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Monetary Policy Statements, Treasury Yields, and Private Yields: Before and After the Zero Lower Bound

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Monetary Policy Statements, Treasury Yields, and Private Yields: Before and After the Zero Lower Bound

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Abstract

Monetary policy actions since 2008 have influenced long-term interest rates through forward guidance and quantitative easing – both "unconventional" strategies. We examine whether the effect of such actions on Treasury yields have passed through to private yields to a degree comparable to experience before 2008. In order to perform this examination, we propose a strategy to identify the comovement between Treasury yields and private yields induced by monetary policy when an observable representing policy changes, such as changes in the interbank rate, is not available, or when other systematic factors may be important. Our strategy implies that least squares regressions, even within an event window, can be misleading, and our empirical results find evidence for such misleading effects. Implementation of our instrumental variables strategy suggests that the movements in Treasury yields induced by monetary policy statements have passed through to private yields, but to a smaller degree than typical prior to the end of 2008. This may suggest that the effectiveness of unconventional policy actions in stimulating activity are attenuated relative to conventional policy actions.

Keywords: Monetary Policy; Treasury Yields, Private Yields

JEL Codes: E52; G14

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Since the end of 2008, the target federal funds rate has been "stuck" at effectively zero, and monetary policy has attempted to influence interest rates, financial conditions, and inflation and economic activity through "unconventional" policies such as forward guidance on the path of the federal funds rate and balance sheet expansion targeted at altering long-term interest rates by changing the supply of assets held by the public – that is, through quantitative easing.[2] To what extent do such actions lower private yields – thereby affecting the cost of borrowing most relevant for private spending decisions? And are such effects different from those witnessed prior to the end of 2008, when monetary policy actions focused on more "conventional" policies – that is, on changes in the target federal funds rate?

We examine these questions using a regression strategy around monetary policy events – specifically, statements from the Federal Open Market Committee. We first outline the complications that arise even in an event study context – emphasizing the possibility of some degree of noise and/or other important economic developments within the event window – and how a simple instrumental variables strategy addresses these complications.

We implement the proposed identification scheme. Both before and after the end of 2008, movements in Treasury yields around monetary policy statements pass through strongly to private yields, as measured by yields on corporate bonds (which are the primary private yield directly relevant for private sector spending that is available at the high (daily) frequency needed for our event-study approach). However, the degree of pass through since the end of 2008 appears attenuated relative to the norm before the end of 2008 – to an economically relevant degree and in a manner that is statististically significant.

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[2] For a review of the role of long-term interest rates in the monetary transmission mechanism, see Bovin, Kiley, and Mishkin (2010).

Our analysis builds on recent research. Most importantly, we take as given an effect of monetary policy actions since 2008 on Treasury yields, as found in, for example, Gagnon et al (2011), Krishnamurthy and Vissing-Joregenson (2011), Li and Wei (2012), and D'Amico and King (forthcoming). (Note that while we take this effect as given, our empirical strategy would be robust to the absence of any effect – in which case we would find no [ass-through to private yields.)

We then focus more specifically on the pass-through to private yields. Previous authors have similarly considered this issue. For example, Krishnamurthy and Vissing-Jorgenson (2011) find that an important component of the effects of Quantitative Easing has been through a "safety" channel that implies somewhat limited pass-through to private yields. Our analysis goes beyond these previous approaches in several respects. Most importantly, we emphasize how a regression strategy built around event windows can overcome concerns about noise and other developments within the event window to allow consideration of a larger sample of data. In contrast, Krishnamurthy and Vissing-Jorgenson (2011) limit (for example) their analysis of the first round of quantitative easing to 5 events because of concerns that noise or other developments dominated movements in yields on other days. As we will demonstrate, our approach addresses such concerns and delivers relatively sharp empirical results. Despite these advantages, our approach also has limitations – specifically, our regression approach demands data samples of a reasonable size, and we therefore consider the entire period of unconventional monetary policies rather than focus on differences across various stages of policy easing since 2008 (as studied by Krishnamurthhy and Vissing-Jorgenson (2011)). Finally, we note that Rosa (2012) and Wright (2012) also consider effects of monetary policy on private yields (and other asset prices) since then end of 2008; however, these studies do not address the degree to which the pass-through of changes in Treasury yields to private yields is different in the recent period.

1. Data and identification strategy

Data

Estimating the response of long-term interest rates to monetary policy actions is complicated by the fact that the market is unlikely to respond to anticipated policy actions, making it essential to distinguish between expected and unexpected policy actions. To obtain exogenous, surprise variation in monetary policy actions, we focus on movements in asset prices within the day of an FOMC announcement—that is, changes in interest rates in short windows around policy actions associated with regularly scheduled FOMC meetings, as well as any intermeeting policy moves. We consider a 30-minute window beginning 10 minutes prior to the FOMC communication and ending 20 minutes after the FOMC communication.

In our analysis, we focus on the movements in Treasury yields and corporate bond yields around these monetary policy events. For corporate bond yields, we use the Baa and Aaa corporate bond yield produced by Moody's on a daily basis. Moody's tries to include bonds with remaining maturities as close as possible to 30 years; Moody's drops bonds if the remaining life falls below 20 years, if the bond is susceptible to redemption, or if the rating changes. Because of these features, movements in these private yields are most closely associated with movements in fairly long-term Treasury yields – with a notably stronger association of daily movements in the corporate bond yields with those in 20-year (coupon) Treasury yields than in 10-year (coupon) Treasuy yields.[3] Our empirical analysis will therefore emphasize daily changes in the yield on a 20-year Treasury security.

Because daily changes may be contaminated by actions other than monetary policy actions, we also include changes within the 30-minute window surrounding FOMC statements within our empirical strategy. We use data on changes in 5-year, 10-year, and 30-year Treasury yields within these windows; note that these are the available data for this study within the tight time windows around events. As highlighted in the next subsection, our identification strategy is designed to use the high-frequency information on Treasury yielde within 30 minute windows around FOMC announcements to identify the component of daily yield changes (in corporate bonds and the 20-year Treasury yield) associated with monetary policy surprises.

Our analysis uses the simple change in the price of these securities over a day or within the event windows; within event windows, this simple change is a very good measure of the *surprise* change, as anticipated changes over a 30-minute window have trivial effects on the value of 5- or 10- or 30-year securities.[4]

In looking at the comovement between private and Treasury yields, we divide the sample into two subperiods. The pre-"zero-lower bound" (ZLB) period extends from November 17, 1993 through December 16, 2008; the first date represents the initial observation available for both the daily change in yields and the changes in yields within the 30-minute window around an FOMC statement, and the latter date is the day on which the FOMC lowered the target federal

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[3] To see this, consider the regression of daily changes in the Baa yield against daily changes in the 20-year and 10-year Treasury yields from October 4, 1993 through December 31, 2012 (with robust standard errors in parentheses):

$$\Delta R^{P}(t) = 0.83\ (0.03)\ \Delta R^{T,20}(t) + 0.01\ (0.03)\ \Delta R^{T,10}(t) \quad \text{(4609 observations)}$$

The 20-year Treasury yield clearly dominates. Note that we do not consider the 30-year yield as daily quotes at this maturity were discontinued (by the Treasury and Federal Reserve) in the early 2000s because of a shortage of bonds at that maturity.

[4] As emphasized elsewhere, e.g., English, Van den Heuvel, and Zakrajsek (2012).

funds rate to effectively zero. This period contains 129 FOMC announcements. The zero-lower bound period includes all FOMC announcements after December 16, 2008 (through December 2012) – for a total of 32 announcements.[5]

Figure 1 presents some key aspects of the data on changes in the 10-year Treasury yields within the 30-minute window around the FOMC statement and the corresponding daily changes in the 20-year Treasury yield and Baa corporate-bond yield. There are large changes across the entire sample period. Note that figure 1 illustrates why an instrumental variables strategy is critical: There are large daily changes in 20-year Treasury yields and the Baa yield on FOMC announcement days – even when the movement in the 10-year yield within the 30-minute window is muted, especially in the ZLB period; this suggests other factors are important and instrumental variables are necessary when considering daily changes.

Identification Strategy

We posit a simple model of the changes in yields near an event. First, we assume that the scale of monetary policy actions is unobservable: It is known that policy actions are revealed with FOMC communications, but the scale of the action is not quantifiable. This seems eminently reasonable for the recent period, where it may be difficult to think of a scalar summary for the degree of surprise in forward guidance and changes in asset purchases by the Federal Reserve. In earlier periods (prior to 2009), it was sometimes assumed in similar studies that the surprise in short-term interest rates was the observable surprise in monetary policy; our approach

[5] A variety of other possible lines could be drawn to differentiate across subperiods. For example, the intense part of the financial crisis began in the summer of 2008; the first quantitative easing occurred on November 25, 2008; finally, the intense phase of the financial crisis was over by spring 2009. Overall, results are robust to these alternative potential dates as definitions of "previous, normal" period and "more recent, unusual" period.

is robust to the availability of an indicator of the size of the monetary policy action – in such a case, ou approach may simply be less efficient.

Denote the unobservable surprise in monetary policy by $\Delta X(t)$. Within a narrow window around the monetary event, this surprise influences yields/interest rates (on Treasuries of maturity j, $R^{T,j}(t)$ with some (independently-distributed) errors/noise, according to the following equations

(1) $\Delta R^{T,j}(t) = b^j \Delta X(t) + e^j(t)$.

On a daily basis, the change in the 20-year Treasury ($\Delta R^{T,20}(t)$) and on corporate bonds ($\Delta R^P(t)$) are similarly related to the monetary surprise and noise. In addition, there may be other systematic factors that occur over the course of a day that also affect both corporate and Treasury yields. Denoting these other systematic factors by $\Delta Z(t)$, the daily movement in the 20-year Treasury and on corporate bonds are given by

(2a) $\Delta R^{T,20}(t) = b^{20} \Delta X(t) + d^{20} \Delta Z(t) + e^{20}(t)$.

(2b) $\Delta R^P(t) = b^P \Delta X(t) + d^P \Delta Z(t) + e^P(t)$

Our interest is in the degree by which corporate bond yields move because of a monetary policy action that changes Treasury yields (in our case, the 20-year Treasury yield) by 100 basis points or 1 percentage point – that is, in the change in private yields prices associated with a change in monetary policy ($\Delta X(t)$) of size $1/b^{20}$; using (2a) and (2b), this change in private yields equals b^P/b^{20}.

Because the scale of the monetary policy action is unobservable, we cannot estimate (2a) and (2b). But we can insert (2a) into (2b), yielding

(3) $\Delta R^P = (b^P/b^{20})\Delta R^{T,20} + w(t),\ w(t) = d^P\Delta Z(t) + e^P(t) - (b^P/b^{20})(d^{20}\Delta Z(t) + e^{20}(t)).$

Clearly, equation (3) cannot be estimated by least squares, as the error term w(t) is a composite of other systematic factors ($\Delta Z(t)$) affecting daily changes in both corporate and Treasury yields, the error in the Treasury yield equation (2a), and the erros in the corporate bond equation (2b); because of the first two factors, w(t) is correlated with $\Delta R(t)^{T,20}$. Nonetheless, we can uncover the coefficient of interest by instrumental variables estimation, using instruments correlated with the change in the 20-year Treasury yield (but uncorrelated with the error term in (2a)). Observations on Treasury yields within the tight 30-minute window surrounding FOMC statements are excellent instruments under our assumptions in (1), where other systematic factors that are relevant for the daily changes are not relevant within the tight 30-minute event window.

Therefore, our identification strategy is the following:

1. The model is given by equations (1)-(3).
2. Choose a set of interest rates governed by (1) as instruments: We will use the yields on the 5-year, 10-year, and 30-year Treasury; as emphasized earlier, it seems plausible that, within the narrow windows we consider, the comovement of these interest rates with those of interest in equations (2a) and (2b) is determined by the monetary policy action.
3. Estimate (3) by instrumental variables (via generalized method of moments, accounting for heteroskedasticity), with attention to tests of the relevance of the instruments and the degree to which they satisfy the expected orthogonality conditions.[6]

Discussion of this Approach and that of Krishnamurthy and Vissing-Jorgenson (2011)

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[6] We use 2-step GMM as outlined in Hansen (1982), and examine both the usual J-test for the orthogonality of the instrument set and the C-test for the orthogonality of individual instruments (Eichenbaum, Hansen, and Singleton (1988)). We also examine whether our instruments are weak using the approach in Stock and Yogo (2002).

At this point, it is useful to highlight what is novel in the approach outlined above.

Previous work on the effects of recent policy actions on corporate and Treasury yields, such as that of Krishamurthy and Vissing-Jorgenson (2011), have followed a "pure" event study approach, looking at the changes on certain days and comparing such changes to the degree of normal variation in daily changes. This approach is straightforward. But as Krishnamurthy and Vissing-Jorgenson (2011) emphasize, this approach requires the strong assumption that other factors are unimportant on event days (i.e., that $\Delta Z(t)$ is zero on event days). Indeed, these authors drop 3 of 8 days they identify as being associated with the first round of quantitative easing on the grounds that the movements in yields on those days induced by monetary policy did not clearly dominate any other factors on those days.

Our approach avoids having to drop such observations under the assumption that, within a tight 30-minute window, the role of other systematic factors is negligible – that is, even if the effect of monetary policy is small, it is cleanly identified (up to random noise e(t)) within the 30-minutes surrounding the FOMC statement. This assumption seems reasonable (but is of course subject to debate). On the other hand, our approach requires a reasonable sample size, as the (instrumental variables) regressions would likely be heavily influenced by noise in a small sample. For this reason, we are constrained to treat the entire post-2008 period as one set of events (and do not distinguish across episodes treated separately in Krishnamurthy and Vissing-Jorgenson (2011)).

2. Results on Comovement Between Treasury and Corporate Bond Yields

We now turn to the comovement between the 20-year Treasury yield and the Baa or Aaa corporate bond yield.

Table 1 presents results for the Baa yield in both the pre-ZLB and the ZLB periods. The initial set of instruments for monetary policy includes the surprises in the 5-year, 10-year, and 30-year Treasury yields within the 30-minute event window. Columns 1 and 2 include least squares results (pre-ZLb and ZLB); columns 3 and 4 present instrumental variables results.

Focusing first on least squares results inc columns 1 and 2, it is clear that least squares suggests no change in pass-through from the 20-year Treasury yield to the Baa yield – the coefficient is 0.80 pre-ZLB and post-ZLB (and, as a result, there is no evidence for a break in coefficients from the Andrew-Fair test).

Instrumental variables estimation suggests a different picture: As can be seen in columns 3 and 4, the pass-through coefficient drops from 0.9 to 0.7 from the pre-ZLB to ZLB period, and the Andrews-Fair test indicates statistical support for a change in relationship at conventional significance levels. The Cragg-Donald statistic does not suggest concen over weak instruments in either sample, and the overidentifying restrictions do not appear to be violated. Overall, the impression from instrumental variables estimation is that least squares results may be misleading and that there is some evidence for less pass-through to private yields from movements in the 20-year Treasury yield since the onset of unconventional policies.

Table 2 presents results for the Aaa yield. In this case, least squares estimation and instrumental variables estimation paint a more similar picture: The pass-through of changes in the 20-year Treasury yield to the Aaa yield around monetary policy announcements is attenuated in recent years, dropping from about 0.9 prior to the ZLB to 0.7 since the onset of unconventional policies. Diagnostics and breakpoint tests for the instrumental variables regressions are similar to those for the Baa yield.

To explore robustness somewhat, Table 3 presents results in which only the surprise in 10-year Treasury yield over the 30 minutes surrounding the FOMC announcement is used as an instrument. This instrument is chosen because the 10-year Treasury yield has been the primary focus of policy discussions surrounding quantitative easing, as well as the primary (albeit not exclusive) focus on much of the related literature summarized in the introduction. The first two columns report results for the Aaa yield (pre-ZLB and ZLB) and the second two columns report results for the Baa yield. In both cases, results are nearly identical to those in tables 1 and 2.

The results point to a moderate degree of attenuation since the end of 2008 – the period of unconventional monetary policy – in the degree to which movements in the 20-year Treasury yield associated with monetary policy actions are passed through to corporate bond yields.

Another important result, related to the overall framework outlined in the previous section, is that least squares regressions may be misleading. In the samples above around FOMC events, this is only apparent for the Baa yield. We note, as a final illustration of this general point, that simple regressions outside of FOMC windows are even more prone to this problem. Indeed, if one were simply to regress the daily change in the Baa yield on the daily change in the 20-year Treasury yield, pre-ZLB and ZLB, the results (standard errors in parentheses) are

Pre-ZLB: $\Delta R^{P} = 0.81\ (0.01)\ \Delta R^{T,20}$ (3641 observations)

ZLB: $\Delta R^{P} = 0.91\ (0.02)\ \Delta R^{T,20}$ (968 observations).

Simple regression would suggest that pass-through has increased. Of course, as highlighted by the discussion in the previous section, this could easily reflect non-monetary forces – and indeed that is what our empirical analysis finds. (Of course, one could also use all daily observations, rather than simply days on which FOMC announcements occur, in an instrumental variables strategy; if one assumed that monetary actions did not occur on non-FOMC announcement days (an unrealistic assumption) and consequently set $\Delta X(t)$ equal to zero on those days, instrumental variables estimation would yield (nearly) identical estimates of the coefficients as the results in tables 1-3, highlighting the importance of identifying monetary policy actions when assessing any change in pass-through.[7])

3. Interpretation and Conclusion

The results suggest there may be some attenuation in the pass-through from Treasury yields to private yields since the onset of unconventional policies: Pass-through from the 20-year Treasury to the Baa or Aaa corporate bond yield is 20 percent lower in the ZLB period.

There could be several rationales for such attenuation. First, a wide variety of researchers have noted that there is no reason, *a priori*, to expect that movements in Treasury yields associated with a lower path for short-term interest rates should have the same effect on other asset prices or economic activity as such movements induced by Quantitative Easing (QE). For example, Woodford (2012) (who expresses considerable skepticism with regard to the efficacy of QE in affecting long-term interest rates) notes that the spillovers of declines in asset prices to other assets – especially risky assets like private bonds – may be minimal if the "preferred habitat" or "portfolio balance" channels through which Quantitative Easing influence long-term Treasury yields reflect special features of Treasuries such as those associated with safety or duration. Indeed, studies focusing solely on yield movements have suggested that spillovers from quantitative easing to private yields may be somewhat limited for exactly these reasons,

[7] Assuming the elements of the matrix containing instruments are zero on non-FOMC announcement days implies that the sums of cross-products of instruments and endogenous regressors and of cross-products of the instruments and the dependent variable are identical. Nonetheless, the estimated errors, and hence error covariance matrix, are affected by all observations, which (in practice) yields small numerical differences in estimates from those in tables 1-3 under the estimation strategy outlined in the text.

most notably Krishnamurthy and Vissing-Jorgenson (2011) (who view much of the effect of quantitative easing as reflecting a safety channel that does not spillover to risky private bonds, consistent with Krishnamurthy and Vissing-Jorgenson (2012)).[8]

Our simple identification strategy cannot directly address the role of different channels (e.g., duration, liquidity, or safety features of government and private bonds); rather, a structural model or additional data is required. However, we would note that tables 1 through 3 present strikingly similar results for Baa and Aaa yields: To the extent Aaa securities capture more of the safety features of Treasuries than do Baa yields, one would have expected attenuation to be more marked for Baa yields than for Aaa yields; as a result, our results are consistent with some attenuation, but not necessarily with a role for a safety channel being the driver of attenuation. (Other channels – for example related to liquidity characteristics – could be an explanation, but we cannot address this question in our limited analysis.)

A further possibility is that FOMC announcements in the ZLB period have communicated more information about the economic outlook than about the policy stance: If FOMC communications provided previously unappreciated information about the outlook, then it is possible that such information would attenuate the response of private bond yields to a policy announcement: This could occur, for example, because announcements communicating an easing in policy also communicated a worse economic outlook, with the former factor lowering long-term interest rates in general, including Treasuries, and the latter factor boosting credit spreads, thereby implying a smaller decline in private yields than in Treasury yields); however,

[8] Some macroeconomic models of the effects of QE emphasize that QE may provide less stimulus than conventional monetary policy, but these models have (for the most part) focused on modeling duration-based channels and have not distinguished between private and government yields (e.g., Andres, Lopez-Salido, and Nelson (2005); Chen, Curdia, and Ferrero (2012); and Kiley (2012)).

as in the discussion above of the results relative to Krishnamurthy and Vissing-Jorgenson (2011), this reasoning does not explain the similar degree of attenuation in Baa and Aaa yields.

Overall, the results point to a moderate degree of attenuation since the end of 2008 – the period of unconventional monetary policy – in the degree to which movements in the 20-year Treasury yield associated with monetary policy actions are passed through to corporate bond yields. While future work is clearly needed, these results do suggest some caution in evaluating the degree to which efforts to lower long-term interest rates pass-through to private yields and, through this channel, stimulate activity.

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Figure 1: Surprises in Yields Around FOMC Announcements

Pre-ZLB and ZLB Period

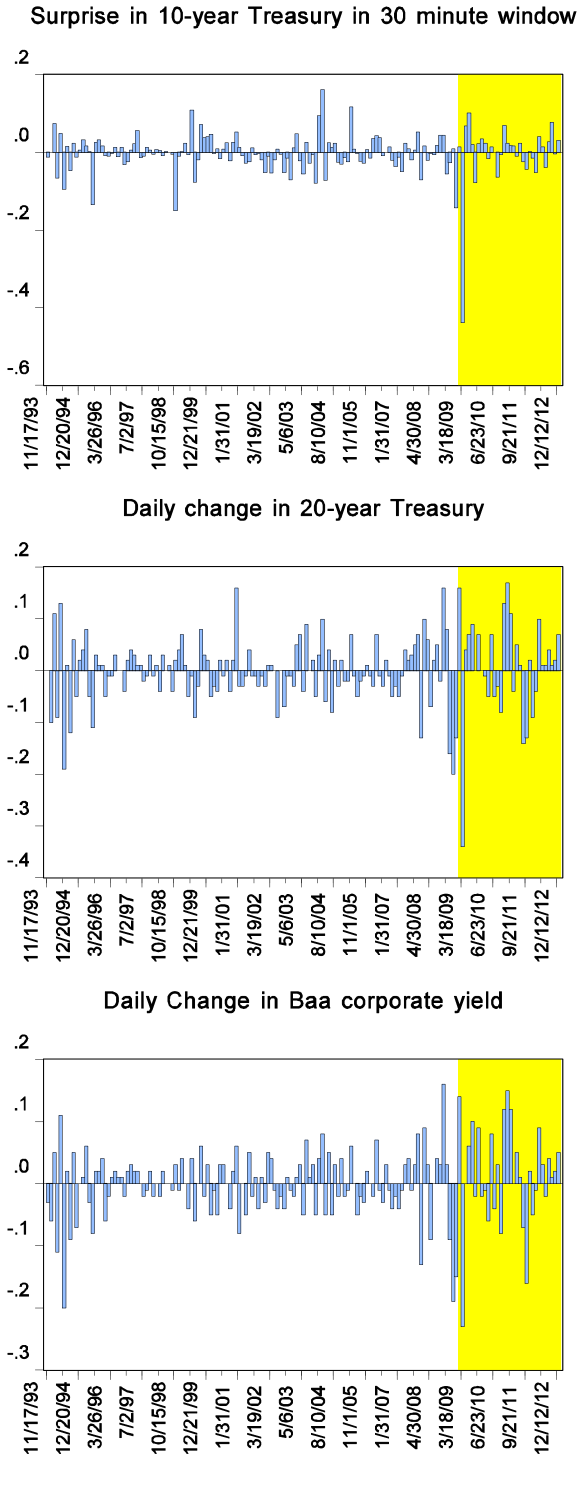

Table 1: Association of 20-year Treasury Yield and Baa Yield Changes

Pre-ZLB and ZLB Periods, Baseline Instruments

	(1)	(2)	(3)	(4)
	Least Squares		IV	
Estimation Sample	Pre-ZLB	ZLB	Pre-ZLB	ZLB
Coefficient (*standard error*) on:				
Change in 20-yr Treasury	0.80	0.80	0.89	0.72
	(0.05)	*(0.06)*	*(0.07)*	*(0.06)*
Test of Overidentifying Restrictions				
(J-test, p-value)	*na*	*na*	*0.46*	*0.25*
Weak Instrument test				
Cragg-Donald F-statistic	na	na	21.5	14.2
Stock-Yogo critical value			9.5	9.5
Tests of Stability Across Samples				
Andrews-Fair test for parameter stability (p-value)		0.18		0.02
Hall-Sen test for stability in overidentifying restrictions (p-value)		na		0.36
Number of observations	129	32	129	32

Note: IV is instrumental variables via 2-step GMM with heteroskedastic errors. Baseline instruments include the surprises in 5-year, 10-year, and 30-year Treasury yields. Weak instrument test refers to the test based on the size of a 5-percent test being no greater than 20 percent, from Stock and Yogo (2002). Both stability tests refer to a breakpoint at the beginning of the ZLB period (that is, after December 16, 2008). Andrews-Fair test is the Wald test from Andrews and Fair (1988). Hall-Sen test is the test for stability in the overidentifying restrictions from Hall and Sen (1999).

Table 2: Association of 20-year Treasury Yield and Aaa Yield Changes

Pre-ZLB and ZLB Periods, Baseline Instruments

	(1)	(2)	(3)	(4)
	Least Squares		IV	
Estimation Sample	Pre-ZLB	ZLB	Pre-ZLB	ZLB
Coefficient (*standard error*) on:				
Change in 20-yr Treasury	0.87	0.73	0.92	0.70
	(0.06)	*(0.04)*	*(0.08)*	*(0.08)*
Test of Overidentifying Restrictions				
(J-test, p-value)	*na*	*na*	*0.73*	*0.27*
Weak Instrument test				
Cragg-Donald F-statistic	na	na	21.5	14.2
Stock-Yogo critical value			9.5	9.5
Tests of Stability Across Samples				
Andrews-Fair test for parameter stability (p-value)		0.00		0.00
Hall-Sen test for stability in overidentifying restrictions (p-value)		na		0.36
Number of observations	129	32	129	32

Note: IV is instrumental variables via 2-step GMM with heteroskedastic errors. Baseline instruments include the surprises in 5-year, 10-year, and 30-year Treasury yields. Weak instrument test refers to the test based on the size of a 5-percent test being no greater than 20 percent, from Stock and Yogo (2002). Both stability tests refer to a breakpoint at the beginning of the ZLB period (that is, after December 16, 2008). Andrews-Fair test is the Wald test from Andrews and Fair (1988). Hall-Sen test is the test for stability in the overidentifying restrictions from Hall and Sen (1999).

Table 3: Association of 20-year Treasury Yield and Aaa/Baa Yield Changes

Pre-ZLB and ZLB Periods, Instrument 10-year Treasury Surprise

	(1)	(2)	(3)	(4)
	Aaa		Baa	
Estimation Sample	Pre-ZLB	ZLB	Pre-ZLB	ZLB
Coefficient (*standard error*) on:				
Change in 20-yr Treasury	0.92	0.70	0.90	0.73
	(0.08)	*(0.06)*	*(0.07)*	*(0.04)*
Weak Instrument test				
Cragg-Donald F-statistic	49.5	38.9	49.5	38.9
Stock-Yogo critical value	6.7	6.7	6.7	6.7
Tests of Stability Across Samples				
Andrews-Fair test for parameter stability (p-value)		0.00		0.02
Number of observations	129	32	129	32

Note: IV is instrumental variables via 2-step GMM with heteroskedastic errors. Instrument includes the surprises in 10-year Treasury yields. Weak instrument test refers to the test based on the size of a 5-percent test being no greater than 20 percent, from Stock and Yogo (2002). Both stability tests refer to a breakpoint at the beginning of the ZLB period (that is, after December 16, 2008). Andrews-Fair test is the Wald test from Andrews and Fair (1988). Hall-Sen test is the test for stability in the overidentifying restrictions from Hall and Sen (1999).