Growth Expectations around FOMC Announcements

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Abstract

We make a novel use of U.S. index dividend futures contracts from 2010-2019 to study the effects of monetary policy shocks on dividend growth expectations over different horizons. We find that a tightening forward guidance shock increases (decreases) growth expectations by 0.15%-0.31% (0.03%-0.30%) across the term structure during the ZLB (post-ZLB) period. A tightening LSAP shock reduces growth expectations by 0.1%-0.16% (0.01%-0.81%) in the same period. The results indicate that both traditional monetary policy channel and central bank information channel are at play and that the unconventional tools effect expectations through a combination of these channels in different time periods.

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1 Introduction

Understanding the link between monetary policy, macro-economy, and the stock market is of fundamental importance to financial economists. How does a monetary policy shock effect growth expectations? How much does it change by? How does it affect the growth expectation over different horizons?

The literature on monetary policy typically studies the effect in a VAR framework and finds a negative effect of a tightening shock on growth expectations. This is known as the pure monetary policy channel. Cieslak and Pang (2021) use a VAR framework to identify economic shocks (monetary, growth, and risk premium news) from stock returns and Treasury yield changes to study asset price dynamics. Pflueger and Rinaldi (2021) use a New-Keynesian model with habit preferences to explain the high-frequency movements in stock prices around FOMC announcements. In their model framework, a surprise increase in interest rates leads to lower output and consumption. On the contrary, the literature on the Fed Information effect assert that there is also an information channel at play where the Fed conveys information about the state of the economy. They show that a surprise increase in interest rates containing information about the state of the economy leads to an increase in growth expectations (Campbell et al., 2012; Nakamura and Steinsson, 2018; Jarociski and Karadi, 2020).

Both channels can be at play simultaneously and have an effect on stock prices. Equity price changes around FOMC announcements show us the cumulative impact on cash flows and discount rate. A tightening monetary policy shock reduces the stock price by increasing the discount rate, reducing the dividend growth expectations, or a combination of both. In order to disentangle the effects on cash flows and discount rate, we make use of index dividend futures contracts. This allows us to estimate the dividend growth expectation changes around monetary policy announcements.

We conduct this investigation in two ways. First, we estimate risk-premia on dividend strips by making use of various predictors and thus, directly estimate the dividend growth expectation changes around FOMC announcements. The second method follows the lower bound estimation procedure of Gormsen and Koijen (2020) and estimates the changes in growth expectations by studying the changes in futures prices around a subset of FOMC announcements where we expect an increase in risk-premia.

Swanson (2020) decomposes the monetary policy shocks along three dimensions - change in Fed Fund Rate (FFR), change in forward guidance (FG), and change in large scale asset purchases (LSAP). This allows us to study the effects of conventional and unconventional monetary policy tools on growth expectations during the zero-lower bound (ZLB hereafter) period and post-ZLB period. We are able to quantify the dividend growth expectation changes through both the pure monetary policy channel and the information channel. Consistent with the theoretical prior of conventional monetary policy, an unexpected tightening of the fed fund rate factor results in a reduction in dividend growth expectations.

During the ZLB period, the Fed adopted unconventional monetary policy tools. These conveyed the Fed's information about the state of the economy and the future expectations. We find that an unexpected tightening in FG stance increases the dividend growth expectations by 0.15%-0.31% across the term structure. During the post-ZLB period, once the economy starts improving, we see that the FG policy acts like a conventional policy tool where a tightening shock reduces growth expectations by 0.03%-0.30%. A tightening LSAP shock reduced growth expectations in both periods. A one-standard deviation shock reduced growth expectations by 0.1%-0.16% in the ZLB period and by 0.01%-0.81% in the post-ZLB period. In the post-ZLB a combination of the conventional and unconventional tools were used by the Fed. Consistent with this, we see that a tightening FFR shock didn't play a role in the ZLB period and reduced growth expectations by 0.47%-1.06% in the post-ZLB period.

Using Jarociski and Karadi (2020)'s poorman sign restriction to identify monetary policy/central bank information dominated announcements, we are able to identify the channel through which the monetary policy shocks affect growth expectations across the different sample periods. We find that the FG factor affects growth expectations predominantly through the information channel in the ZLB period and the monetary policy channel in the post-ZLB period. In the ZLB period, both information channel and monetary policy channel have a complementary effect on growth expectations through the LSAP shock. In the post-ZLB period, LSAP factor affects growth expectations through the monetary policy channel.

Related Literature. Our paper links to the literature on the real effects of monetary policy. Nakamura and Steinsson (2018) and Campbell et al. (2012) use private sector forecast changes at a monthly frequency to estimate growth expectations of GDP, unemployment, and inflation. Cieslak and Schrimpf (2019) and Jarociski and Karadi (2020) study the information effect of monetary policy announcements by the Fed. Exploiting various identification techniques, they find that the Fed affects the stock market through the traditional monetary policy channel and also by communicating information on the state of the economy and future direction. Swanson (2020) and Lewis (2021) decompose the monetary policy shocks across various dimensions and study the effect of both conventional and unconventional monetary policy tools. Using asset prices enables us to identify the changes in dividend growth expectations at the daily frequency. Furthermore, we are able to quantify the effect on not only the stock market but across different maturities (horizons) as well. By studying the impact of monetary policy tools and the various channels through which the Fed can influence the stock market across the term structure, our results help shed light on and provide guidance to theoretical models on the real effects of monetary policy.

Our paper builds on the literature studying the impact of macro announcements on asset prices. Savor and Wilson (2013) find that most of the market premium is earned on macro-announcement days. Furthermore, Savor and Wilson (2014) document that asset pricing models work well on these macro-announcement days. Cieslak et al. (2019) suggest that that stock returns move cyclically in FOMC cycle time, with most of the equity premium being earned in even weeks. This is due to the fact that macro news is released not only on announcement days but in a biweekly pattern. Ai and Bansal (2018) develop a model of generalized risk sensitivity to explain the announcement day premiums earned. Wachter and Zhu (2021) model the announcement premium in a model where investors demand risk compensation as they learn about the latent disaster probabilities on announcement days. Pflueger and Rinaldi (2021) develop a new-Keynesian model with habit preferences to study asset price dynamics around FOMC announcements. Cieslak and Pang (2021) use a VAR framework to identify economic shocks and study asset price dynamics. In their framework, on FOMC announcements, both growth and risk-premia shocks play a role. Whilst most of the focus is on the announcement effect on risk premium, we use index dividend futures contracts to study and quantify the effect on cash flow expectations.

Our paper is also related to the literature on the term structure of equity returns. Initially, Binsbergen et al. (2012) used options data on the S&P500 Index to price the dividend strips. Binsbergen et al. (2013) extended the analysis of Binsbergen et al. (2012) by making use of index dividend futures contracts, allowing for the direct measurement of the dividend strip prices for a longer maturity upto 10 years. Binsbergen and Koijen (2017) reviewed the theories and facts around the term structure of equity returns and documented existing structural models failed to reconcile the downward sloping term structure observed using the dividend futures data. Bansal et al. (2020) find that the equity term structure is upward sloping during expansion periods and downward sloping during recessions. They use a consumption-based regime-shifting model to reconcile the facts observed in the data. Similar to Gormsen and Koijen (2020)'s use of dividend futures contracts, we study the monetary policy effect on growth expectations across different horizons.

The remainder of the paper is as follows. In Section 2 presents the conceptual framework to understand the changes in growth expectations and risk-premia dynamics around monetary policy announcements. Section 3 describes the data used and provides the empirical results of the different approaches in estimating growth expectation changes. Section 4 concludes.

2 Conceptual Framework

2.1 Notation and Definition

We let S_t be price of the stock market index. Its value is defined as the present value of all future dividend claims.

$$S_t = \sum_{n=1}^{\infty} \frac{\mathbb{E}_t \left[D_{t+n} \right]}{1 + \mu_t^{(n)}} \tag{1}$$

Here, $\mathbb{E}_t \left[D_{t+n} \right]$ is the expected value of the future dividend claim and $1 + \mu_t^{(n)}$ is the discount rate on that dividend claim. The price of the stock market can be written as a portfolio of dividend strips, where the dividend strips only pay the dividend claims in a given year.

$$S_t = \sum_{n=1}^{\infty} P_t^{(n)} \tag{2}$$

Analogous to (1), the dividend strip price is as follows:

$$P_t^{(n)} = \frac{\mathbb{E}_t \left[D_{t+n} \right]}{1 + \mu_t^{(n)}} \tag{3}$$

In the data we observe the futures price on the dividend strip and not the spot price. Hence, using the no-arbitrage condition gives us:

$$\begin{aligned} F_t^{(n)} &= P_t^{(n)} \left(1 + y_t^{(n)} \right) \\ &= \frac{\mathbb{E}_t \left[D_{t+n} \right]}{\frac{1+\mu_t^{(n)}}{1+y_t^{(n)}}} = D_t \frac{G_t^{(n)}}{1 + \theta_t^{(n)}} \end{aligned} \tag{4}$$

where, $G_t^{(n)} = \mathbb{E}_t \left[\frac{D_{t+n}}{D_t} \right]$ is the dividend growth expectation between time t and $t + n$, $y_t^{(n)}$ is the n-period risk free rate, and $\theta_t^{(n)} = \frac{1+\mu_t^{(n)}}{1+y_t^{(n)}} - 1$ is the excess return on the n-period dividend risk. A one-period dividend strip return with time to maturity n can be defined as:

$$R_{t+1}^{(n)} = \frac{P_{t+1}^{(n-1)}}{P_t^{(n)}} = \frac{F_{t+1}^{(n-1)}}{F_t^{(n)}} \times \frac{\exp\left(-(n-1)\,y_{t+1}^{(n-1)}\right)}{\exp\left(-ny_t^{(n)}\right)} \tag{5}$$

Following from (5), the dividend strip return to maturity is written as:

$$R_{t,t+n} = \frac{D_{t+n}}{F_t^{(n)}} \times \frac{1}{\exp\left(-ny_t^{(n)}\right)} \tag{6}$$

Therefore, the hold-to-maturity excess return is:

$$\log \Theta_t^{(n)} = r_{t,t+n} - y_t^{(n)} \tag{7}$$

where, $r_{t,t+n}$ is the log hold-to-maturity return.

Following from (4), changes in futures price over a short period of time, from t to t' where $t' > t$, can either come from changes in risk-premia, or changes in growth expectations, or a combination of the two.

$$\Delta \log F_{t'}^{(n)} = \Delta \log G_{t'}^{(n)} - \Delta \log \Theta_{t'}^{(n)} \tag{8}$$

In order to analyze the term-structure effects, we scale (8) by maturity (n).

2.2 Identification Challenge

We are interested in inferring the changes in growth expectations ($\Delta \log G_{t'}^{(n)}$) around monetary policy announcements. However, we cannot directly observe this as we only observe the changes in futures price ($\Delta \log F_{t'}^{(n)}$). Furthermore, our identification is contaminated by changes in risk-premia around monetary policy announcements.

- Risk-premia systematically reduces in the lead up to FOMC announcements due to the resolution of uncertainty. According to Hu et al. (2020), the change in VIX in the 24 hours prior to FOMC announcements can proxy for the resolution of uncertainty.
- Risk-premia may increase/decrease depending on the fundamental news contained in the announcement.

2.3 Identification Strategy

Ying (2021) shows that not all FOMC announcement days are the same. FOMC announcements exhibit a strong pre-drift only when there is some risk compensation for market makers. We can identify these announcements by looking at the change in VIX in the 24-hours prior to the announcement. He finds that this is correlated with a high VIX drop. In order to analyze monetary policy announcements where the resolution of uncertainty channel is muted, we sort the announcements based on the uncertainty resolution in the 24-hours prior to the announcement and focus on the set of announcements which are in the bottom two terciles of drop in VIX.

Our strategy involves 2 approaches. In the first approach we directly estimate risk-premia and thus, pinning down the changes in growth expectations by observing the changes in the futures price and risk-premia. In the second approach, we estimate the lower bound on growth expectations in the spirit of Gormsen and Koijen (2020).

Approach 1 - Estimate Changes in Risk-Premia.

From (2), we know that the stock market index can be written as a portfolio of dividend strips. Thus, the risk-premium on the aggregate market can be written as a weighted average of the risk-premia on dividend strips of different maturity. That is:

$$\log \Theta_t^{MKT} \approx \gamma^{(n)} \times \log \Theta_t^{(n)} \tag{9}$$

We follow Martin (2017) to compute the lower bound estimate on the stock market. Furthermore, following Hu et al. (2020), we also use VIX as a proxy for risk-premia. We use Baker et al. (2016)'s EPU Index as our 3^{rd} predictor of risk-premia. Thus, to estimate the risk-premia on the dividend strips, we regress the realized hold-to-maturity excess return on the lower bound estimate of market equity risk premium, VIX, and EPU Index. We use the fitted values of the regression as our measure of expected risk-premia on the dividend strips of different maturities.

$$\log \Theta_t^{(n)} = \alpha^{(n)} + \beta_1^{(n)} \log \Theta_{t,LB}^{MKT} + \beta_2^{(n)} \log VIX_t + \beta_3^{(n)} \log EPU_t + \epsilon_t^{(n)} \tag{10}$$

$$\log \hat{\Theta}_t^{(n)} = \hat{\alpha}^{(n)} + \hat{\beta}_1^{(n)} \log \Theta_{t,LB}^{MKT} + \hat{\beta}_2^{(n)} \log VIX_t + \hat{\beta}_3^{(n)} \log EPU_t \tag{11}$$

Once, we estimated the risk premium, we compute the changes in growth expectations as:

$$\Delta \log G_t^{(n)} = \Delta \log F_t^{(n)} + \Delta \log \hat{\Theta}_t^{(n)} \tag{12}$$

Approach 2 - Lower Bound on Growth Expectations. In the context of COVID-19, Gormsen and Koijen (2020) are able to compute the lower bound on growth expectations by making a key assumption that the risk-premia did not decline (i.e. $\Delta \log \Theta_t^{(n)} > 0$). However, as discussed above, due to competing forces, risk-premia may either increase or decrease around monetary policy announcements.

Thus, we focus on a subset of announcements where we can apply the key assumption made in Gormsen and Koijen (2020) and estimate a lower bound on the changes in growth expectations in the event of a tightening shock.

3 Empirical Evidence

3.1 Data Source

Dividend Futures Prices. We get this data from 2 sources. The 1^{st} dataset is the proprietary data of a financial institution that is active in this market. The data consists of Bid and Ask prices from January 2010 to February 2017. The 2^{nd} dataset is the exchange traded data on MID prices available on Bloomberg. The sample period is from November 2015 to December 2019. Both sets of price data are at a daily frequency. It is standard practice in the literature to analyze fixed maturity contracts. Thus, following Bansal et al. (2020), we linearly interpolate between futures prices. To get standard maturity returns we interpolate between the holding period returns.

Monetary Policy Shocks. We use 3 different types of FOMC monetary policy shocks - Swanson (2020), Bernanke and Kuttner (2005), and Nakamura and Steinsson (2018). The Swanson (2020) shocks are calculated as the first three principal components of high-frequency changes of Fed-Fund futures and EuroDollar futures contratcs around FOMC announcements. These shocks can be understood to be along 3 dimensions (a) change in the federal funds rate (FFR), (b) change in forward guidance (FG), and (c) large scale asset purchase (LSAP) announcements. The Bernanke and Kuttner (2005) and Nakamura and Steinsson (2018) policy shocks are sourced from Miguel Acostas website[1]. The BK surprise is calculated using the Fed Fund Futures. The NS shock is calculated as the first principal component of the 30-minute changes of various interest rate futures around FOMC announcements.

S&P500 Index Data. Daily frequency data on the returns of the index and dividends

[1]Monetary Policy Shocks data is available at https://www.acostamiguel.com/research

earned in the past 12 months is sourced from Bloomberg.

Zero-Coupon Bond Yields Data. To compute the hold-to-maturity returns on the dividend strips we need the the zero-coupon yields for different maturities. This data comes from Gürkaynak et al. (2006) which is available on the Fed website[2].

EPU Data. Daily frequency data is based on Baker et al. (2016) and is sourced the policy uncertainty website[3].

VIX Data. Daily frequency data is sourced from Bloomberg. The high-frequency intra-day data is from Reuters Refintiv.

3.2 Summary Statistics

Table 1 provides the summary statistics of the S&P500 Index Dividend Futures data used in our analysis. The yields and returns are scaled by maturity and reported in % form. We first look at the Forward Equity Yield in Panel A. The unconditional term structure is upward sloping in both sample periods for U.S. equity. The proprietary data sample overlaps with the ZLB period while the exchange data sample overlaps withe the post-ZLB period in the U.S. Consistent with the findings of Binsbergen and Koijen (2017), the volatility of the dividend strips is downward sloping with maturity.

Panel B and C report the statistics for the Daily Futures Price Changes and Realized Hold-to-Maturity Excess Returns. Since our exchange sample data spans from 2015 to 2019, we report the statistics on HTM returns for upto 5 years maturity. Consistent with the underlying relationship between HTM returns and forward equity yields, the realized HTM excess returns also exhibit an upward sloping term structure.

Table 2 provides the summary statistics on the monetary policy shocks on FOMC announcements days over our sample period. There are 77 scheduled FOMC announcements over our entire sample period. The Swanson (2020) shocks data ends in June 2019, as such we have data for 75 of the 77 scheduled announcements. The Bernanke and Kuttner (2005) and Nakamura and Steinsson (2018) shocks are reported in basis points.

The monetary policy shocks have different scales. The Nakamura and Steinsson (2018) shock has a scale such that its effect on the one-year nominal treasury yield is equal to one. Footnote 8 of Swanson (2020) states that "the scale of the federal funds rate factor is normalized to have a unit standard deviation from July 1991 to December 2008. The LSAP

[2]US Government Bond Yields data is available at https://www.federalreserve.gov/pubs/feds/2006/200628/200628abs.html

[3]EPU Index data is available at https://www.policyuncertainty.com/us_monthly.html

factor is normalized to have a unit standard deviation over the period from Jan 2009 to Oct 2015. The forward guidance factor is normalized to have a unit standard deviation over the period July 1991 to June 2019."

Table 1: **S&P500 Index Dividend Futures - Summary Statistics (All Days)**

This table reports the summary statistics of the S&P500 Index Dividend Futures data used in our analysis. Panels A, B, and C report the summary statistics for the forward equity yields, daily futures returns, and hold-to-maturity excess returns. Forward Equity Yields are computed as $e^f_{n,t} = \frac{1}{n}\log\left(\frac{D_t}{F_t^{(n)}}\right)$, where $F_t^{(n)}$ is the n-maturity futures price and D_t is the trailing 12-months dividends earned on the index. Daily Futures Price Changes are computed as $\Delta \log F_{t'}^{(n)} = \log F_{t'}^{(n)} - \log F_t^{(n)}$. Realized Hold-to-Maturity Excess Returns are computed as $\frac{1}{n}\log\Theta_t^{(n)} = \frac{1}{n}\left(r_{t,t+n} - y_t^{(n)}\right)$, where, $r_{t,t+n}$ is the log hold-to-maturity return and $y_t^{(n)}$ is the n-maturity zero-coupon yield. Both yields and returns are scaled by maturity and reported in % form. The proprietary data sample period is from Jan 2010 to Feb 2017. Exchange data sample is from Nov 2015 to Dec 2019.

n	**1Y**	**2Y**	**3Y**	**4Y**	**5Y**	**6Y**	**7Y**
			Panel A: Forward Equity Yield				
			Proprietary Data				
Mean	-6.2161	-5.7031	-5.0628	-4.6596	-4.4172	-4.2498	-4.1245
Median	-6.4904	-6.1008	-5.4311	-5.0054	-4.8157	-4.5773	-4.4227
Std Dev	3.0698	2.5240	2.2055	1.9562	1.7959	1.6852	1.6050
Num Obs	1844	1844	1844	1844	1844	1844	1844
			Exchange Data				
Mean	-4.1155	-3.8135	-3.4653	-3.2365	-3.0507	-3.4757	-3.3298
Median	-4.6680	-4.1587	-3.6495	-3.4055	-3.2665	-3.5402	-3.4107
Std Dev	2.1489	1.8778	1.7109	1.5574	1.4147	0.9770	0.9075
Num Obs	972	972	972	972	972	699	697
			Panel B: Daily Futures Price Changes				
			Proprietary Data				
Mean	0.0406	0.0423	0.0435	0.0435	0.0435	0.0434	0.0433
Median	0.0231	0.0132	0.0118	0.0115	0.0116	0.0110	0.0111
Std Dev	0.2696	0.3284	0.4259	0.4907	0.6003	0.6299	0.6905
Num Obs	1842	1847	1847	1847	1847	1847	1847
			Exchange Data				
Mean	0.0245	0.0178	0.0123	0.0065	0.0015	0.0125	0.0101
Median	0.0160	0.0084	0.0097	0.0091	0.0083	0.0105	0.0194
Std Dev	0.1713	0.3401	0.5477	0.5927	0.6691	0.5296	0.5418
Num Obs	970	975	975	975	975	701	700

n	1Y	2Y	3Y	4Y	5Y	6Y	7Y
			Panel C: Hold-to-Maturity Excess Return				
			Proprietary Data				
Mean	2.2900	3.1797	3.7088	3.8166	3.8908	4.1351	4.5553
Median	2.1405	2.9900	3.6207	3.7849	3.8126	3.8777	4.2534
Std Dev	0.9807	1.4035	1.5813	1.6917	1.7400	1.5225	1.1341
Num Obs	1769	1773	1727	1477	1226	977	728
			Exchange Data				
Mean	0.7986	1.5815	2.7178	4.0125	3.2608		
Median	0.3907	1.3206	3.1642	3.9229	3.4765		
Std Dev	1.1914	1.4690	1.3703	0.7718	0.8924		
Num Obs	966	775	526	275	25		

Table 2: **Monetary Policy Shocks - Summary Statistics**

This table reports the summary statistics of the different monetary policy shocks on scheduled FOMC announcement days. Change in FFR, Change in FG, and Change in LSAP are the shocks from Swanson (2020). FFR Shock - BK is the shock from Bernanke and Kuttner (2005). Policy Shock - NS is the shocks from Nakamura and Steinsson (2018). The FFR Shock - BK and Policy Shock - NS are reported in basis points. The Policy Shock - NS has a scale such that its effect on one-year nominal treasury yield is equal to one. The scale of Swanson (2020)'s Change in FFR factor is normalized to have a unit standard deviation from July 1991 to December 2008. The scale of change in FG factor is normalized to have a unit standard deviation from July 1991 to June 2019. The scale of change in LSAP factor is normalized to have a unit standard deviation from January 2009 to October 2015.

Shocks	**Change in FFR**	**Change in FG**	**Change in LSAP**	**FFR Shock - BK**	**Policy Shock - NS**
Mean	0.1425	-0.0729	0.0062	0.0397	0.2706
Median	0.1391	0.005	-0.0122	0	0.5252
Std Dev	0.1488	0.7711	0.5477	1.4615	1.9596
# Announcements	75	75	75	77	77
Start Date	16-03-10	16-03-10	16-03-10	16-03-10	16-03-10
End Date	19-06-19	19-06-19	19-06-19	18-09-19	18-09-19

3.3 Approach 1 - Estimating Changes in Risk Premia

To directly estimate the changes in growth expectations, we first calculate the expected risk-premia on the dividend strips as in (10) and (11). Table 3 reports the results of the regression of realized hold-to-maturity returns on S&P500 Index Dividend Futures on Martin (2017)'s measure of equity premium lower bound, VIX, and Baker et al. (2016)'s EPU Index. The coefficients are statistically significant across all maturities and different data samples suggesting that the lower bound on market equity premium is a good instrument for the equity premium on dividend strips. In Panel B we only have estimates from 1-5 years as the longest possible maturity for realized returns is 5 years. Thus, we use the coefficients in Panel C to compute the estimated risk-premia in both the proprietary data and exchange data sample.

Next, as defined in (12), the changes in growth expectation is the computed as the sum of changes in futures price and expected changes in risk-premia. The changes in growth expectation is scaled by maturity to reflect the per annum average change. We then capture the effect of monetary policy on dividend growth expectations by running the following regression specification:

$$\begin{aligned}\Delta \log G_t^{(n)} = \alpha_0 + &\sum_{i=1}^{\#\text{shocks}} \beta_i * \text{High Resolution of Uncertainty}_t \times Shock_{i,t} \\ &+ \sum_{i=1}^{\#\text{shocks}} \beta_{\#\text{shocks}+i} * \text{Low Resolution of Uncertainty}_t \times Shock_{i,t} + \epsilon_t^{(n)} \end{aligned} \quad (13)$$

The main specification takes into account both FOMC announcement days and other days. On non-FOMC announcement days we set the shocks to 0. High (Low) Resolution of Uncertainty are dummy variables that indicate whether on a certain FOMC announcement date there is a high (low) drop in VIX in the 24-hours prior to the announcement based on a tercile cut. Our variables of interest is the interaction term between the Low Resolution of Uncertainty dummy and the monetary policy shocks. Here, the risk-premia effect due to the resolution of uncertainty channel is muted. Since we directly estimate the risk-premia changes and take it into account, the coefficients identify the effect changes in growth expectations.

Our main results in Table 4 use the Swanson (2020) shocks. This allows us to study the impact of conventional and unconvential monetary policy tools used by the Fed. Panel A reports the results for the ZLB period. During this period, the Fed adopted unconventional monetary policy tools such as forward guidance and large scale asset purchases. Consistent with the Fed's actions, we see that the FG and LSAP factors have a greater impact on growth expectations than the FFR factor. The FG factor has a statistically significant effect on the dividend growth expectations across all maturities. A one-standard deviation tightening of FG increases the growth expectations by 0.15% - 0.31%. Given that the economy was in a bad shape during this period of time, the Fed's forward guidance approach conveys its information about the state of the economy. Thus, consistent with the findings of Nakamura and Steinsson (2018), an unexpected future increase in interest rate is perceived to be good news for the economy and hence, the growth expectations increase. A one-standard deviation decrease in LSAPs decreases growth expectations by 0.08% - 0.16% (significant at short maturities). A one-standard deviation increase in the Fed Fund Rate reduces the growth expectations by 0.01% - 0.56%, although the effect is not statistically significant. These effects on growth expectations tend to be non-monotonic along the term structure.

Panel B reports the results for the post-ZLB period using the exchange data. During this period the Fed adopts a mixture of both conventional and unconventional monetary policy instruments. Thus, we see that the FFR factor plays an important role in determining growth expectations. A one-standard deviation increase in Fed Fund Rate reduces growth expectations by 0.46% - 1.06% over 1 to 7 years. This is statistically significant at all maturities. The FG factor also has a similar impact, where a one-standard deviation tightening FG reduces growth expectations 0.03% - 0.3%. Similarly, a one-standard deviation decrease in LSAPs decreases growth expectations by 0.01% - 0.81%.

Tables 5 and 6 report the results analogous to those in Table 4. We now use Bernanke and Kuttner (2005)'s and Nakamura and Steinsson (2018)'s measures of monetary policy shocks. Given that during the ZLB period the unconventional monetary policy tools were used, we see that the FFR and Policy News shocks don't have a statistically significant impact on growth expectations. During the post-ZLB period the Fed starts to use a mixture conventional and unconventional monetary policy tools and as such we see in Panel B of both tables that a tightening shock reduces growth expectations.

Table 3: **Estimated Risk-Premia on S&P500 Index Dividend Futures Contracts**

This table reports the results of the regression of realized hold-to-maturity returns on S&P500 Index Dividend Futures on Martin (2017)'s measure of lower bound on the market equity premium, VIX, and Baker et al. (2016) EPU Index. The proprietary data sample is from Jan 2010 to Feb 2017 covering the Zero Lower Bound period. Exchange data sample is from Nov 2015 to Dec 2019 covering the Post-Zero Lower Bound period. The combined sample uses both data sources. t-statistics based on robust standard errors are reported in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. R^2 is in % form.

n	1Y	2Y	3Y	4Y	5Y	6Y	7Y
				Panel A: Proprietary Data			
Intercept	-0.028***	-0.073***	-0.086***	-0.103***	-0.108***	-0.099***	-0.061***
	[-5.99]	[-15.37]	[-22.88]	[-28.65]	[-34.05]	[-20.98]	[-11.02]
Equity Premium	0.145***	0.136**	0.085**	0.076**	0.024*	-0.038	-0.05**
	[2.63]	[2.51]	[2.43]	[2.55]	[1.76]	[-1.30]	[-2.33]
VIX	0.015***	0.028***	0.035***	0.04***	0.042***	0.041***	0.03***
	[6.76]	[12.88]	[21.55]	[25.67]	[36.02]	[26.06]	[21.94]
EPU	0.001***	0.005***	0.004***	0.006***	0.006***	0.004***	0.004***
	[3.32]	[11.07]	[10.05]	[11.57]	[10.34]	[6.73]	[4.87]
Regression R^2	42.170	60.174	59.406	67.978	66.856	63.529	47.089
Num Obs	1765	1765	1719	1469	1219	970	721
				Panel B: Exchange Data			
Intercept	0.031***	0.028***	-0.045***	-0.002	0.057		
	[5.87]	[3.46]	[-8.45]	[-0.42]	[1.41]		
Equity Premium	0.445***	0.504***	0.096	-0.025	0.008		
	[3.24]	[2.98]	[1.61]	[-1.10]	[0.19]		
VIX	-0.009***	-0.002	0.035***	0.02***	-0.015		
	[-3.37]	[-0.56]	[17.17]	[11.09]	[-0.66]		
EPU	-0.002***	-0.005***	-0.005***	-0.003***	0.004		
	[-3.00]	[-4.42]	[-6.06]	[-4.29]	[0.67]		
Regression R^2	9.714	15.169	55.409	34.687	4.745		
Num Obs	1021	771	523	275	25		

n	1Y	2Y	3Y	4Y	5Y	6Y	7Y
				Panel C: Combined Data			
Intercept	-0.029***	-0.066***	-0.081***	-0.087***	-0.108***	-0.099***	-0.061***
	[-5.25]	[-12.19]	[-24.46]	[-24.65]	[-34.21]	[-20.98]	[-11.02]
Equity Premium	0.231***	0.205***	0.09***	0.08**	0.024*	-0.038	-0.05**
	[3.02]	[2.82]	[2.59]	[2.53]	[1.76]	[-1.30]	[-2.33]
VIX	0.012***	0.025***	0.036***	0.037***	0.041***	0.041***	0.03***
	[4.70]	[9.81]	[25.24]	[24.86]	[35.92]	[26.06]	[21.94]
EPU	0.001**	0.004***	0.002***	0.004***	0.006***	0.004***	0.004***
	[2.52]	[7.88]	[6.34]	[7.88]	[10.24]	[6.73]	[4.87]
Regression R^2	26.893	44.166	59.789	60.745	66.153	63.529	47.089
Num Obs	2786	2536	2242	1744	1244	970	721

Table 4: **Estimated Effects of Changes in Fed Fund Rate, Forward Guidance, and LSAPs on Dividend Growth Expectations**

This table reports the results of the regression of daily changes in dividend growth expectations of constant maturity S&P500 Index Dividends futures on Swanson (2020)'s monetary policy factors. On non-FOMC announcement days the factors are set to 0. High (Low) VIX Drop are dummy variables which take on the value of 1 if the FOMC announcement has a drop in VIX in the top (bottom 2) tercile(s) and 0 otherwise. The proprietary data sample period is from Jan 2010 to Feb 2017 covering the Zero Lower Bound period. The exchange data sample is from Nov 2015 to June 2019 covering the Post-Zero Lower Bound period. Coefficients are expressed in percentage per standard deviation change in the shocks. *t*-statistics based on robust standard errors are reported in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. R^2 is in % form.

n	1Y	2Y	3Y	4Y	5Y	6Y	7Y
				Panel A: Proprietary Data			
Intercept	0.041***	0.021	0.015	0.011	0.008	0.007	0.006
	[2.88]	[1.61]	[1.59]	[1.16]	[0.78]	[0.73]	[0.81]
High VIX Drop * Change in FFR	-0.195	-0.198	-0.551	-0.465	-0.325	-0.382	-0.218
	[-0.66]	[-0.54]	[-1.1]	[-0.88]	[-0.57]	[-0.72]	[-0.56]
High VIX Drop * Change in FG	0.074*	0.054	0.071	0.065	0.06	0.064	0.044
	[1.67]	[1.08]	[1.00]	[0.95]	[0.85]	[0.95]	[0.92]
High VIX Drop * Change in LSAP	0.025	0.034	-0.017	-0.01	0.01	0.006	0.016
	[0.29]	[0.38]	[-0.15]	[-0.08]	[0.08]	[0.05]	[0.17]
Low VIX Drop * Change in FFR	-0.01	-0.39	-0.51	-0.556	-0.521	-0.49	-0.468
	[-0.04]	[-0.84]	[-0.99]	[-1.08]	[-0.86]	[-0.95]	[-1.13]
Low VIX Drop * Change in FG	0.152**	0.212	0.311**	0.282*	0.311	0.289*	0.182
	[2.17]	[1.62]	[2.28]	[1.95]	[1.63]	[1.88]	[1.48]
Low VIX Drop * Change in LSAP	0.100**	0.127*	0.156**	0.138*	0.123	0.115	0.079
	[1.99]	[1.76]	[2.11]	[1.77]	[1.43]	[1.49]	[1.24]
Regression R^2	0.081	0.213	0.912	0.753	0.633	0.716	0.544
Num Obs	1759	1760	1760	1760	1760	1760	1760

n	**1Y**	**2Y**	**3Y**	**4Y**	**5Y**	**6Y**	**7Y**
			Panel B: Exchange Data				
Intercept	0.027***	0.013	0.007	0.005	0.005	0.01	0.008
	[2.70]	[1.08]	[0.63]	[0.41]	[0.33]	[0.64]	[0.68]
High VIX Drop * Change in FFR	0.233	0.088	0.149	0.149	0.222	-0.618***	-0.52***
	[1.05]	[0.33]	[0.48]	[0.44]	[0.54]	[-3.78]	[-5.03]
High VIX Drop * Change in FG	0.079***	0.145***	0.183***	0.184***	0.205***	-0.139*	-0.144***
	[3.00]	[3.23]	[3.33]	[3.07]	[3.15]	[-1.85]	[-2.82]
High VIX Drop * Change in LSAP	-0.179	-0.668**	-0.723**	-0.741**	-0.763*	0.392***	0.268***
	[-0.88]	[-2.47]	[-2.18]	[-2.07]	[-1.75]	[3.26]	[3.33]
Low VIX Drop * Change in FFR	-0.467**	-0.805***	-0.63***	-0.705***	-1.06***	-0.979***	-0.869***
	[-2.18]	[-3.86]	[-3.51]	[-3.40]	[-3.68]	[-3.60]	[-3.53]
Low VIX Drop * Change in FG	-0.029	-0.19***	-0.146***	-0.205***	-0.302***	-0.185**	-0.161**
	[-0.83]	[-4.48]	[-3.39]	[-4.15]	[-3.88]	[-2.24]	[-2.39]
Low VIX Drop * Change in LSAP	0.009	0.512***	0.388***	0.533***	0.814***	0.38*	0.281
	[0.06]	[3.81]	[4.75]	[3.92]	[3.49]	[1.77]	[1.61]
Regression R^2	0.282	0.992	0.978	1.085	1.196	0.793	0.946
Num Obs	900	901	901	901	901	629	628

Table 5: **Estimated Effects of Fed Fund Rate shock on Dividend Growth Expectations**

This table reports the results of the regression of daily changes in dividend growth expectations of constant maturity S&P500 Index Dividend Futures on Bernanke and Kuttner (2005)'s Fed Fund Rate shock. On non-FOMC announcement days the shock is set to 0. High (Low) VIX Drop are dummy variables which take on the value of 1 if the FOMC announcement has a drop in VIX in the top (bottom 2) tercile(s) and 0 otherwise. The proprietary data sample is from Jan 2010 to Feb 2017 covering the Zero Lower Bound period. The exchange data sample is from Nov 2015 to Sep 2019 covering the Post-Zero Lower Bound period. Coefficients are expressed in percentage per basis point change in the shock. t-statistics based on robust standard errors are reported in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. R^2 is in % form.

n	1Y	2Y	3Y	4Y	5Y	6Y	7Y
	Panel A: Proprietary Data						
Intercept	0.041***	0.02	0.013	0.009	0.007	0.005	0.005
	[2.92]	[1.55]	[1.42]	[0.98]	[0.64]	[0.57]	[0.63]
High VIX Drop * Shock	0.021	0.03	0.034	0.038	0.046	0.041	0.029
	[1.10]	[0.89]	[0.77]	[0.76]	[0.80]	[0.79]	[0.76]
Low VIX Drop * Shock	0.086	0.093	0.146	0.149	0.309	0.225	0.113
	[1.18]	[0.66]	[0.89]	[0.95]	[1.56]	[1.45]	[0.94]
Regression R^2	0.017	0.028	0.114	0.117	0.328	0.234	0.104
Num Obs	1759	1760	1760	1760	1760	1760	1760
	Panel B: Exchange Data						
Intercept	0.024***	0.009	0.004	0.002	0.001	0.006	0.004
	[2.65]	[0.82]	[0.39]	[0.16]	[0.08]	[0.39]	[0.40]
High VIX Drop * Shock	0.058*	0.055	0.072	0.077	0.101	-0.033	-0.044**
	[1.90]	[0.72]	[0.84]	[0.84]	[1.04]	[-1.20]	[-2.24]
Low VIX Drop * Shock	-0.018	-0.044**	-0.036	-0.051*	-0.076**	-0.066*	-0.058**
	[-1.49]	[-1.99]	[-1.19]	[-1.73]	[-2.12]	[-1.88]	[-2.27]
Regression R^2	0.171	0.209	0.241	0.316	0.419	0.361	0.470
Num Obs	964	965	965	965	965	693	692

Table 6: **Estimated Effects of Policy News shock on Dividend Growth Expectations**

This table reports the results of the regression of daily changes in dividend growth expectations of constant maturity S&P500 Index Dividend Futures on Nakamura and Steinsson (2018)'s Policy News shock. On non-FOMC announcement days the shock is set to 0. High (Low) VIX Drop are dummy variables which take on the value of 1 if the FOMC announcement has a drop in VIX in the top (bottom 2) tercile(s) and 0 otherwise. The proprietary data sample is from Jan 2010 to Feb 2017 covering the Zero Lower Bound period. The exchange data sample is from Nov 2015 to Sep 2019 covering the Post-Zero Lower Bound period. Coefficients are expressed in percentage per unit change in the shock. t-statistics based on robust standard errors are reported in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. R^2 is in % form.

n	1Y	2Y	3Y	4Y	5Y	6Y	7Y
			Panel A: Proprietary Data				
Intercept	0.04***	0.019	0.012	0.008	0.006	0.004	0.004
	[2.88]	[1.49]	[1.31]	[0.89]	[0.55]	[0.48]	[0.56]
High VIX Drop * Shock	0.019	0.006	0.004	0.004	0.004	0.005	0.003
	[1.16]	[0.28]	[0.13]	[0.12]	[0.13]	[0.18]	[0.14]
Low VIX Drop * Shock	0.04	0.046	0.068	0.055	0.064	0.057	0.03
	[1.17]	[0.78]	[1.1]	[0.84]	[0.76]	[0.84]	[0.55]
Regression R^2	0.027	0.031	0.138	0.085	0.093	0.095	0.040
Num Obs	1759	1760	1760	1760	1760	1760	1760
			Panel B: Exchange Data				
Intercept	0.024***	0.009	0.004	0.002	0.001	0.004	0.003
	[2.64]	[0.81]	[0.37]	[0.15]	[0.07]	[0.31]	[0.30]
High VIX Drop * Shock	0.023	0.022	0.032	0.032	0.041	-0.053	-0.056*
	[1.23]	[0.63]	[0.76]	[0.75]	[0.91]	[-1.22]	[-1.8]
Low VIX Drop * Shock	-0.001	-0.019	-0.008	-0.023	-0.037	-0.006	-0.01
	[-0.08]	[-0.64]	[-0.29]	[-0.67]	[-0.76]	[-0.14]	[-0.31]
Regression R^2	0.045	0.059	0.065	0.099	0.140	0.044	0.089
Num Obs	964	965	965	965	965	693	692

3.4 Effect of Information Shocks on Growth Expectation Changes

According to Swanson (2020), the FG and LSAP factors capture the average "total forward guidance" and "total LSAP"effect. As such the effect of these shocks on growth expectations could be due to the traditional monetary policy channel, information channel, or some combination of both. The switching signs for the forward guidance factor in the ZLB and post-ZLB period suggest that a combination of these channels are at play at different times.

We use Jarociski and Karadi (2020)'s poorman sign restriction to identify which announcements are information channel dominant and monetary policy channel dominant. This restriction classifies the FOMC announcement into monetary policy (central bank information) dominated if there is a negative (positive) co-movement between 3-month Fed Fund Futures and S&P500 Index in the 30-min window around the FOMC announcements. Those announcements where there is no movement in the 3-month Fed Fund Futures are identified as unclassified.

In order to validate our prior results we use the additional restriction in the following regression specification:

$$\begin{aligned}\Delta \log G_t^{(n)} = \alpha_0 &+ \sum_{i=1}^{3} \beta_i * \text{High Resolution of Uncertainty}_t \times Shock_{i,t} \\ &+ \beta_4 * \text{Low Resolution of Uncertainty}_t \times FFR_t \\ &+ \sum_{i=1}^{3} \beta_{i+4} * \text{Low Resolution of Uncertainty}_t \times FG_t \times \text{JK Restriction}_{i,t} \\ &+ \sum_{i=1}^{3} \beta_{i+7} * \text{Low Resolution of Uncertainty}_t \times LSAP_t \times \text{JK Restriction}_{i,t} \\ &+ \epsilon_t^{(n)} \qquad (14)\end{aligned}$$

Table 7 reports the result of the regression specification above. Our variables of interest is the interaction term between the Low Resolution of Uncertainty dummy, the FG and LSAP shocks, and the MP/CBI dominated announcement indicator. Focusing on the FG shock, we can see that the CBI interaction term is statistically significant in Panel A whilst the MP interaction is statistically significant in Panel B. This provides further evidence that during the ZLB, the Fed's forward guidance approach conveys information about the state of the economy whereas during the post-ZLB, once the state of the economy has improved, the forward guidance approach has a similar effect as that of the traditional monetary policy shock (FFR factor). As such, a tightening FG shock has a positive (negative) effect on growth expectations in the ZLB (post-ZLB) period.

In the case of the LSAP shock, we see that it captures both the Fed information effect and the traditional monetary policy effect in the ZLB period. Here both channels have a complementary effect on growth expectations. In the post-ZLB period, the LSAP shock predominantly effects growth expectations similar to the traditional monetary policy channel.

Table 7: **Estimated Effects of Information Shocks and Changes in Fed Fund Rate, Forward Guidance, and LSAPs on Dividend Growth Expectations**

This table reports the results of the regression of daily changes in dividend growth expectations of constant maturity S&P500 Index Dividends futures on Swanson (2020)'s monetary policy factors. On non-FOMC announcement days the factors are set to 0. High (Low) VIX Drop are dummy variables which take on the value of 1 if the FOMC announcement has a drop in VIX in the top (bottom 2) tercile(s) and 0 otherwise. MP and CBI refer to the monetary policy channel and central bank information channel dominated FOMC announcements according to Jarociski and Karadi (2020)'s poorman sign restrictions. UC refer to the FOMC announcements that are not classified as MP or CBI. The proprietary data sample period is from Jan 2010 to Feb 2017 covering the Zero Lower Bound period. The exchange data sample is from Nov 2015 to June 2019 covering the Post-Zero Lower Bound period. Coefficients are expressed in percentage per standard deviation change in the shocks. t-statistics based on robust standard errors are reported in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. R^2 is in % form.

n	1Y	2Y	3Y	4Y	5Y	6Y	7Y
				Panel A: Proprietary Data			
Intercept	0.04***	0.021	0.014	0.01	0.007	0.006	0.005
	[2.86]	[1.56]	[1.51]	[1.08]	[0.69]	[0.65]	[0.72]
High VIX Drop * Change in FFR	-0.195	-0.197	-0.55	-0.464	-0.323	-0.381	-0.217
	[-0.66]	[-0.53]	[-1.10]	[-0.88]	[-0.56]	[-0.71]	[-0.56]
High VIX Drop * Change in FG	0.074*	0.054	0.07	0.065	0.06	0.064	0.044
	[1.67]	[1.07]	[0.99]	[0.95]	[0.85]	[0.95]	[0.92]
High VIX Drop * Change in LSAP	0.025	0.034	-0.017	-0.01	0.01	0.006	0.015
	[0.29]	[0.38]	[-0.15]	[-0.09]	[0.08]	[0.05]	[0.17]
Low VIX Drop * Change in FFR	0.239	0.21	0.194	0.147	0.279	0.208	0.092
	[1.18]	[0.77]	[0.66]	[0.48]	[0.70]	[0.62]	[0.36]
Low VIX Drop * Change in FG * UC	0.011	0.009	0.063	0.071	0.052	0.058	0.031
	[0.15]	[0.06]	[0.35]	[0.37]	[0.23]	[0.28]	[0.19]
Low VIX Drop * Change in FG * MP	0.009	-0.06	0.042	0	0.044	0.044	-0.051
	[0.15]	[-0.55]	[0.39]	[0]	[0.16]	[0.23]	[-0.39]
Low VIX Drop * Change in FG * CBI	0.514***	1.133***	1.394***	1.372***	1.553***	1.369***	1.054***
	[5.75]	[9.73]	[10.37]	[10.21]	[9.32]	[9.41]	[9.78]
Low VIX Drop * Change in LSAP * UC	-0.026	-0.029	-0.021	-0.021	-0.04	-0.042	-0.037
	[-0.54]	[-0.27]	[-0.18]	[-0.16]	[-0.25]	[-0.30]	[-0.34]
Low VIX Drop * Change in LSAP * MP	0.34***	0.478***	0.469***	0.462***	0.382	0.371*	0.347***
	[4.88]	[4.36]	[3.72]	[3.19]	[1.38]	[1.86]	[2.63]
Low VIX Drop * Change in LSAP * CBI	0.294**	0.553***	0.926***	0.927***	1.021***	0.966***	0.681***
	[2.22]	[2.86]	[3.40]	[3.45]	[3.19]	[3.25]	[3.18]
Regression R^2	0.159	0.603	1.891	1.696	1.542	1.608	1.489
Num Obs	1759	1760	1760	1760	1760	1760	1760

n	**1Y**	**2Y**	**3Y**	**4Y**	**5Y**	**6Y**	**7Y**
				Panel B: Exchange Data			
Intercept	0.027***	0.013	0.007	0.005	0.005	0.009	0.007
	[2.72]	[1.08]	[0.63]	[0.41]	[0.32]	[0.56]	[0.61]
High VIX Drop * Change in FFR	0.233	0.088	0.149	0.149	0.222	-0.614***	-0.517***
	[1.05]	[0.33]	[0.48]	[0.44]	[0.54]	[-3.76]	[-5.00]
High VIX Drop * Change in FG	0.079***	0.145***	0.183***	0.184***	0.204***	-0.139*	-0.144***
	[3.00]	[3.23]	[3.33]	[3.07]	[3.15]	[-1.85]	[-2.82]
High VIX Drop * Change in LSAP	-0.18	-0.668**	-0.723**	-0.741**	-0.763*	0.39***	0.267***
	[-0.88]	[-2.47]	[-2.18]	[-2.07]	[-1.75]	[3.25]	[3.31]
Low VIX Drop * Change in FFR	-0.437**	-0.733***	-0.742***	-0.622**	-0.779**	0.055	-0.024
	[-2.22]	[-2.63]	[-3.56]	[-2.18]	[-1.96]	[0.18]	[-0.08]
Low VIX Drop * Change in FG * UC	-0.052*	-0.157***	-0.171***	-0.216***	-0.239***	-0.109***	-0.1**
	[-1.88]	[-3.38]	[-2.72]	[-4.69]	[-3.84]	[-2.75]	[-2.50]
Low VIX Drop * Change in FG * MP	-0.05	-0.273***	-0.19***	-0.271***	-0.447***	-1.129***	-0.906***
	[-1.35]	[-7.43]	[-2.94]	[-3.74]	[-5.66]	[-7.53]	[-7.77]
Low VIX Drop * Change in FG * CBI	-0.134	-0.132	0.023	-0.061	-0.143	-0.227***	-0.212**
	[-1.14]	[-1.21]	[0.25]	[-0.50]	[-0.77]	[-2.84]	[-2.47]
Low VIX Drop * Change in LSAP * UC	0.705**	0.821**	1.013**	0.534	0.366	-0.692*	-0.626
	[2.51]	[2.05]	[2.32]	[1.13]	[0.57]	[-1.81]	[-1.63]
Low VIX Drop * Change in LSAP * MP	0.12*	0.764***	0.442***	0.783***	1.361***	3.923***	3.104***
	[1.68]	[5.63]	[3.29]	[4.91]	[6.27]	[8.77]	[9.95]
Low VIX Drop * Change in LSAP * CBI	-1.358	-0.435	0.217	-0.229	-0.61	-1.32***	-1.131***
	[-1.45]	[-1.35]	[0.83]	[-0.42]	[-0.72]	[-3.96]	[-3.17]
Regression R^2	0.480	1.110	1.040	1.196	1.417	1.226	1.388
Num Obs	900	901	901	901	901	629	628

3.5 Robustness Check: Approach 2 - Lower Bound on Dividend Growth Expectations

In this section, we follow the empirical procedure of Gormsen and Koijen (2020) and estimate the lower bound on growth expectations by looking at daily changes in futures price. This allows us to qualitatively verify the results in Section 3.3. We run the following regression specification:

$$\Delta \log F_t^{(n)} = \alpha_0 + \sum_{i=1}^{\#\text{shocks}} \beta_i * \text{High Resolution of Uncertainty}_t \times Shock_{i,t} + \sum_{i=1}^{\#\text{shocks}} \beta_{\#\text{shocks}+i} * \text{Low Resolution of Uncertainty}_t \times Shock_{i,t} + \epsilon_t^{(n)} \quad (15)$$

Similar to the analysis in Section 3.3, we scale the daily futures price changes by maturity. We take into account both FOMC announcement days and other days. On non-FOMC announcement days we set the shocks to 0. High (Low) Resolution of Uncertainty are dummy variables that indicate whether on a certain FOMC announcement date there is a high (low) drop in VIX in the 24-hours prior to the announcement based on a tercile cut. Our variables of interest is the interaction term between the Low Resolution of Uncertainty dummy and the monetary policy shock. Here, the risk-premia effect is muted and in the event of a tightening shock, is positive if at all. Thus, the coefficients on these variables identify the lower bound on growth expectations.

Table 8 reports the results using Swanson (2020) shocks. Panel A reports the estimates for the ZLB period. A one-standard deviation tightening of FG increases the growth expectations by 0.03% to 0.12% across the different maturities. A one-standard deviation decrease in LSAPs (which causes interest rates to rise) decreases growth expectations by 0.04% - 0.05% across the different maturities. A one-standard deviation increase in the Fed Fund Rate reduces the growth expectations by 0.01% - 0.15% over 2 to 7 years, although the effect is not statistically significant. The effect of these monetary policy shocks on growth expectations tend to be non-monotonic along the term-structure.

Panel B reports the results for the post-ZLB period using the exchange data. A one-standard deviation increase in Fed Fund Rate reduces growth expectations by 0.11% - 0.31% across the different maturities. The FFR effect is statistically significant for maturities 3, 5, 6, and 7 years. A one-standard deviation tightening of FG reduces the growth expectations by 0.01% - 0.05% over 2 to 7 years, although the effect is marginally statistically significant for the 4 year maturity.

Tables 9 and 10 report the results analogous to those in Table 8. In Panel A of Table 9, growth expectations increase by 0.02% - 0.21% across different maturities. The Nakamura and Steinsson (2018) shock captures the impact of forward guidance as well as a traditional monetary policy shock. Thus, in Panel A of Table 10, we see that a tightening shock increases growth expectations 0.02% - 0.05% over 1 to 7 years. It is statistically significant for the 2 and 6 year growth expectation. Similar to our findings in Panel B of Table 8 we see that a tightening FFR shock or Policy News shock reduces growth expectations by 0.004% - 0.008% (Table 9) and by 0.001% - 0.011 % (Table 10). This effect is statistically significant over the long maturities in Table 10.

Overall, our results are qualitatively similar to that in Section 3.3. Statistically the results are weaker because here we are unable to fully shut down the risk-premia effect. We are able to shut down the resolution of uncertainty effect on risk-premia but not the effect of the fundamental news itself on risk-premia.

Table 8: **Estimated Effects of Changes in Fed Fund Rate, Forward Guidance, and LSAPs on Futures Price Changes**

This table reports the results of the regression of daily price changes of constant maturity S&P500 Index Dividends futures on Swanson (2020)'s monetary policy factors. On non-FOMC announcement days the factors are set to 0. High (Low) VIX Drop are dummy variables which take on the value of 1 if the FOMC announcement has a drop in VIX in the top (bottom 2) tercile(s) and 0 otherwise. The proprietary data sample period is from Jan 2010 to Feb 2017 covering the Zero Lower Bound period. The exchange data sample is from Nov 2015 to June 2019 covering the Post-Zero Lower Bound period. Coefficients are expressed in percentage per standard deviation change in the shocks. t-statistics based on robust standard errors are reported in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. R^2 is in % form.

n	**1Y**	**2Y**	**3Y**	**4Y**	**5Y**	**6Y**	**7Y**
				Panel A: Proprietary Data			
Intercept	0.04***	0.021***	0.015***	0.011***	0.009***	0.008***	0.007***
	[5.99]	[5.24]	[4.27]	[3.75]	[3.05]	[2.94]	[2.80]
High VIX Drop * Change in FFR	-0.017	-0.056	-0.168	-0.155	-0.151	-0.131	-0.098
	[-0.08]	[-0.46]	[-1.29]	[-1.36]	[-1.45]	[-1.30]	[-1.07]
High VIX Drop * Change in FG	0.045	0.015	0.008	0.006	0.007	0.008	0.008
	[1.48]	[0.83]	[0.40]	[0.40]	[0.57]	[0.77]	[0.85]
High VIX Drop * Change in LSAP	0.032	0.031	0.001	0.001	0.006	0.012	0.014
	[0.47]	[1.16]	[0.05]	[0.03]	[0.25]	[0.47]	[0.60]
Low VIX Drop * Change in FFR	0.21	-0.009	-0.119	-0.134	-0.034	-0.066	-0.153
	[1.39]	[-0.05]	[-0.62]	[-0.81]	[-0.15]	[-0.41]	[-1.00]
Low VIX Drop * Change in FG	0.028	0.061	0.064	0.055	0.119*	0.083*	0.055
	[1.07]	[1.50]	[1.34]	[1.32]	[1.70]	[1.79]	[1.44]
Low VIX Drop * Change in LSAP	0.04	0.042***	0.046**	0.03**	0.018	0.015	0.011
	[1.49]	[2.64]	[2.42]	[1.97]	[0.61]	[0.67]	[0.61]
Regression R^2	0.068	0.149	0.338	0.365	0.875	0.650	0.536
Num Obs	1759	1760	1760	1760	1760	1760	1760

n	1Y	2Y	3Y	4Y	5Y	6Y	7Y
				Panel B: Exchange Data			
Intercept	0.026***	0.011*	0.006	0.003	0.002	0.004	0.004
	[4.49]	[1.93]	[0.97]	[0.63]	[0.37]	[1.17]	[1.15]
High VIX Drop * Change in FFR	0.119	-0.188*	-0.15*	-0.189*	-0.207***	-0.2***	-0.185***
	[0.98]	[-1.69]	[-1.81]	[-1.96]	[-2.65]	[-4.72]	[-4.85]
High VIX Drop * Change in FG	-0.003	-0.005	-0.014	-0.019	-0.018	-0.072***	-0.077***
	[-0.20]	[-0.24]	[-0.59]	[-0.70]	[-0.73]	[-5.50]	[-6.53]
High VIX Drop * Change in LSAP	0.064	-0.186*	-0.113	-0.098	-0.031	-0.163***	-0.167***
	[0.71]	[-1.73]	[-1.48]	[-1.16]	[-0.46]	[-3.19]	[-3.70]
Low VIX Drop * Change in FFR	-0.305	-0.179	-0.23**	-0.127	-0.106*	-0.2**	-0.187**
	[-1.44]	[-1.58]	[-2.22]	[-1.40]	[-1.75]	[-2.50]	[-2.03]
Low VIX Drop * Change in FG	0.012	-0.012	-0.042	-0.046*	-0.028	-0.032	-0.03
	[0.29]	[-0.43]	[-1.59]	[-1.77]	[-1.62]	[-1.61]	[-1.32]
Low VIX Drop * Change in LSAP	-0.154	-0.04	-0.028	-0.02	-0.034	-0.061	-0.056
	[-1.00]	[-0.53]	[-0.41]	[-0.41]	[-1.14]	[-1.28]	[-1.64]
Regression R^2	0.336	0.328	0.218	0.322	0.284	1.219	1.521
Num Obs	900	901	901	901	901	629	628

Table 9: **Estimated Effects of Fed Fund Rate shock on Futures Price Changes**

This table reports the results of the regression of daily price changes of constant maturity S&P500 Index Dividend Futures on Bernanke and Kuttner (2005)'s Fed Fund Rate shock. On non-FOMC announcement days the shock is set to 0. High (Low) VIX Drop are dummy variables which take on the value of 1 if the FOMC announcement has a drop in VIX in the top (bottom 2) tercile(s) and 0 otherwise. The proprietary data sample is from Jan 2010 to Feb 2017 covering the Zero Lower Bound period. The exchange data sample is from Nov 2015 to Sep 2019 covering the Post-Zero Lower Bound period. Coefficients are expressed in percentage per basis point change in the shock. t-statistics based on robust standard errors are reported in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. R^2 is in % form.

n	**1Y**	**2Y**	**3Y**	**4Y**	**5Y**	**6Y**	**7Y**
			Panel A: Proprietary Data				
Intercept	0.041***	0.021***	0.014***	0.011***	0.009***	0.007***	0.006**
	[6.16]	[5.27]	[4.15]	[3.59]	[2.95]	[2.81]	[2.55]
High VIX Drop * Shock	0.001	-0.011	-0.015	-0.014	-0.014	-0.015	-0.013
	[0.06]	[-0.80]	[-1.04]	[-1.12]	[-1.08]	[-1.11]	[-1.08]
Low VIX Drop * Shock	0.021	0.008	0.03	0.039	0.209*	0.126**	0.048
	[0.79]	[0.15]	[0.47]	[0.77]	[1.88]	[2.09]	[1.13]
Regression R^2	0.003	0.017	0.063	0.104	1.710	0.857	0.194
Num Obs	1759	1760	1760	1760	1760	1760	1760
			Panel B: Exchange Data				
Intercept	0.024***	0.009	0.004	0.002	0	0.002	0.002
	[4.40]	[1.63]	[0.71]	[0.34]	[0.08]	[0.72]	[0.63]
High VIX Drop * Shock	0.02	-0.032	-0.026	-0.032*	-0.034***	-0.06***	-0.061***
	[1.06]	[-1.39]	[-1.51]	[-1.76]	[-2.97]	[-7.03]	[-6.98]
Low VIX Drop * Shock	-0.004	0.003	0.001	-0.003	-0.004	-0.007	-0.008
	[-0.24]	[0.23]	[0.10]	[-0.35]	[-0.51]	[-0.94]	[-1.00]
Regression R^2	0.050	0.122	0.066	0.165	0.227	0.605	0.840
Num Obs	964	965	965	965	965	693	692

Table 10: **Estimated Effects of Policy News shock on Futures Price Changes**

This table reports the results of the regression of daily price changes of constant maturity S&P500 Index Dividend Futures on Nakamura and Steinsson (2018)'s Policy News shock. On non-FOMC announcement days the shock is set to 0. High (Low) VIX Drop are dummy variables which take on the value of 1 if the FOMC announcement has a drop in VIX in the top (bottom 2) tercile(s) and 0 otherwise. The proprietary data sample is from Jan 2010 to Feb 2017 covering the Zero Lower Bound period. The exchange data sample is from Nov 2015 to Sep 2019 covering the Post-Zero Lower Bound period. Coefficients are expressed in percentage per unit change in the shock. t-statistics based on robust standard errors are reported in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. R^2 is in % form.

n	1Y	2Y	3Y	4Y	5Y	6Y	7Y
			Panel A: Proprietary Data				
Intercept	0.04***	0.021***	0.014***	0.011***	0.008***	0.007***	0.006**
	[6.13]	[5.2]	[4.07]	[3.51]	[2.8]	[2.69]	[2.48]
High VIX Drop * Shock	0.014	-0.002	-0.008	-0.008	-0.007	-0.006	-0.005
	[1.24]	[-0.36]	[-1.29]	[-1.38]	[-1.41]	[-1.32]	[-1.16]
Low VIX Drop * Shock	0.016	0.026*	0.024	0.019	0.045	0.031*	0.018
	[1.00]	[1.75]	[1.30]	[1.21]	[1.56]	[1.65]	[1.22]
Regression R^2	0.030	0.106	0.142	0.132	0.608	0.385	0.159
Num Obs	1759	1760	1760	1760	1760	1760	1760
			Panel B: Exchange Data				
Intercept	0.024***	0.009	0.004	0.002	0	0.002	0.002
	[4.39]	[1.63]	[0.73]	[0.36]	[0.10]	[0.67]	[0.57]
High VIX Drop * Shock	0.005	-0.015	-0.013	-0.015	-0.014	-0.043**	-0.044**
	[0.55]	[-1.05]	[-1.19]	[-1.23]	[-1.33]	[-2.43]	[-2.56]
Low VIX Drop * Shock	-0.001	-0.003	-0.009	-0.015*	-0.011**	-0.011**	-0.011*
	[-0.11]	[-0.32]	[-1.19]	[-1.95]	[-2.03]	[-2.00]	[-1.94]
Regression R^2	0.006	0.051	0.057	0.177	0.152	0.656	0.887
Num Obs	964	965	965	965	965	693	692

4 Conclusion

Post-2008 financial crisis, the U.S. Fed made use of unconventional monetary policy tools such as forward guidance and large scale asset purchases to stimulate the economy. It is unclear how these unconventional tools shape dividend growth expectations. We make use of index dividend futures contracts to address this. We find evidence of the traditional monetary policy channel and the central bank information channel at play.

Our results suggest that the forward guidance tightening shocks increase (decrease) growth expectations in the ZLB (post-ZLB) period. This is due to the fact that the forward guidance shocks convey information about the economy during bad times and convey the Fed's policy stance in good times. The LSAP tightening shocks decrease growth expectations in both the ZLB and post-ZLB period. Furthermore, using Jarociski and Karadi (2020)'s sign restrictions to identify monetary policy/information dominated FOMC announcements, we find that both channels can be at play in shaping dividend growth expectations. In the context of LSAP shocks, we see that both channels have a complementary effect on growth expectations.

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A Appendix

A.1 Verification of Growth Expectation Estimation Approaches

In this section we verify that our empirical procedure in Approach 1 is appropriate. Given that we directly estimate changes in dividend growth expectations in Section 3.3, we analyze the effects on growth expectations across all FOMC announcements and not just the ones where the resolution of uncertainty channel is muted. We run the following regression specification:

$$\Delta \log G_t^{(n)} = \alpha_0 + \sum_{i=1}^{\#\text{shocks}} \beta_i * Shock_{i,t} + \epsilon_t^{(n)} \tag{16}$$

Tables 11, 12, and 13 reports the results of the above regression specification using Swanson (2020)'s, Bernanke and Kuttner (2005)'s, and Nakamura and Steinsson (2018)'s measures of monetary policy shocks respectively. The effect on dividend growth expectations is qualitatively similar to that in Sections 3.3 and 3.5. This suggests our empirical procedure to estimate risk-premia captures the discount rate dynamics around FOMC announcements. Thus, our approach is appropriate in overcoming the identification challenges.

Table 11: **Estimated Effects of Changes in Fed Fund Rate, Forward Guidance, and LSAPs on Dividend Growth Expectations**

This table reports the results of the regression of daily changes in dividend growth expectations of constant maturity S&P500 Index Dividend futures onn Swanson (2020)'s monetary policy factors. On non-FOMC announcement days the factors are set to 0. The proprietary data sample is from Jan 2010 to Feb 2017 covering the Zero Lower Bound period. Exchange data sample is from Nov 2015 to June 2019 covering the Post-Zero Lower Bound period. Coefficients are expressed in percentage per standard deviation change in shocks. t-statistics based on robust standard errors are reported in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. Regression R^2 is in %.

n	**1Y**	**2Y**	**3Y**	**4Y**	**5Y**	**6Y**	**7Y**
				Panel A: Proprietary Data			
Intercept	0.041***	0.021	0.015*	0.011	0.009	0.007	0.006
	[2.92]	[1.63]	[1.67]	[1.21]	[0.83]	[0.78]	[0.83]
Change in FFR	-0.109	-0.36	-0.599	-0.583	-0.531	-0.526	-0.411
	[-0.52]	[-1.00]	[-1.44]	[-1.38]	[-1.11]	[-1.25]	[-1.24]
Change in FG	0.11***	0.14*	0.194**	0.179**	0.189*	0.179**	0.12*
	[2.63]	[1.88]	[2.34]	[2.14]	[1.86]	[2.10]	[1.76]
Change in LSAP	0.08*	0.099	0.107	0.095	0.09	0.084	0.059
	[1.66]	[1.56]	[1.47]	[1.30]	[1.12]	[1.15]	[1.06]
Regression R^2	0.071	0.176	0.752	0.628	0.499	0.583	0.451
Num Obs	1759	1760	1760	1760	1760	1760	1760
				Panel B: Exchange Data			
Intercept	0.026***	0.011	0.006	0.003	0.002	0.01	0.008
	[2.62]	[0.93]	[0.49]	[0.25]	[0.14]	[0.63]	[0.68]
Change in FFR	-0.069	-0.325	-0.21	-0.242	-0.356	-0.815***	-0.71***
	[-0.33]	[-1.04]	[-0.66]	[-0.68]	[-0.79]	[-4.41]	[-4.33]
Change in FG	0.037	-0.005	0.032	0.002	-0.03	-0.171***	-0.152***
	[0.94]	[-0.05]	[0.36]	[0.02]	[-0.22]	[-2.69]	[-2.98]
Change in LSAP	-0.071	-0.14	-0.233	-0.184	-0.064	0.428***	0.324***
	[-0.43]	[-0.49]	[-0.79]	[-0.55]	[-0.15]	[3.29]	[2.92]
Regression R^2	0.051	0.154	0.164	0.120	0.100	0.761	0.895
Num Obs	900	901	901	901	901	629	628

Table 12: **Estimated Effects of Fed Fund Rate shock on Dividend Growth Expectations**

This table reports the results of the regression of daily changes in dividend growth expectations of constant maturity S&P500 Index Dividend Futures on Bernanke and Kuttner (2005)'s Fed Fund Rate shock. On non-FOMC announcement days the shock is set to 0. The proprietory data sample is from Jan 2010 to Feb 2017 covering the Zero Lower Bound period. Exchange data sample is from Nov 2015 to Sep 2019 covering the Post-Zero Lower Bound period. Coefficients are expressed in percentage per basis point change in the shock. t-statistics based on robust standard errors are reported in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. Regression R^2 is in %.

n	1Y	2Y	3Y	4Y	5Y	6Y	7Y
Panel A: Proprietary Data							
Intercept	0.041***	0.02	0.013	0.009	0.007	0.006	0.005
	[2.93]	[1.56]	[1.44]	[1.00]	[0.67]	[0.60]	[0.64]
Shock	0.029	0.038	0.048	0.052	0.08	0.065	0.04
	[1.42]	[1.08]	[1.07]	[1.06]	[1.26]	[1.20]	[1.05]
Regression R^2	0.011	0.021	0.071	0.077	0.148	0.123	0.069
Num Obs	1759	1760	1760	1760	1760	1760	1760
Panel B: Exchange Data							
Intercept	0.024***	0.009	0.004	0.001	0	0.006	0.004
	[2.62]	[0.78]	[0.34]	[0.11]	[0.03]	[0.40]	[0.40]
Shock	0.004	-0.015	-0.004	-0.014	-0.024	-0.063**	-0.056**
	[0.22]	[-0.42]	[-0.10]	[-0.31]	[-0.45]	[-1.97]	[-2.45]
Regression R^2	0.003	0.021	0.002	0.017	0.035	0.352	0.468
Num Obs	964	965	965	965	965	693	692

Table 13: **Estimated Effects of Policy News shock on Dividend Growth Expectations**

This table reports the results of the regression of daily changes in dividend growth expectations of constant maturity S&P500 Index Dividend Futures on Nakamura and Steinsson (2018)'s Policy News shock. On non-FOMC announcement days the shock is set to 0. The proprietary data sample is from Jan 2010 to Feb 2017 covering the Zero Lower Bound period. Exchange data sample is from Nov 2015 to Sep 2019 covering the Post-Zero Lower Bound period. Coefficients are expressed in percentage per unit change in the shock. t-statistics based on robust standard errors are reported in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. Regression R^2 is in %.

n	1Y	2Y	3Y	4Y	5Y	6Y	7Y
	Panel A: Proprietary Data						
Intercept	0.04***	0.02	0.013	0.009	0.006	0.005	0.004
	[2.91]	[1.52]	[1.38]	[0.94]	[0.60]	[0.53]	[0.59]
Shock	0.027	0.022	0.029	0.024	0.028	0.026	0.014
	[1.61]	[0.83]	[0.97]	[0.77]	[0.75]	[0.82]	[0.56]
Regression R^2	0.024	0.017	0.065	0.041	0.045	0.049	0.021
Num Obs	1759	1760	1760	1760	1760	1760	1760
	Panel B: Exchange Data						
Intercept	0.024***	0.009	0.004	0.001	0	0.004	0.003
	[2.62]	[0.78]	[0.34]	[0.11]	[0.02]	[0.31]	[0.30]
Shock	0.008	-0.004	0.006	-0.003	-0.009	-0.012	-0.016
	[0.73]	[-0.18]	[0.25]	[-0.1]	[-0.24]	[-0.32]	[-0.54]
Regression R^2	0.014	0.003	0.006	0.001	0.007	0.016	0.047
Num Obs	964	965	965	965	965	693	692