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Intermeeting Rate Cuts as a Response to Rare Disasters

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Abstract

This paper measures the probability of rare disasters by measuring the probability of the intermeeting federal funds rate cuts they provoke. Differentiating between months with Federal Open Market Committee (FOMC) meetings and months without identifies excess returns on federal funds futures averaging -1.5 bps per horizon month-ahead at short horizons, corresponding to a 3-5% per month risk-neutral probability of an intermeeting rate cut. The excess returns differ between months with and without meetings, suggesting a positive risk premium associated with meetings. The federal funds excess returns explain a significant portion of equity excess returns, and hence the equity premium puzzle.

JEL classification: E44, G12

Keywords: Rare Disasters, Equity Premium, Risk Premium, Federal Funds Futures

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1 Introduction

Rare disasters, economic crises that are rarely observed but whose potential for economic destruction lays latent, have been put forth as an explanation for many economic phenomena, most prominently the equity premium puzzle as in Barro (2006). Federal funds futures offer a new way to identify the probability of such events: identify the probability of an emergency, unscheduled federal funds rate cut by the Federal Open Market Committee (FOMC) which would be brought on by a rare disaster. Excess returns on the futures are around -1.5 bps per contract month-ahead, translating to a risk-neutral probability of an intermeeting cut of 3-5% per month, similar to the empirical realization. Applied to the equity premium puzzle, the intermeeting cut probability strongly influences equity excess returns.

I find the probability of an intermeeting rate cut using a simple identification scheme. Federal funds futures are available to predict the federal funds rate every month. However, the FOMC has scheduled meetings only 8 months of the year. Thus the federal funds futures covering the 4 remaining months should predict that the federal funds rate is unchanged over those months. The futures do not do so: during those 4 months, there is a statistically significant difference of -1.5 bps – the excess returns – between the rate the futures predict and the actual federal funds rate, reflecting the probability of an unexpected intermeeting rate cut by the FOMC. In months with meetings, the difference is only -0.5 bps, suggesting the existence of a partially offsetting risk premium in those months.

The excess returns have the opposite, positive, sign during the period when the federal funds rate was at the zero lower bound (ZLB). At the ZLB, further rate cuts, both expected and unexpected, were impossible. Any excess returns due to an unexpected cut disappear, leading to the positive excess returns. Moreover, during that period, and unlike normal times, there is no difference in excess returns between months with meetings and months without.

An intermeeting rate cut is not the same as the usual definition of rare disaster: an intermeeting rate cut is a response to a rare disaster, rather than

the disaster itself. Historically, they have been induced by disasters such as the onset of recessions, banking crises, and a terrorist attack. For example, a sudden fall in the stock market is a rare disaster, while the intermeeting rate cut following the fall is a response to that fall, and could cause the stock market to rise, as happened in 2007. In this way, an intermeeting rate cut is a form of insurance, or Fed ‘put’, on the economy. As established by Lucca and Moench (2015), the Federal Reserve has significant power over equity returns. This relationship explains why I find that federal funds excess returns help explain equity excess returns: the more likely an intermeeting cut, the more exposed equities are to a disaster, even if the Fed intervenes.

Federal funds futures can be used to generate a market-implied forecast of the federal funds rate. This forecast includes the possibility of intermeeting rate cuts. Using the measured excess returns, we can adjust the market-implied forecast for the possibility of intermeeting cuts. This new market-implied forecast without intermeeting risk will better reflect the choices policymakers are expected to take if the economy continues to evolve along the expected path.

To preview results, using 1 month ahead federal funds futures from 2000-2019 excluding the ZLB period, I find excess returns of -1.6 bps for months without meetings, and excess returns of 0 for months with meetings. Using 2 month ahead federal funds futures, I find excess returns of -3.1 bps for contracts covering periods with 1 FOMC meeting, and excess returns of -1.7 bps for contracts covering periods with 2 FOMC meetings. Regressions including the 1 month ahead excess returns, together with financial controls, can explain 25% of the variance of equity excess returns in months without meetings, and 10% of the variance if the after-meeting parts of months with meetings are included.

This paper brings together literatures on excess returns in federal funds futures, rare disasters, and federal reserve impact on equity returns. The calculation of excess returns on federal funds futures has been done before, though not this paper’s identification method. Most notably, Piazzesi and T.Swanson (2008) find large excess returns using a sample from 1994-2006.

Bundick (2007) drops months with intermeeting moves and shows that excess returns are relatively small. This paper shows that excess returns are insignificant if the regressions do not control for whether a month has an FOMC meeting, and when that meeting occurs. Controlling for these factors reveals small, but significant, excess returns that correlate with intermeeting rate cut risk.

The modern form of rare disasters was promulgated by Barro (2006). Rare extreme events can, in theory, explain much of the equity premium puzzle of Mehra and Prescott (1985). Gabaix (2012) formalizes the computation of the impact of rare disasters on various macro-finance puzzles. Barro and Ursua (2008) measures the risk of rare disasters by looking at cross-country consumption records. This paper offers a novel way to measure the probability of a specific type of rare disaster: the type of rare disaster that provokes an intermeeting cut by the FOMC. Other papers, such as Barro and Liao (2019), use options pricing to measure the risk priced into the stock market.

A relatively new literature beginning with Lucca and Moench (2015) documents the impact the Federal Reserve has on equity markets. They find that a significant amount of equity returns are accumulated just after an FOMC meeting. Later work by Kurov et al. (2019) extends the sample of data used and finds this impact is disappearing. This paper finds a significant amount of equity returns is correlated with the probability of an intermeeting rate cut, hence is controlled by the Federal Reserve.

The next section defines excess returns, and provides evidence of negative excess returns on federal funds futures. Section 3 shows the impact these excess returns have on equity excess returns. Section 4 shows how the excess returns correlate with other macro risk measures.

2 Excess Returns on Federal Funds Futures

Federal funds futures are monthly contracts that settle at 100 minus the average effective federal funds rate for each month. For simplicity, I modify all reported contract prices to equal the average effective federal funds rate alone

rather than 100 minus the average effective federal funds rate. Define f_t^n to be the price of the federal funds future at the beginning of month t that covers the month $n + t - 1$. r_t is the average effective federal funds rate over month t . For example, $f_{\text{May } 2008}^1$ is the price of the front month contract on May 1st, 2008, settling at $r_{\text{May } 2008}$ the average effective federal funds rate for May 2008.

Define the excess return on a federal funds future of horizon n in month t as

$$rx_{t+n}^n = f_t^n - r_{t+n}$$

While federal funds futures are futures, not forwards, treating them as forwards simplifies calculation and interpretation as shown in Piazzesi and T.Swanson (2008). The futures track the effective federal funds rate – the real-world federal funds rate faced by banks – rather than the target federal funds rate, or midpoint of the range of the federal funds rate, set by the FOMC. While the difference between these two measures was, at times, noisy before the ZLB, the two rates now move in parallel upon changes in the federal funds rate corridor.

I will be running regressions of excess returns on indicators of how many months with FOMC meetings are in the excess returns's n horizon, Meetings Indicator $_{t+n}$ and controls X_{t+n}

$$rx_{t+n}^n = \text{Meetings Indicator}_{t+n} + X_{t+n} + \epsilon_{t+n}$$

When running these regressions, I include two controls to account for the state of financial markets and the difference between the target and effective federal funds rate. The first control is the level of the target federal funds rate, or midpoint of the federal funds rate range when applicable, from the beginning of the month. The second control is the standard deviation of the daily difference between the target federal funds rate and the effective federal funds rate, excluding days with meetings, from the previous month. Both of these controls are known by market participants at the beginning of the month.

In addition to whether a month has a meeting or not, months with meetings

consistent (HAC) due to overlapping contracts.

Mean Excess Returns (Annualized bps)		
	2000-2019 Sample	ZLB
1-month ahead	-0.65 (3.41)	7.95*** (2.02)
2-months ahead	3.78 (4.72)	7.73** (3.42)
3-months ahead	3.27 (6.52)	7.71** (3.71)

Note: *p<0.1; **p<0.05; ***p<0.01
HAC standard errors for 2 and 3-month ahead contracts

Table 1: Mean Excess Returns for 1, 2, and 3-month ahead contracts

Table 1 presents the mean excess return on 1, 2, and 3-month ahead federal funds futures over the sample described above, and the ZLB period. In order to compare excess returns between contracts at different horizons, all results are in annualized basis points calculated by multiplying the excess returns by $12/n$ where n is the contract's horizon. Notably, there are no statistically significant excess returns during the non-ZLB period, while the ZLB period has strong, positive, excess returns.

2.1 Results

This paper's main innovation is to identify the probability of an intermeeting rate cut by comparing months with an FOMC meeting from those without in

1-month ahead federal funds futures.

	Excess Returns (Annualized bps)	
	(1)	(2)
Meeting in Month	35.78*** (9.84)	33.74*** (9.89)
Days Left	1.29*** (0.43)	1.21*** (0.43)
Constant	-49.32*** (14.08)	-55.04*** (15.23)
Controls	No	Yes
Observations	142	140
Adjusted R ²	0.08	0.10
F Statistic	6.80*** (df = 2; 139)	4.94*** (df = 4; 135)

Note: *p<0.1; **p<0.05; ***p<0.01

Table 2: Excess Returns on 1-Month Ahead Futures

Table 2 shows the main result. Months without meetings have significant negative excess returns. Using Column 2, and the mean number of days left in a month without a meeting, 30.1, excess returns in months without meetings average -18 annualized basis points, or -1.5 non-annualized basis points. Months with meetings average 13.8 days left, hence have excess returns of -5 annualized basis points, or -0.4 non-annualized basis points.

Since all months have a chance of a disaster occurring during the month, they should all have similar excess returns.¹ However, the difference in excess returns between months with meetings and months without is large, roughly 1 bp. The size and sign of this difference points to the existence of a risk premium associated with an FOMC meeting, as theorized by Miranda-Agrippino (2016).

Table 3 provides the same analysis for 2-month ahead futures. All the main results, extended to 2 months, hold. The number of meetings in the period covered by the contract is now either 1 or 2 meetings. (There are no 2 month

periods without a meeting.) The “2 Mo. Days Left” variable is the sum of the “Days Left” variable over the 2 months covered by the contract.

	Excess Returns (Annualized bps)	
	(1)	(2)
Num. Meetings = 2	22.17 (14.48)	17.12* (9.81)
2 Mo. Days Left	0.72 (0.55)	0.64* (0.38)
Constant	-31.40 (22.68)	-44.70*** (16.41)
Controls	No	Yes
Observations	135	133
Adjusted R ²	0.04	0.18
F Statistic	3.68** (df = 2; 132)	8.42*** (df = 4; 128)

Note: *p<0.1; **p<0.05; ***p<0.01
HAC standard errors

Table 3: Excess Returns on 2-Month Ahead Futures

Using Column 2, months with 1 meeting average 43 days left over the contract period, hence excess returns are -16.5 annualized basis points, or -2.75 non-annualized basis points. Months with 2 meetings average 29.8 days left over the contract period, hence excess returns are -7.9 annualized basis points, or -1.3 non-annualized basis points.

The existence and size of excess returns at the 2-month horizon confirms the intuition behind the 1-month ahead excess returns. The probability of an intermeeting rate cut over the next two months should be strictly larger than the probability of an intermeeting rate cut over the next month. The actual size, roughly 2x, fits closely with the 1-month ahead excess returns findings. The difference in excess returns between contracts covering 1 meeting vs. contracts covering 2 meetings shows the risk premium associated with

meetings continues.

See Appendix B for the equivalent table for 3-month ahead futures. They do not show any statistically significant relationships. The number of independent observations decreases with longer horizons as more contracts cover months with intermeeting moves and hence are removed from the sample. Fewer observations combined with the impact of using HAC standard errors lead to no significance.

2.1.1 Expected Federal Funds Path Without Intermeeting Risk

We can use the excess return results to produce a simple forecast of monetary policy purged of the possibility of intermeeting cuts. Such a forecast would represent the market-implied belief about the choices of the FOMC at its regularly scheduled meetings. To produce the forecast, simply add 1.5 bps per contract-month ahead to the market price of the futures contract. For example, 1-month ahead contracts would be adjusted by 1.5 bps, and 3-month ahead contracts by 4.5 bps.

The scale of adjustment of the federal funds rate forecast is very similar to the adjustment derived through measurement of the risk premium. Diercks and Carl (2019) using the covariance of real variables, find a risk premium on federal funds futures of around -1 bps per month. The similarity suggests that the majority of the risk in the market risk premium is the risk of an intermeeting rate cut.

2.1.2 Intermeeting Risk Probability

Translating the excess returns into the probability of a rate cut per month requires assumptions about the size of an intermeeting rate cut, and correlation of risks. I assume any cut will be 50 bps, as almost all modern cuts have been. Define p_m to be the per month cut probability, and p_d to be the daily

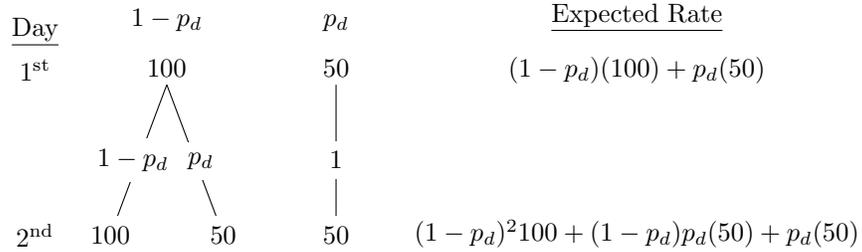
¹A disaster occurring in a month with a meeting would not necessarily provoke an *intermeeting* rate cut. Instead, the disaster would force a larger cut at the scheduled meeting than demanded by the non-disaster economic conditions foreseen at the beginning of the month.

probability. I analyze the two extreme cases: rate cuts are either a once per month, or once per day calculation.

First, assume that the risk of an intermeeting cut is dependent on economic conditions, and thus doesn't change much over a month. This calculation is simple: $(-50)p_m = -1.5$ hence the probability is 3%. Second, assume that the risk of an intermeeting cut is identical and independent per day, dependent on unpredictable events such as terrorist attacks.

After an intermeeting rate cut, the rate stays cut for the rest of the month, hence the probability of a lower rate on any day depends non-linearly on the number of days that came before it. Figure 2 illustrates a two-day example where the rate either stays constant, or is cut by 50 bps. If each day has an independent probability p_d of a cut, the price of the contract, and hence the excess returns, has a p_d^2 term.

Figure 2: Non-Linear Impact of Days Left



$$\text{Price} = \frac{1}{2} [(1 - p_d)(100) + p_d(50) + (1 - p_d)^2 100 + (1 - p_d)p_d(50) + p_d(50)]$$

Then using the same logic as Figure 2 that each day has a probability of a cut, and the probability that there was a cut on a previous day,

$$\frac{1}{30} \left(\sum_{t=1}^{30} (31 - t)(1 - p_d)^{t-1} p_d (-50) \right) = -1.5$$

$$1 - (1 - p_d)^{30} = p_m$$

Solving for p_m shows there is a roughly 5.5% chance of an intermeeting rate

cut per month.

3 Equity Returns

I use the measure of federal funds excess returns to see the impact intermeeting risk has on equity excess returns. The data for equity excess returns comes from Ken French's website. Intermeeting risk is a measure of disaster risk. The higher the probability of an intermeeting cut, the higher the risk of disaster. As equities are risky assets, their return should be higher at times of higher risk.

	Equity Excess Returns			
	Non-Meeting Months		After and Non-Meeting Months	
	(1)	(2)	(3)	(4)
Excess Returns	-0.05** (0.03)	-0.07*** (0.02)		
Alt. Excess Returns			-0.03** (0.01)	-0.02* (0.01)
Days Left			0.07* (0.03)	0.07* (0.04)
Meeting in Month			2.55*** (0.75)	2.43*** (0.74)
Constant	-1.39** (0.61)	-0.02 (0.91)	-3.18*** (1.14)	-2.18* (1.21)
Controls	No	Yes	No	Yes
Observations	47	40	134	132
Adjusted R ²	0.06	0.24	0.08	0.11
F Statistic	4.19** (df = 1; 45)	5.14*** (df = 3; 36)	4.60*** (df = 3; 130)	4.20*** (df = 5; 126)

Note:

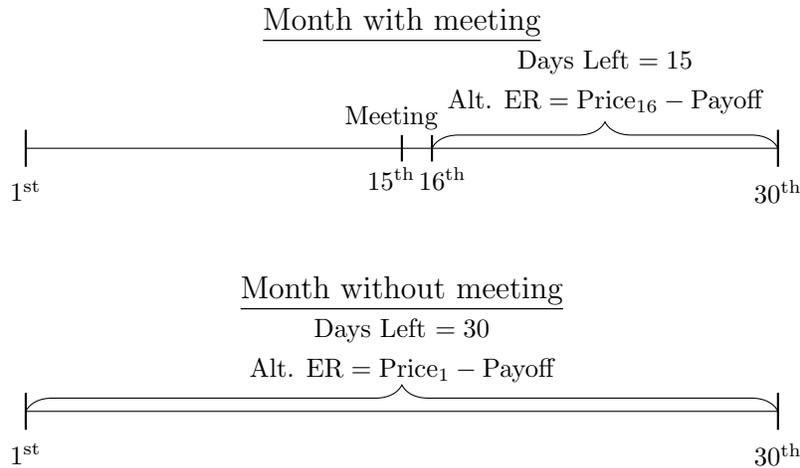
*p<0.1; **p<0.05; ***p<0.01

Table 4: Equity Excess Returns

Table 4 shows the impact federal funds excess returns have on equity excess returns. Columns 1 and 2 use equity excess return data only from months without meetings. The negative coefficients indicate that negative federal funds excess returns are connected to higher equity excess returns. The tail risk represented by intermeeting rate cut risk has a significant impact on equity excess returns in non-meeting months.

In order to incorporate more data, I define the Alternative Excess Returns variable as the excess returns that exist in the parts of months after meetings in months with meetings, and the excess returns from the months without meetings.

Figure 3: Partial Month with Meeting and Whole Month without Meeting



Columns 3 and 4 use these alternative excess returns to show their impact on equity excess returns. While relationship is not as strong as when using solely the non-meeting months, the relationship is still statistically significant.

4 Other Risk Measures

In this section I show how excess returns on federal funds futures are connected with other measures of market risk. Specifically, I relate excess returns to

the VIX measure, the excess bond premium of Favara et al. (2016), the rare disaster probability derived from S&P options computed by Barro and Liao (2019), and the economic policy uncertainty index of Baker et al. (2016).

	VIX	EBP	Rare Disaster	EPU
Excess Returns	-0.10** (0.04)	-0.01 (0.004)	-0.001** (0.0002)	0.001 (0.16)
Constant	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes
Observations	41	41	36	41
Adjusted R ²	0.18	0.08	0.17	0.22
F Statistic	3.97** (df = 3; 37)	2.21 (df = 3; 37)	3.36** (df = 3; 32)	4.66*** (df = 3; 37)

Note:

*p<0.1; **p<0.05; ***p<0.01

Table 5: Relationship between Excess Returns and Other Risk Measures in Non-Meeting Months

I present the results as regressions in Table 5 in order to follow the conventions earlier, and include the same financial controls. As Table 5 shows, excess returns are highly correlated with both the VIX Index and the Rare Disaster measure. These relationships are of the proper sign to add evidence that excess returns on federal funds futures are a measure of rare disaster risk, albeit a rare disaster that induces an intermeeting rate cut.

5 Conclusion

It's not easy to define a disaster, but federal funds futures offer a way to do so. A disaster is any negative event that causes an intermeeting rate cut. Federal funds futures reflect this possibility, leading to negative excess returns. The risk of such disasters helps explain a significant portion of equity excess returns, confirming that disasters are important to asset pricing.

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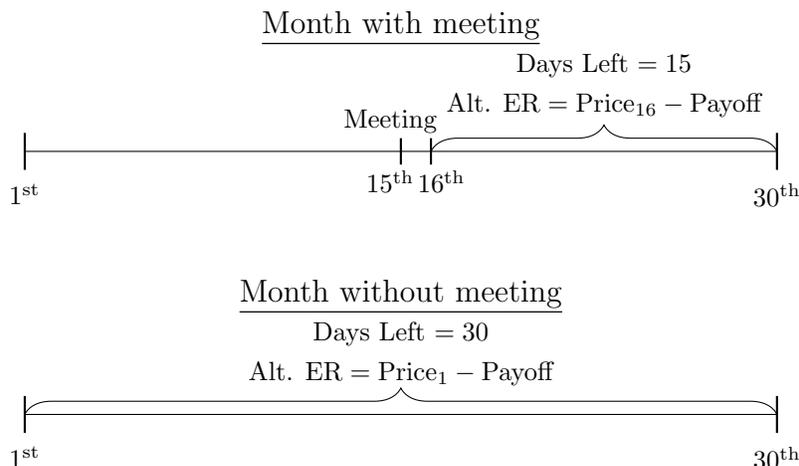
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A Months of Unusual Size

In addition to whether a month has a meeting or not, months with meetings differ from each other based on when the meeting takes place. Regressions will include a variable “Days Left” that takes the value of the number of days after the meeting in a month with a meeting, and the value of the number of days in the month in a month without a meeting. Underlying the definition of this variable is a hypothesis that the sections of months after a meeting differ from months without meetings only in the number of days.

Figure 4: Synthetic Month and Whole Month without Meeting



To test this hypothesis, I create synthetic months, calculating alternative excess returns on the 1-month ahead contract for the partial month after meetings. If the meeting occurs on the last day of the month, I drop the month from the sample. See Figure 4 for a visual explanation of the variables. Combining these synthetic months of varying lengths with the set of whole months without meetings, I regress the alternative excess returns on the number of days in the whole or synthetic month.

Alt. Excess Returns (Annualized bps)				
	(1)	(2)	(3)	(4)
Days Left	-0.28* (0.16)	-0.26 (0.17)		
(Days Left) ²			-0.01* (0.004)	-0.01* (0.005)
Constant	1.51 (3.70)	-1.18 (4.60)	0.005 (2.83)	-2.55 (3.87)
Controls	No	Yes	No	Yes
Observations	134	132	134	132
Adjusted R ²	0.01	0.01	0.02	0.01
F Statistic	3.01* (df = 1; 132)	1.25 (df = 3; 128)	3.38* (df = 1; 132)	1.37 (df = 3; 128)

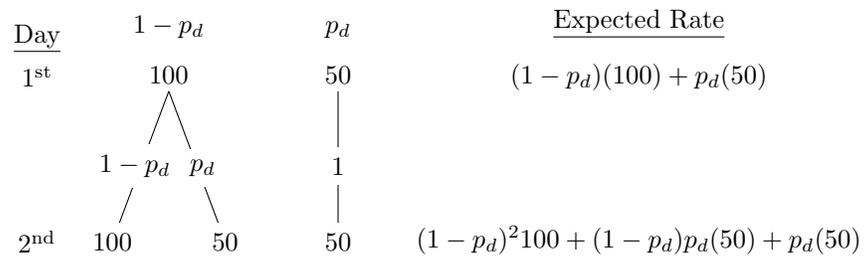
Note:

*p<0.1; **p<0.05; ***p<0.01

Table 6: Impact of Days Left on Excess Returns

Table 6 shows the hypothesized relationship between the number of days in the month fragment and excess returns. Columns 1 and 2 provide evidence that each day in the fragment results in -0.3 annualized basis points in excess returns.

Figure 5: Non-Linear Impact of Days Left



$$\text{Price} = \frac{1}{2} [(1 - p_d)(100) + p_d(50) + (1 - p_d)^2 100 + (1 - p_d)p_d(50) + p_d(50)]$$

Columns 3 and 4 provide evidence of a further refinement of the hypothesis: alternative excess returns should be non-linear in the number of days left. After an intermeeting rate cut, the rate stays cut for the rest of the month. Hence the probability of a lower rate on any day depends non-linearly on the number of days that came before it. Figure 5 illustrates a two-day example where the rate either stays constant, or is cut by 50 bps. If each day has an independent probability p_d of a cut, the price of the contract, and hence the excess returns, has a p_d^2 term. In general, most regressions will show a better fit when Days Left is taken to a power greater than 1.

The importance of the number of days left also provides an opportunity to illustrate the difference between times when the federal funds rate was above the ZLB, and the ZLB period. Table 7 runs a similar regression to Table 6, but the sample now includes ZLB months. An indicator variable, interacted with the number of days left, denotes whether a month was during the ZLB period or not. As both columns show, each day left results in negative excess returns during normal times when an intermeeting rate cut was possible, and positive excess returns during the ZLB period when an intermeeting rate cut was impossible.

	Alt. Excess Returns (Annualized bps)	
	(1)	(2)
Days Left x (ZLB = 0)	-0.29** (0.12)	
Days Left x (ZLB = 1)	0.28** (0.14)	
Days Left ² x (ZLB = 0)		-0.01*** (0.003)
Days Left ² x (ZLB = 1)		0.01** (0.004)
Constant	-0.05 (2.66)	0.03 (2.17)
Controls	No	No
Observations	212	212
Adjusted R ²	0.08	0.08
F Statistic (df = 4; 207)	5.86***	5.84***

Note:

*p<0.1; **p<0.05; ***p<0.01

Table 7: Impact of Days Left During ZLB

B 3-month Ahead Futures

Repeating the same analysis that was done with 1 and 2-month ahead futures shows nothing at the 3-month ahead horizon. A 3 month contract can cover

a period with 1, 2, or 3 meetings. I add up the Days Left variable in each of the 3 months covered to produce “3 Mo. Days Left”.

Excess Returns (Annualized bps)		
	(1)	(2)
Num. Meetings = 2	3.19 (10.85)	2.19 (11.17)
Num. Meetings = 3	34.07 (32.62)	23.22 (22.45)
3 Mo. Days Left	0.04 (0.42)	-0.001 (0.32)
Constant	-4.84 (32.93)	-16.76 (26.55)
Controls	No	Yes
Observations	128	126
Adjusted R ²	0.02	0.16
F Statistic	1.71 (df = 3; 124)	5.67*** (df = 5; 120)

Note: *p<0.1; **p<0.05; ***p<0.01

Table 8: