). The main results are unchanged, though the interaction term between the MEP

[20] The details of constructing these variables are provided in the data appendix.

and long-term debt dependence is significant at the 10 percent level in the case of cash holdings (column 3).

Among those firms more dependent on long-term debt, there is some evidence that firms with greater financial flexibility evinced a greater supply elasticity with respect to the "gap" in longer-dated maturities created by the MEP. Therefore, if the investment and employment results stem from the increased availability of external funds during the MEP, then the coefficient on the interaction term between the MEP and long-term debt dependence should be largest for the sample of firms with greater financial flexibility; these firms after all were more likely to access external funds during the MEP.

Using the growth in spending on plant, property, and equipment as the dependent variable, Panel C of Table 8 examines whether the coefficient on the interaction term between the MEP and long-term debt dependence varies by the degree of firm financial flexibility. As before, we rely primarily on the Hadlock and Pierce (2010) age-size index of financial constraints. From Panel C, the evidence is suggestive that the MEP's impact might have been larger among less financially constrained firms. Among those firms in the top quartile of the age-size index—recall that higher values suggest greater financial constraints—the interaction term between long-term debt dependence and the MEP is both small and statistically insignificant (column 2). Yet, for firms outside the top quartile, the point estimates are economically and statistically meaningful (column 1). Column 3 suggests that these differences across the two samples are statistically significant. In contrast, the remaining columns of Panel C indicate little difference in the employment response to the MEP across these two groups.

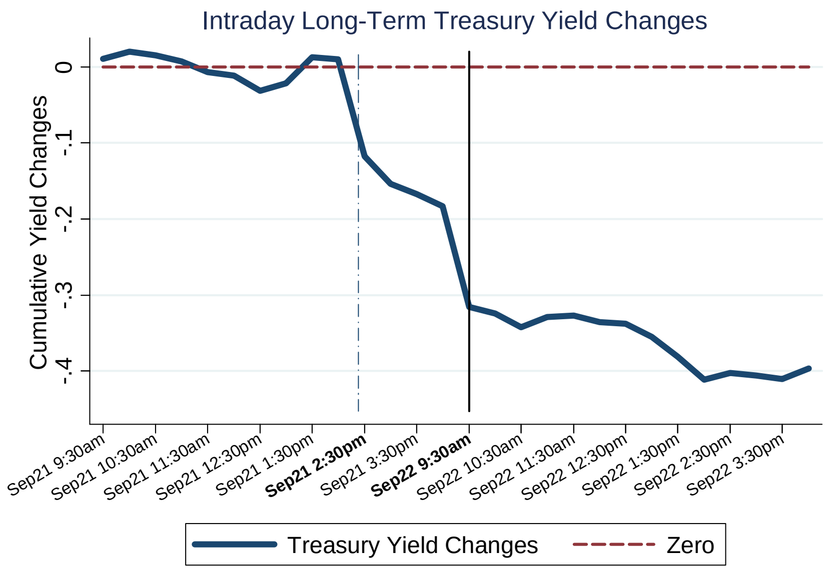
5. Conclusion

Despite the extensive literature focused on the impact of unconventional monetary policy on asset prices, little is known about whether these programs are effective in stimulating real economic activity or the underlying mechanisms through which they might work. The current paper fills this gap by examining the impact of the maturity extension program on firms' financial constraints. Consistent with the Federal Reserve's forward guidance, and those theories that emphasize limits to arbitrage and segmentation in the bond market, we first document that abnormal returns around the MEP's announcement were higher among firms more dependent on longer-term debt. That is, financial markets seemed to anticipate that the MEP would help disproportionately relax financial constraints for this set of firms. In keeping with this expectation, we find that these firms issued more long-term debt during the MEP's implementation. These firms also appeared to have expanded employment and investment faster during the MEP. Also, among the set of firms more reliant on longer-term debt, these responses to the MEP are somewhat more pronounced for those with greater financial flexibility, as measured by the size and age of firms.

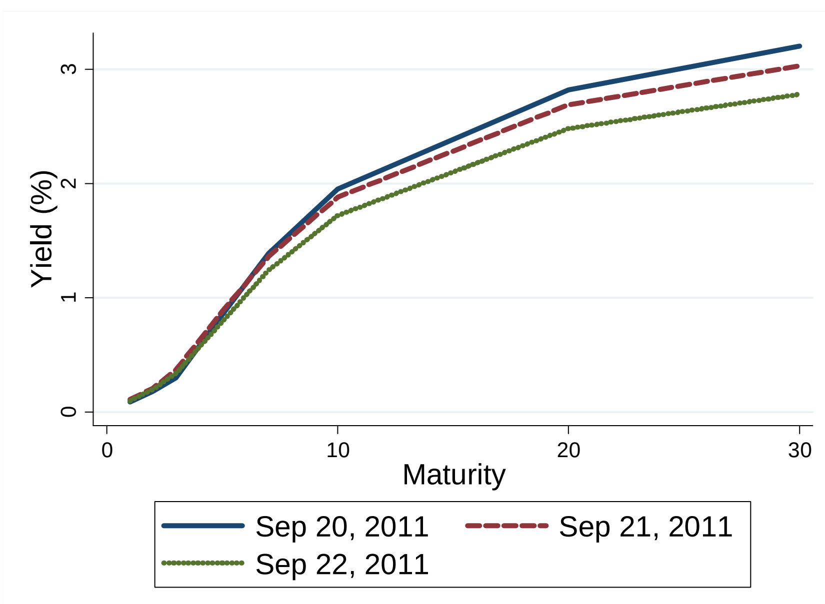
But we also find some evidence of reach for yield behavior. Credit spreads fell disproportionately for firms issuing longer-term riskier debt during the MEP, and those insurance companies more reliant on income from Treasuries appeared to have increased their holdings of riskier corporate debt during the MEP. When taken together, the MEP might have been effective in relieving financial constraints and stimulating economic activity in the aftermath of the crisis for some types of firms. But the reach for yield evidence also suggests that these policies could affect the pricing of risk in bond markets. We leave it to future research to understand better the longer-term implications of these policies for bond markets and other asset classes.

Figure 1. The MEP and bond yields.

Panel A of Fig.1 plots the yield on the 30-year (solid line) and one-year Treasury (red dashed line) over a 17 day window, centered on the MEP's announcement date (Sept. 21, 2011), which is indicated by the vertical dashed line. Data source: U.S. Treasury, accessed through: https://www.treasury.gov/resource-center/data-chart-center/interest-rates/Pages/TextView.aspx?data=yield



Panel B of Fig.1 plots the cumulative change in the 30-year Treasury yield at 30-minute intervals over Sept. 21 and 22, 2011. The vertical dashed line indicates the announcement time of the MEP at 2:23 p.m. on Sept. 21, 2011. The solid vertical line indicates the stock market opening time of Sept. 22, 2011. Data source: Trade and Quote database accessed through Wharton Research Data Services (WRDS), wrds-web.wharton.upenn.edu/wrds/about/databaselist.cfm



Panel C of Fig. 1 plots the Treasury yield curve over a three-day window centered on Sept. 21, 2011. Data source: U.S. Treasury, accessed through: https://www.treasury.gov/resource-center/data-chart-center/interest-rates/Pages/TextView.aspx?data=yield

Figure 2. Coefficient estimates around the event date

Fig. 2 plots the long-term debt dependence point estimates and confidence bands obtained from a series of daily regressions, for a 10-day window around Sept. 22, 2011, the event date, which is indicated by the vertical line. The regression specifications are based on column 8 of Table 3, which regresses abnormal returns for a given day on long-term debt dependence and the set of controls from column 8 of Table 3. Standard errors are clustered at the three-digit SIC level. Data sources: Center for Research in Security Prices (CRSP), CRSP/Compustat Merged Database, accessed through Wharton Research Data Services (WRDS), wrds-web.wharton.upenn.edu/wrds/about/databaselist.cfm

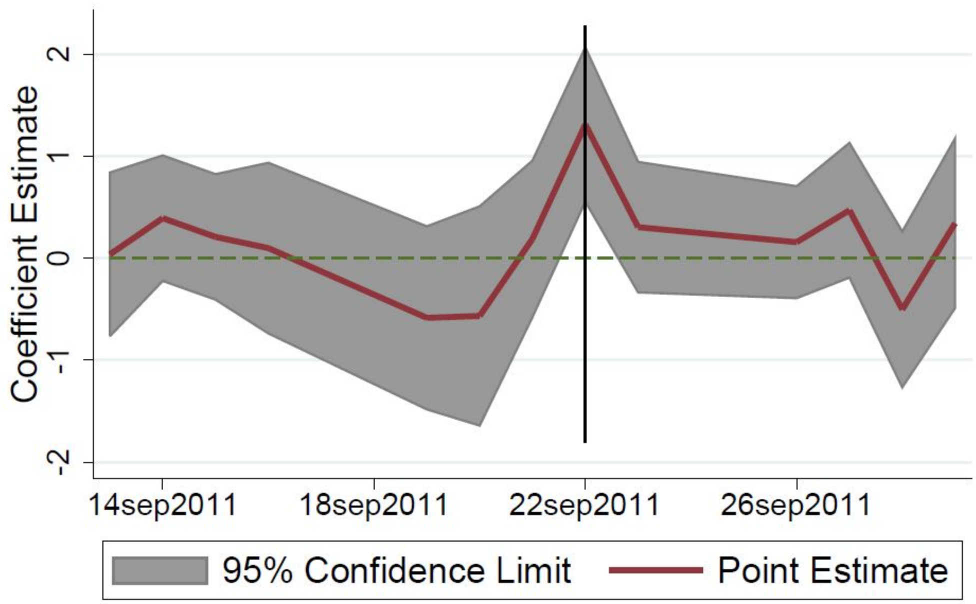
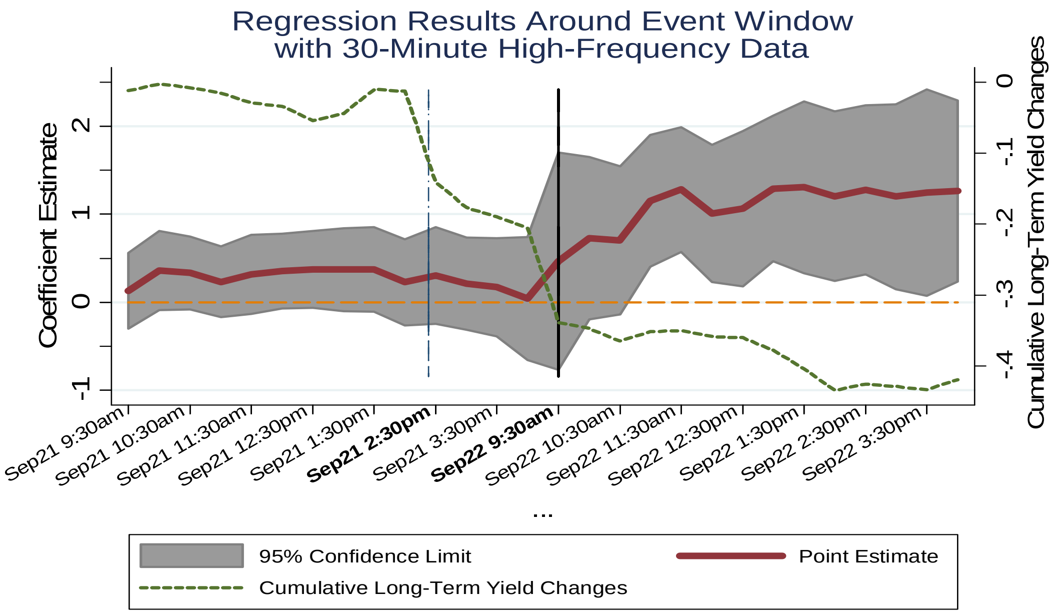
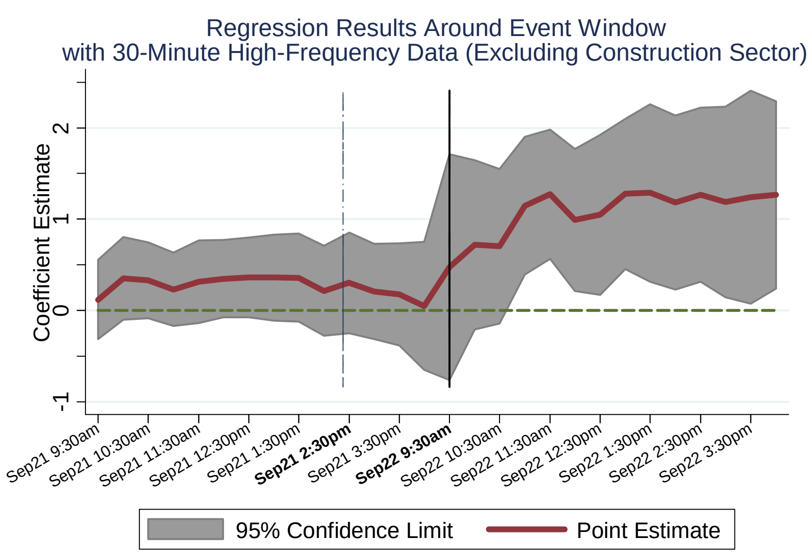


Figure 3. Abnormal Returns and Long-term Debt Dependence, Sept. 21, 9:30 a.m.--Sept. 22, 4 p.m.

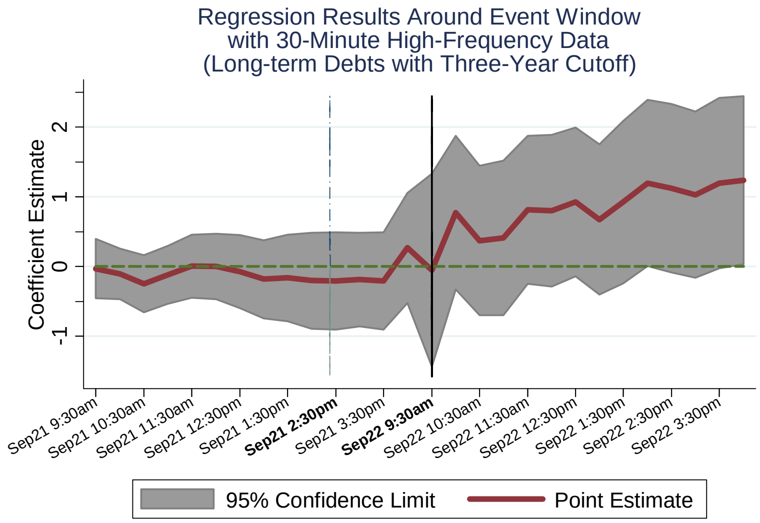


Panel A of Fig. 3 plots the point estimates and 95% confidence bands for the long-term debt (one-year cutoff) variable obtained from 26 regressions, one for each 30-minute time period. In these regressions, the dependent variable is the cumulative abnormal returns, beginning on Sept. 21, 9:30 a.m. through the end of the trading day Sept. 22. The other controls are as in column 8 of Table 3. Standard errors are clustered at the three-digit SIC level. The green dotted line shows the cumulative changes in 30-year Treasury yields from 9:30 a.m. Sept. 21, 2011. The vertical dashed line indicates the announcement time of the MEP at 2:23 p.m. on Sept. 21, 2011. The solid vertical line indicates the stock market opening time of Sept. 22, 2011. Data sources: Trade and Quote database, Center for Research in Security Prices (CRSP), CRSP/Compustat Merged Database, accessed through Wharton Research Data Services (WRDS), wrds-web.wharton.upenn.edu/wrds/about/databaselist.cfm



Panel B of Fig. 3 plots the point estimates and 95% confidence bands for the long-term debt (one-year cutoff) variable obtained from 26 regressions, one for each 30-minute time period. In these regressions, the dependent variable is the cumulative abnormal returns, beginning on Sept. 21, 9:30 a.m. through the end of the trading day Sept. 22. The other controls are as in column 8 of Table 3. Standard errors are clustered at the three-digit SIC level. Note that firms in the construction sector are excluded (SIC 1500 – 1799). The vertical dashed line indicates the announcement time of the MEP at 2:23 p.m. on Sept. 21, 2011. The solid vertical line indicates the stock market opening time of Sept. 22, 2011. Data sources: Trade and

Quote database, Center for Research in Security Prices (CRSP), CRSP/Compustat Merged Database, accessed through Wharton Research Data Services (WRDS), wrds-web.wharton.upenn.edu/wrds/about/databaselist.cfm



Panel C of Fig. 3 plots the point estimates and 95% confidence bands for the long-term debt (three-year cutoff) variable obtained from 26 regressions, one for each 30-minute time mark. In these regressions, the dependent variable is the cumulative abnormal returns, beginning on Sept. 21, 9:30 a.m. through the end of the trading day Sept. 22. The other controls are as in column 8 of Table 3. Standard errors are clustered at the three-digit SIC level. Note that these regressions use the full available sample of firms. The vertical dashed line indicates the announcement time of the MEP at 2:23 p.m. on Sept. 21, 2011. The solid vertical line indicates the stock market opening time of Sept. 22, 2011. Data sources: Trade and Quote database, Center for Research in Security Prices (CRSP), CRSP/Compustat Merged Database, accessed through Wharton Research Data Services (WRDS), wrds-web.wharton.upenn.edu/wrds/about/databaselist.cfm

Figure 4. Insurers' Median Fixed Income Holdings Rated A- as a Share of Total NAIC Risk Category 1.

Fig. 4 plots the quarterly median holdings of fixed income securities rated A- as a share of the total NAIC risk category 1 (ratings AAA to A-) from 2002Q1 to 2013Q4 for the insurance industry. The shaded MEP region covers 2011Q4 through 2012Q4. Data source: Thomson Reuters eMAXX.

TABLE 1. THE MEP Bond-Buying Program

The top panel of Table 1 shows the weights and amounts of Treasury securities to be purchased in 2012 at different maturities under the $600 billion MEP bond buying program. The bottom panel shows the stock of outstanding Treasuries at various maturities at the end of 2011. The maturity bin in each column is defined at the start year and one day less than the end year. For example, “6-8 years” means Treasury securities with a maturity between 6 years and 7 years and 364 days. Data source: Federal Reserve Bank of New York: (www.newyorkfed.org/markets/opolicy/operating_policy_120620.html) and the United States Treasury: (www.treasury.gov/resource-center/data-chart-center/quarterly-refunding/Documents/Nov%202013%20QR%20-%20TBAC%20Discussion%20Charts%20%28Final%29.pdf)

Weights and amounts used in the purchase of the Treasury securities during the MEP bond buying program

	6-8 years	8-10 years	10-20 years	20-30 years	TIPS 6-30 years
Shares	32%	32%	4%	29%	3%
Amount ($billion)	192	192	24	174	18

Outstanding Stock of Treasuries, 2011 ($billion)

	5-6 years	7-10 years	>=10 years
	1,136	1,053	1,017

Table 2. Summary Statistics

Panel A of Table 2 reports the number of observations, mean, standard deviation, and various percentiles of two measures of long-term debt dependence and the key control variables. All variables are averages of firm-level characteristics through 2006. Variables are winsorized at the 1% level to reduce the effects of outliers. The data description in the appendix provides more detail on the variable constructions. Data source: CRSP/Compustat Merged Database, accessed through Wharton Research Data Services (WRDS), wrds-web.wharton.upenn.edu/wrds/about/databaselist.cfm.

Variables	No. Obs.	MEAN	SD	5%	25%	50%	75%	95%
Long-Term Debt Dependence (One-Year Cutoff)	3297	0.82	0.25	0.22	0.74	0.92	1.00	1.00
Long-Term Debt Dependence (Three-Year Cutoff)	2713	0.43	0.3	0	0.15	0.45	0.67	0.9
Market Capitalization (billions)	2564	1.58	4.24	0.02	0.11	0.35	1.09	6.49
Book-to-Market Ratio	2563	0.56	0.39	0.11	0.29	0.49	0.75	1.24
Total Debts (Normalized by Total Assets)	2713	0.36	0.96	0.000	0.003	0.03	0.22	2.00
Total Assets	2717	1.16	2.85	0.01	0.05	0.22	0.80	5.79
Net Income Growth	2601	0.19	0.35	-0.32	0.06	0.14	0.30	0.81
Return on Assets	2447	0.00	0.09	-0.18	-0.017	0.03	0.05	0.07
Income over Assets	2634	-0.03	0.79	-0.85	0.06	0.15	0.21	0.37
Average Q	2542	6.33	16.09	1.18	1.58	2.43	4.81	18.05
Short-Term Financial Constraint	2668	-0.13	1.16	-0.42	0.00	0.07	0.13	0.24
Capital Intensity	2634	0.06	0.05	0.02	0.03	0.05	0.07	0.14

Panel B. Long-Term Debt Dependence (Ratio of Debt with Maturity Beyond One Year to Total Debt)

Panel B of Table 2 investigates the relationship between long-term debt dependence and other firm characteristics; all variables are averaged through 2006, creating a cross-section. In column 1, the dependent variable in the regression is long-term debt dependence; the regression also includes sector fixed effects (three-digit SIC code), and standard errors (in parentheses) are clustered at the sector level. Column 2 reports the simple bivariate correlation between long-term debt dependence and each variable. *** p<0.01, ** p<0.05, * p<0.1. Data source: CRSP/Compustat Merged Database, accessed through Wharton Research Data Services (WRDS), wrds-web.wharton.upenn.edu/wrds/about/databaselist.cfm.

	(1)	(2)
	OLS	Unconditional correlations
Market Capitalization (billions)	-0.0020	0.02
	(0.0035)	
Book-to-Market Ratio	-0.014	-0.01
	(0.013)	
Total Debt (Normalized by Total Assets)	0.030**	0.10**
	(0.013)	
Total Assets	-0.0057	0.07***
	(0.0077)	
Net Income Growth	0.011	-0.02
	(0.018)	
Return on Assets	-0.0042	0.07**
	(0.11)	
Income over Assets	0.025*	0.12***
	(0.013)	
Average Q	-0.0011**	-0.17***
	(0.00049)	
Short-Term Financial Constraint	0.00091	0.01
	(0.0040)	

Capital Intensity	0.37** (0.16)	0.03
Observations	2373	
R-Squared	0.233	

Table 3. Stock Returns and MEP

This table studies the impact of long-term debt dependence on stock returns around the MEP's announcement. The table reports regression results from an event study using daily stock returns. The dependent variable is abnormal stock returns on September 22, 2011, after controlling for the S&P 500 returns using a one-factor model. The details of computing the abnormal stock returns are provided in the appendix. Standard errors in parentheses are clustered at the SIC 3 industry level. *** p<0.01, ** p<0.05, * p<0.1. All columns except for column 1 includes sector fixed effects. In columns 1-8, long-term debt dependence is defined as the ratio of debt with a maturity in excess of one year divided by total debt; in column 9 this variable is computed using debt with a maturity in excess of three years in the numerator. In all columns except columns 6 and 7. The variables are averaged using data before 2007. In column 6, the control variables are averaged using data before 2011. In conlumn 7, all variables are the last available data point before September 21, 2011. Data sources: Center for Research in Security Prices (CRSP), CRSP/Compustat Merged Database, accessed through Wharton Research Data Services (WRDS), wrds-web.wharton.upenn.edu/wrds/about/databaselist.cfm.

	(1)	(2	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Long-Term Debt Dependence (One-Year Cutoff)	0.85**	0.91**	0.90**	0.93***	0.97**	0.96**	1.61***	1.05***	
	(0.39)	(0.43)	(0.36)	(0.36)	(0.38)	(0.38)	(0.50)	(0.37)	
Long-Term Debt Dependence (Three-Year Cutoff)									0.24
									(0.32)
Market Capitalization (billions)			-0.0095	0.0079	0.0028	0.0048	-0.024	0.0053	0.0069
			(0.015)	(0.015)	(0.020)	(0.0080)	(0.023)	(0.021)	(0.022)
Book-to-Market Ratio			-0.62***	-0.60***	-0.55***	-0.37	-0.73***	-0.45*	-0.49**
			(0.19)	(0.19)	(0.20)	(0.35)	(0.17)	(0.23)	(0.24)
Total Debt (Normalized by Total Assets)				-0.14	-0.15	-0.024	-0.11	-0.17	-0.16
				(0.086)	(0.13)	(0.055)	(0.11)	(0.13)	(0.13)
Total Assets					0.012	-0.0078	0.027	0.012	0.00030
					(0.061)	(0.020)	(0.053)	(0.064)	(0.067)
Net Income Growth					-0.35	-0.012	0.014	-0.36	-0.37
					(0.25)	(0.12)	(0.36)	(0.26)	(0.27)
Return on Assets					1.92	3.28	0.23	1.62	1.78
					(1.64)	(2.00)	(1.07)	(1.66)	(1.69)
Income over Assets					-0.10	-0.52	0.16	-0.055	-0.093
					(0.13)	(0.51)	(0.19)	(0.14)	(0.13)
Average Q					0.018**	-0.0038	0.019*	0.018**	0.016*
					(0.0074)	(0.045)	(0.012)	(0.0077)	(0.0085)
Short-Term Financial Constraint					0.087	-0.37*	0.051	0.048	0.049
					(0.12)	(0.21)	(0.11)	(0.11)	(0.12)
Capital Intensity					-2.24	-2.64	-3.15	-1.88	-1.19
					(2.13)	(3.63)	(2.49)	(2.19)	(2.23)
Sensitivity to Monetary Shocks								43.6	33.1
								(62.7)	(71.5)
Observations	2618	2618	2492	2492	2373	2373	2759	2344	2280
R-Squared	0.003	0.145	0.150	0.150	0.154	0.151	0.155	0.147	0.148

Table 4. Alternative Dates

This table reports regression results from a series of event studies using daily stock returns for alternative dates. Each event date is listed at the top of the column. Panel A focuses on the 10 days centered on September 21 (the day of the MEP's announcement), but for 2009, 2010 and 2012. Panel B focuses on the dates centered on QE2 and QE 3 announcement, as well as the MEP. In all cases, the dependent variable is abnormal stock returns after controlling for the S&P 500 returns. The independent variable of interest is long-term debt dependence: the ratio of debt with a maturity in excess of one year divided by total debt, and averaged through 2007. Each regression includes the same set of controls as in column 8 of Table 3. Standard errors in parentheses are clustered at the SIC 3 industry level. *** p<0.01, ** p<0.05, * p<0.1. Data sources: Center for Research in Security Prices (CRSP), CRSP/Compustat Merged Database, accessed through Wharton Research Data Services (WRDS), wrds-web.wharton.upenn.edu/wrds/about/databaselist.cfm.

Panel A of Table 4. Event studies around same time of year

2009	Sep 14	Sep 15	Sep 16	Sep 17	Sep 18	Sep 21	Sep 22	Sep 23	Sep 24	Sep 25	Sep 28
	-0.94	-0.21	0.29	-0.13	0.68	-0.19	-0.77*	-0.10	0.51	-0.61	0.28
	(0.61)	(0.51)	(0.45)	(0.46)	(0.52)	(0.49)	(0.42)	(0.42)	(0.44)	(0.37)	(0.58)
2010	Sep 14	Sep 15	Sep 16	Sep 17	Sep 20	Sep 21	Sep 22	Sep 23	Sep 24	Sep 27	Sep 28
	0.100	-0.30	-0.31	0.55	0.28	-0.43	-0.31	0.29	0.11	-0.40	0.38
	(0.25)	(0.29)	(0.36)	(0.35)	(0.57)	(0.43)	(0.42)	(0.26)	(0.31)	(0.37)	(0.29)
2012	Sep 14	Sep 17	Sep 18	Sep 19	Sep 20	Sep 21	Sep 24	Sep 25	Sep 26	Sep 27	Sep 28
	0.17	-0.62*	-0.55	-0.14	-0.091	-0.46	-0.31	-0.0095	-0.30	0.17	-0.080
	(0.38)	(0.33)	(0.50)	(0.38)	(0.41)	(0.43)	(0.46)	(0.29)	(0.30)	(0.35)	(0.28)

Panel B of Table 4: Event studies around announcements of different QEs

QE2	Oct 27	Oct 28	Oct 29	Nov 1	Nov 2	Nov 3	Nov 4	Nov 5	Nov 8	Nov 9	Nov 10
2010	0.23	0.49	0.24	-0.47	0.50	0.035	-0.050	-0.34	-0.92**	0.18	0.25
	(0.42)	(0.36)	(0.39)	(0.40)	(0.31)	(0.40)	(0.35)	(0.54)	(0.42)	(0.34)	(0.35)
MEP	Sep 14	Sep 15	Sep 16	Sep 19	Sep 20	Sep 21	**Sep 22**	Sep 23	Sep 26	Sep 27	Sep 28
2011	0.27	0.17	0.13	-0.63	-0.58	0.12	**1.05*** **	0.24	0.21	0.39	-0.53
	(0.29)	(0.29)	(0.41)	(0.43)	(0.50)	(0.40)	**(0.37)**	(0.33)	(0.27)	(0.33)	(0.36)
QE3	Sep 6	Sep 7	Sep 10	Sep 11	Sep 12	Sep 13	Sep 14	Sep 17	Sep 18	Sep 19	Sep 20
2012	0.85*	-0.65*	-0.064	0.41	0.15	-0.83*	0.17	-0.62*	-0.55	-0.14	-0.089
	(0.48)	(0.35)	(0.42)	(0.37)	(0.38)	(0.47)	(0.38)	(0.33)	(0.50)	(0.38)	(0.41)

Table 5. The Change in Long-Term Debt and the MEP

Panel A. This table studies the impact of long-term debt dependence on long-term debt growth during the MEP. The dependent variable in column 1 is the growth in long-term debt outstanding (one year cutoff). In column 2, the dependent variable is the growth in short-term debt. Standard errors are clustered by firms and years. *** p<0.01, ** p<0.05, * p<0.1. The MEP indicator variable equals 1 if the year is 2012 and 0 otherwise. The data are an annual panel with sample period: 2007-2013; all specifications include firm and year fixed effects, and all the time invariant firm observables in column 8 of Table 3 interacted with the MEP indicator variable. All time invariant variables are observed pre-2007. These variables also enter linearly as time varying controls. Variables are winsorized at the 1% level. Data sources: Center for Research in Security Prices (CRSP), CRSP/Compustat Merged Database, accessed through Wharton Research Data Services (WRDS), wrds-web.wharton.upenn.edu/wrds/about/databaselist.cfm.

	(1)	(2)
	Long-Term Debt Growth	Short-Term Debt Growth
Long-Term Debt Dependence * MEP	0.33***	0.34
	(0.12)	(0.25)
Market Capitalization (billions) * MEP	-0.0067	-0.0020
	(0.0044)	(0.019)
Book-to-Market Ratio * MEP	0.022	0.015
	(0.015)	(0.038)
Total Debt (Normalized by Total Assets) * MEP	0.018	0.024
	(0.016)	(0.068)
Total Assets * MEP	-0.0024	-0.011
	(0.0053)	(0.022)
Net Income Growth * MEP	0.12*	0.093
	(0.072)	(0.22)
Return on Assets * MEP	0.025	-0.61
	(0.39)	(0.81)
Income over Assets * MEP	0.028	0.091
	(0.046)	(0.13)
Average Q * MEP	-0.0033	0.0053
	(0.0026)	(0.0065)
Short-Term Financial Constraint * MEP	0.0019	-0.0013
	(0.031)	(0.068)
Capital Intensity * MEP	0.36	0.050
	(0.55)	(1.70)
Number of Observations	16498	6129

Table 5. The Change in Long-Term Debt and the MEP

Panel B: This table studies whether financial constraints mediate the impact of long-term debt dependence on bond issuance during the MEP. The dependent variable is the growth in long-term debt outstanding (one year cutoff). In column 1, the sample is restricted to those firms that score below the 75th percentile of the age-size index from Hadlock and Pierce (2010). These are the “Low” financially constrained firms, as measured by the index. Column 2 uses the sample of firms in the top quartile of this index. Higher values of the index suggest more financial constraints. The MEP indicator variable equals 1 if the year is 2012 and 0 otherwise. Column 3 uses the full sample of firms and includes age-size index interaction terms. The sample period is 2007--2013. The control variables are identical to column 1 of Panel A. Data sources: Center for Research in Security Prices (CRSP), CRSP/Compustat Merged Database, accessed through Wharton Research Data Services (WRDS), wrds-web.wharton.upenn.edu/wrds/about/databaselist.cfm.

	(1)	(2)	(3)
	Low	High	Full Sample
Long-Term Debt Dependence * MEP	0.32***	0.25	0.31***
	(0.12)	(0.25)	(0.10)
Age-Size Index* MEP			0.00010**
			(0.000048)
Age-Size Index*Long-Term Debt Dependence * MEP			-0.00014**
			(0.000057)
Number of Observations	12332	4112	16219

Table 6. Did a Firm Issue Debt?

Panel A. This table studies the impact of the long-term debt dependence on the probability of issuing corporate bond during the MEP. The dependent variable equals 1 if a firm issued debt in the calendar year and 0 otherwise. Standard errors clustered at the firm level for columns (1) and (2) and are clustered at firm and year levels for the other columns. *** p<0.01, ** p<0.05, * p<0.1. All specifications include year effects. Column 2 include a first-order autoregressive term. Column 3 includes firm fixed effects. Column 4 includes all the time invariant firm observables in column 8 of Table 3 interacted with the MEP indicator variable. The MEP indicator variable equals 1 if the year is 2012 and 0 otherwise. The sample period is 2007—2013. Interaction terms between the MEP indicator and average firm characteristics before 2007 are included in the regressions. In addition, time varying firm characteristics are included all regressions. These variables are Market capitalization, Book-to-Market Ratio, Total Debt, Long-term Debt, Total Assets, Net Income Growth, Return on Assets, Income over Assets, Average Q, Short-term Financial Constraint, and Capital Intensity. Data sources: CRSP/Compustat Merged Database, accessed through Wharton Research Data Services (WRDS), wrds-web.wharton.upenn.edu/wrds/about/databaselist.cfm and Mergent Fixed Income Securities Database.

	(1)	(2)	(3)	(4)
Variables	No Controls	AR(1)	Firm Fixed Effects	Firm Controls
Long-term Debt Dependence * MEP	0.050***	0.049***	0.045***	0.040***
	(0.0089)	(0.010)	(0.0095)	(0.015)
Observations	35771	29152	35771	21593
R-squared	0.013	0.163	0.469	0.502

Panel B: This table studies whether financial constraints mediate the impact of long-term debt dependence on bond issuance during the MEP. The dependent variable equals 1 if a firm issued debt in the calendar year and 0 otherwise, and all regressions use the same controls as in column 4 of Panel A. In column 1, the sample is restricted to those firms that score below the 75th percentile of the age-size index from Hadlock and Pierce (2010). Column 2 uses the sample of firms in the top quartile of this index. Higher values of the index suggest more financial constraints. The MEP indicator variable equals 1 if the year is 2012 and 0 otherwise. Column 3 uses the full sample of firms and includes Age-Size Index interaction terms. The sample period is 2007--2013. Standard errors are clustered at firm and year levels. *** p<0.01, ** p<0.05, * p<0.1. Data source: CRSP/Compustat Merged Database, accessed through Wharton Research Data Services (WRDS), wrds-web.wharton.upenn.edu/wrds/about/databaselist.cfm and Mergent Fixed Income Securities Database.

	(1)	(2)	(3)
	Low	High	Full Sample
Long-Term Debt Dependence * MEP	0.050**	0.0049	0.040***
	(0.022)	(0.0048)	(0.015)
Age-Size Index* MEP			-0.000034
			(0.000024)
Age-Size Index*Long-Term Debt Dependence * MEP			0.000040
			(0.000028)
Number of Observations	16039	5349	21104

Table 7. Reaching for Yield

Panel A: This table studies the impact of the MEP on bond spreads. The dependent variable is the log spread between a bond and the corresponding Treasury of the same maturity. Numbers in parentheses are standard errors clustered at the issuer (firm) level. *** p<0.01, ** p<0.05, * p<0.1. All specifications include firm, year, and quarter fixed effects; the time-varying firm observables in Panel A Table 5; the log of the principal issued; log maturity; and the bond credit rating; these bond-level variables are also interacted with the MEP. All continuous variables are winsorized at the 1 percent level. Columns 2—5 also include the time-varying firm observables interacted with the MEP. Category 1 bonds are rated AAA through A-. Category 2 bonds are rated BBB+ through BBB-. The MEP indicator variable equals 1 if the year is 2012 and 0 otherwise. The sample period is 2007—2013. Columns 1 and 2 include only category 1 bonds. Data source: CRSP/Compustat Merged Database, accessed through Wharton Research Data Services (WRDS), wrds-web.wharton.upenn.edu/wrds/about/databaselist.cfm and insurers' annual statutory filings provided by SNL Financial.

	(1)	(2)	(3)	(4)	(5)
Variables	Category 1	Category 1	AAA to BBB+	Category 1 & 2	Category 1 & 2
A- Rating*MEP	-0.231**	-0.295*			-0.270***
	(0.11)	(0.17)			(0.10)
BBB+ Rating*MEP			0.149		
			(0.14)		
BBB- Rating*MEP				0.0961	
				(0.13)	
Observations	738	738	994	1,590	1,590
R-Squared	0.811	0.819	0.817	0.826	0.826

Panel B: This table studies the impact of the MEP on insurers' bond portfolios. The dependent variable in columns 1 and 2 is the share of A- debt in an insurer's bond portfolio. In columns 3 and 4 the dependent variable is the share of new A- debt in new bond purchases within the calendar year. "Pre-crisis" variables are averaged over 2004-2006. The data are an annual panel of life insurers from 2007-2013. All specifications include insurer and year fixed effects. Data source: CRSP/Compustat Merged Database, accessed through Wharton Research Data Services (WRDS), wrds-web.wharton.upenn.edu/wrds/about/databaselist.cfm and insurers' annual statutory filings provided by SNL Financial.

	(1)	(2)	(3)	(4)
	A- share in portfolio		A- share in new purchases	
MEP * Pre-crisis ratio of income earned treasury Securities to total earned income	0.0725**	0.0603**	0.143**	0.159**
	(0.0278)	(0.0289)	(0.0642)	(0.0615)
Log of size of general account	0.0112	0.0113	-0.00529	-0.00430
	(0.00880)	(0.00892)	(0.0115)	(0.0115)
Portfolio duration, weighted by amount held	-0.000206	-0.000350	0.00235	0.00226
	(0.00303)	(0.00306)	(0.00376)	(0.00373)
Squared portfolio duration, weighted by amount held	7.27e-05	7.70e-05	-3.74e-06	-2.95e-06
	(8.39e-05)	(8.43e-05)	(0.000105)	(0.000104)
Portfolio rating, weighted by amount held	1.430	1.072	-11.06	-8.223
	(6.017)	(5.638)	(9.493)	(7.692)
MEP * Log of size of general account	-0.00120	-0.00225	0.00176	-0.00447
	(0.00181)	(0.00424)	(0.00328)	(0.00800)
MEP * Portfolio duration, weighted by amount held	0.00248	0.00608*	-0.000561	-0.00497
	(0.00342)	(0.00357)	(0.00774)	(0.00917)
MEP * Squared portfolio duration, weighted by amount held	-7.36e-05	-0.000204	2.62e-05	0.000206
	(0.000136)	(0.000140)	(0.000336)	(0.000370)
MEP * Portfolio rating, weighted by amount held	-0.551	-2.108	14.58	12.81
	(3.723)	(4.039)	(14.22)	(9.457)
MEP * Pre-crisis share of portfolio in A- rated securities	0.0100	0.0407	0.0656	0.0624
	(0.0981)	(0.108)	(0.189)	(0.213)
MEP * Pre-crisis log of size of general account		0.000396		0.0119
		(0.00440)		(0.00827)
MEP * Pre-crisis portfolio duration, weighted by amount held		-0.00769*		0.00419
		(0.00408)		(0.00811)
MEP * Pre-crisis squared portfolio duration weighted by amount held		0.000295**		-0.000202
		(0.000130)		(0.000249)
MEP * Pre-crisis portfolio rating, weighted by amount held		2.663		46.09
		(17.47)		(30.58)
Observations	1,126	1,126	1,122	1,122
R-squared	0.628	0.630	0.371	0.374

TABLE 8. THE REAL EFFECTS OF THE MEP

Panel A. This table studies the impact of long-term debt dependence and the MEP on a number of outcomes. The dependent variable in column 1 is the growth in plant and equipment expenditures (PPENT). In column 2, it is the growth in the number of employees; column 3 uses the growth in cash holdings and column 4 is the growth in dividend and share repurchases. Standard errors are clustered at the firm-year level. *** p<0.01, ** p<0.05, * p<0.1. The MEP indicator variable equals 1 if the year is 2012 and 0 otherwise. The sample period is 2007—2013. Time varying firm characteristics are included in all regressions. These variables are Market capitalization, Book-to-Market Ratio, Total Debt, Long-term Debt, Total Assets, Net Income Growth, Return on Assets, Income over Assets, Average Q, Short-term Financial Constraint, and Capital Intensity. All regressions also include firm and year fixed effects. Data source: CRSP/Compustat Merged Database, accessed through Wharton Research Data Services (WRDS), wrds-web.wharton.upenn.edu/wrds/about/databaselist.cfm.

	(1)	(2)	(3)	(4)
	Growth in PPENT	Growth in Employees	Growth in Cash Holdings	Growth in Dividend and Share Repurchase
Long-term Debt Dependence * MEP	0.085**	0.057**	0.012	0.0081
	(0.039)	(0.025)	(0.087)	(0.16)
Market Capitalization (billions) * MEP	0.00018	-0.00066	-0.00082	-0.0020
	(0.0016)	(0.0013)	(0.0049)	(0.0093)
Book to Market Ratio * MEP	0.016*	-0.00011	-0.024	0.0063
	(0.0096)	(0.0054)	(0.020)	(0.030)
Total Debt (normalized by total assets) * MEP	0.016**	0.014**	0.00022	-0.037
	(0.0066)	(0.0055)	(0.018)	(0.037)
Total Assets * MEP	-0.0043*	-0.0038**	0.0046	0.0023
	(0.0023)	(0.0018)	(0.0063)	(0.011)
Net income growth * MEP	0.020	0.011	0.10	0.051
	(0.031)	(0.018)	(0.061)	(0.15)
Return on Assets * MEP	-0.22	0.072	-0.18	0.33
	(0.15)	(0.087)	(0.32)	(0.70)
Income over assets * MEP	0.020	-0.0098	-0.024	-0.037
	(0.020)	(0.014)	(0.047)	(0.074)
Average Q * MEP	-0.000091	0.00030	-0.0011	-0.0024
	(0.0011)	(0.00072)	(0.0023)	(0.0035)
Short-term Financial Constraint * MEP	0.0090	-0.0061	-0.013	-0.011
	(0.016)	(0.0090)	(0.024)	(0.046)
Capital Intensity * MEP	-0.059	-0.31**	-0.76	-1.54**
	(0.21)	(0.14)	(0.50)	(0.78)
Number of Observations	26128	24642	25814	13723

Panel B: Alternative measure of long-term debt dependence. Panel B replicates Panel A but long-term debt dependence is defined as the ratio of debt with remaining maturity in excess of three years divided by total debt. Standard errors are clustered at the firm-year level. *** p<0.01, ** p<0.05, * p<0.1. The MEP indicator variable equals 1 if the year is 2012 and 0 otherwise. The sample period is 2007--2013. As with Panel A, interaction terms between the MEP and firm characteristics observed before 2007 are included in the regressions. In addition, time varying firm characteristics are included all regressions. These variables are Market capitalization, Book-to-Market Ratio, Total Debt, Long-term Debt, Total Assets, Net Income Growth, Return on Assets, Income over Assets, Average Q, Investment Opportunity, Short-term Financial Constraint and Capital Intensity. Data source: CRSP/Compustat Merged Database, accessed through Wharton Research Data Services (WRDS), wrds-web.wharton.upenn.edu/wrds/about/databaselist.cfm.

	(1)	(2)	(3)	(4)
	Growth in PPENT	Growth in Employees	Growth in Cash Holdings	Growth in Dividend and Share Repurchase
Long-term Debt Dependence (3Years) * MEP	0.058**	0.058***	0.15*	-0.10
	(0.026)	(0.021)	(0.080)	(0.13)
Number of Observations	25135	23740	24846	13216

Panel C: Financial constraints. The dependent variable in columns 1-3 is the growth in plant and equipment expenditures. In columns 4-6, the dependent variable is the growth in the number of employees. In columns 1 and 4, the sample is restricted to those firms that score below the 75th percentile of the age-size index from Hadlock and Pierce (2010). Columns 2 and 5 use the sample of firms in the top quartile of this index. Columns 3 and 6 use the full sample of firms and includes Age-Size Index interaction terms. Higher values of the index suggest more financial constraints. The MEP indicator variable equals 1 if the year is 2012 and 0 otherwise. The sample period is 2007--2013. The other variables are as in Panel A. Data source: CRSP/Compustat Merged Database, accessed through Wharton Research Data Services (WRDS), wrds-web.wharton.upenn.edu/wrds/about/databaselist.cfm

	Growth in PPENT			Growth in Employees		
	(1)	(2)	(3)	(4)	(5)	(6)
	Low	High	Full Sample	Low	High	Full Sample
Long-Term Debt Dependence * MEP	0.063***	0.020	0.070*	0.055	0.058	0.058**
	(0.024)	(0.057)	(0.042)	(0.035)	(0.100)	(0.025)
Age-Size Index* MEP			0.000033**			0.000016
			(0.000014)			(0.000012)
Age-Size Index*Long-Term Debt Dependence * MEP			-0.000036*			-0.000014
			(0.000021)			(0.000019)
Number of Observations	18427	6144	21333	19526	6513	20256

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Appendix: Data Description

The firm level data come from Compustat. Variables of firms' financial statement variables are downloaded for U.S. firms at an annual frequency for all years that are available. Financial firms with SIC code between 6000 and 6999 are dropped.

Long-Term Debt Dependence

We construct the baseline long-term debt dependence as follows: in financial statements, assets and liabilities of different maturities are distinguished at the one-year cutoff. Following Greenwood, Hanson, and Stein (2010), long-term liability is defined as all debts with a maturity of one year or longer. Since some of the short-term liabilities on the balance sheets are long-term debts with remaining maturing less than one year, the total amount of long-term debts is the sum of total long-term debt (*dltt*) and long-term debt due in one year (*dd1*). Similarly, short-term debt is calculated as Debt in Current Liabilities minus long-term debt due in one year (*dd1*). This ratio is then averaged over years to obtain the long-term debt dependence ratio. For the baseline case, the average is computed with observations before 2007.

We compute long-term debt dependence with maturity in excess of three years as follows. The variables *dd2* and *dd3* measure debt with **remaining** maturity between one and two years, and two and three years, respectively. Total long-term debt (*dltt*)-*dd2-dd3* gives the stock of debt with maturity in excess of three years. Unfortunately, because variables like *dd2* and *dd3* measure the remaining maturity of debt, rather than the maturity at issuance, a long-term loan (at issuance) can be misclassified as a short-term loan if the long-term loan is close to maturity. [21] Consider a loan that was issued with maturity of 30 years and is now 28 years old. This loan will have a remaining maturity of two years (*dd2)*, and be omitted in an imputation like *ddlt-dd2-dd3*, potentially mismeasuring a firm's long-

[21] The choice of remaining maturity and issuance maturity does not affect long-term debts measures with one-year cutoff. The two measures are identical for the one-year cutoff.

term debt dependence. This mismeasurement problem can become worse when the imputation is extended to longer maturities *dd4* and *dd5.*

Also, the reporting in Compustat can make these imputations unreliable. In the case of *dltt-dd2-dd3*, some 3.5% of the observations are negative, and another 32% are missing, relative to the baseline one year cutoff definition for long-term debt. Extending the imputation to debt with remaining maturity beyond five years: *dltt-dd2-dd3-dd4-dd5* gives negative values in 9.1% of the observations, and missing values in 37% of the cases relative to the one year cutoff baseline.

Other Controls

A couple of size variables are controlled for in the model. All variables are at an annual frequency. Total assets are obtained directly from Compustat (at). Market capitalization is the product of closing stock price on financial year end (prcc_f) and total amount of outstanding common shares of the firm (csho). Sizes of debts are controlled for by total long-term debts and total debts, both normalized by lagged total assets (at). Book-to-market ratio is the ratio of book equity (ceq) over market capitalization. We have a few measures of firms' profitability: (1) net income growth is the log growth rate of firms net income (item ni); (2) return on assets is net income divided by the sum of market capitalization and total liabilities (item ni divided by the sum of market capitalization and lt); (3) i2a is computed by dividing operating income before depreciation (item oibdp) normalized by lagged total assets.

Two measures are used to control for firms' investment opportunity: average Q and investment opportunity i2s. A firm's average Q is the sum of market capitalization and total assets minus book equity and all normalized by lagged total assets. Investment opportunity is defined to be capital expenditure (item capx) divided by net sales (item sale) of firms. This variable is similarly defined as in Gorodnichenko and Weber (2013). Capital intensity (d2a) is the ratio of depreciation (dp) over lagged total assets (at).

We have variables to measure a firm's dependence on short term financing and external financing and. Short-term financing need (rp2s) is calculated first by taking the difference between receivables (rect) and payables (ap), and then by the dividing this difference by total sales (sale).

And as before, to limit any spurious associations induced by the crisis, we take the historical average of all the control variables through 2007. For robustness, we also try taking the average of the control variables through to Sept. 21, 2011, or just use the last available observation before 2007. All variables are winsorized at the 1% level to reduce the impact of outliers.

In the sections of evaluating the effect of MEP on firm activities, we have other firm-level variables at an annual frequency. Growth in long-term debt and in short-term debt are log growth rates of long-term debts and short-term debts, respectively. Growth in properties, plants, and equipment, a measure of net investment, is computed as the log growth rate of the item ppent in Compustat. Growth in employment is computed as the log growth rate of the item emp in Compustat. Similarly, growth in cash holdings is the log growth rate of cash and short-term investments (item che) in Compustat. Dividend and shares repurchase is equal to total dividend (item dvt) plus purchase of preferred and common stocks (item prstkc) minus redemption of preferred stocks (item pstkrv). Then we compute the log growth rate for this variable. All of these four variables are winsorized at the 1% level.

Abnormal Returns

We obtained daily returns of stocks of public firms from CRSP to compute abnormal returns. The abnormal returns used on the left hand side of the regressions are predicted residuals from a one-factor model controlling for market returns (MacKinlay, 1997). To be more specific, suppose the event date is denoted as T, we first run a one-factor regression using data range from one year and one month before the event date to one month before the event date. The one-factor regression for firm i is given as

$$r_{it} = \alpha_{iT} + \beta_{iT} r_{mt} + \varepsilon_{it}$$

where t=T-395,...,T-30, and r_{mt} the returns of the S&P 500 portfolio. After obtaining the coefficient estimates α_{iT} and β_{iT}, the abnormal returns are computed as the predicted residuals $\hat{\varepsilon}_{iT} = r_{iT} - \hat{\alpha}_{iT} - \hat{\beta}_{iT} r_{mT}$ for firm i at event date T.

Bond Data

We obtain bond issuance data from the Mergent FISD database, which contains comprehensive bond issuance data since the 1980s. The database provides a lot of information about a particular issuance, including date of issuance, maturity, amount issued, coupon, and credit rating. We first collected all bond issuances for nonfinancial firms from FISD. From the data, we see that a firm typically issues very few bonds per year. For example, among firms that have ever issued a corporate bond in a given year, over 50% of those firm issued only one corporate bond in that year. Given this sparse nature of bond issuance, we aggregate the issuance to firm-calendar year and merge the data set from FISD to the Compustat file by CUSIP and company names. This merge results in a match of 2,517 firm year, and it allows us to test whether the MEP affected the probability of a firm issuing a corporate bond.

We constructed NAIC bond credit ratings from the credit ratings assigned by the three major credit rating agencies and provided by FISD. Following the NAIC procedure similarly applied by Becker and Ivashina (forthcoming), we compute the median credit rating when all three ratings are available, and the minimum credit rating when only two ratings are available.

Insurance company data

Our source for information about insurance companies is the annual statutory filings collated by the National Association of Insurance Commissioners and provided by SNL Financial. We extract data on individual bond holdings from the Schedule D (Part 1), including bond identifier (CUSIP), type of bond (e.g. Treasury), the date of first purchase, the residual maturity, and the par value held. We obtain the size of each insurer company's portfolio, excluding the separate account, from the summary balance sheet tables. And we collect data on the income earned from Treasuries from the exhibit of net investment income. We merge these data with the FISD database to obtain ratings information for each bond at year end. Our final sample is an unbalanced panel of 150 insurance companies over the years 2004-2014.

Age-size index

We compute the age-size index using the methodology in Hadlock and Pierce (2010). Similar to their paper, we measure firm size using total assets of a firm in 2007 in millions of inflation-adjusted year 2004 dollars. The age of a firm is measured by the number of years that the firm has non-missing stock prices on Compustat before 2007. In order to capture the "flat" region, where the financial constraint does not vary with age and assets, we cap the size of firms at 4 million dollars and the age for firms at 37 years, as in Hadlock and Pierce (2010). Then the age-size index is computed using the formulae:

$$\text{Age-size Index} = (-0.737 \times Size) + (0.043 \times Size^2) - (0.040 \times Age)$$