Monetary Policy Expectation Errors

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Introduction

- Expectations are central to macroeconomics and finance

- Do money market derivatives, i.e. Fed Funds Futures and Overnight Index Swaps, reflect expectations of future monetary policy?

  - ⋆ Forward rates *overestimate* the future short rate
  - ⋆ Leads to positive excess returns: $f_t^{(n)} - i_{t+n} = rx_{t+n}^{(n)}$
  - ⋆ Typically attributed to time-varying and counter-cyclical *term premia*

- We revisit these facts and challenge the conventional wisdom that term premia play a major role at the short end of the yield curve

  - ⋆ "Expectation errors" much more important

- Shed light on investor expectations and the central bank reaction function

The paper in a nutshell

1. Use surveys to decompose money market excess returns into:
   (i) term premia and (ii) expectation errors
   - ⋆ Term premia quantitatively small and mostly *negative*
   - ⋆ Expectation errors account for almost all of excess returns
2. Strong asymmetry in accuracy of expectations about future monetary policy
   - ⋆ Rate hikes: accurate forecasts / expectations hypothesis holds
   - ⋆ Rate cuts: biased forecasts as investors underestimate aggressiveness of Fed easing
3. Support for the view that market participants are learning about the Fed reaction function in an environment of uncertainty
   - ⋆ Negative stock market returns predict positive excess returns
   - ⋆ Suggests investors slow to learn about role of financial conditions as reaction function ingredient
   - ⋆ Supportive evidence in an international sample of major currencies

Link to literature

- Tests of the expectations hypothesis in general and in money markets specifically
  - ⋆ Fama and Bliss (1987), Campbell and Shiller (1991), Krueger and Kuttner (1996), Longstaff (2000), Gürkaynak et al. (2007), Della Corte et al. (2008), Piazzesi and Swanson (2008)
- Earlier literature on survey-implied term premia and expectation errors
  - ⋆ Froot (1989), Froot and Frankel (1989), Gourinchas and Tornell (2004), Ichiue and Yuyama (2009), Bacchetta et al. (2009)
- Recent literature on survey expectations and link to actual behavior
  - ⋆ Greenwood and Shleifer (2014), Egan et al. (2020), Giglio et al. (2020)
- Expectation formation in general and short rate expectations in particular
  - ⋆ Mankiw and Miron (1986), Rudebusch (1995), Coibion and Gorodnichenko (2015), Cieslak (2018), Guidolin and Thornton (2018), Bordalo et al. (2020)
- Fed's reaction to changes in stock returns/financial conditions
  - ⋆ Bernanke and Gertler (1999), Rigobon and Sack (2003), Cieslak and Vissing-Jorgensen (2017)

Survey-implied term premia and expectation errors

- Starting from definition of excess returns on money market derivatives ...

$$rx_{t+n}^{(n)} = f_t^{(n)} - i_{t+n},$$

$$f_t^{(n)} = E_t[i_{t+n}] + E_t[rx_{t+n}^{(n)}]$$

$\longrightarrow$ after some rearranging, we can express excess return as

$$rx_{t+n}^{(n)} = \underbrace{E_t[rx_{t+n}^{(n)}]}_{\text{term premium}} + \underbrace{E_t[i_{t+n}] - i_{t+n}}_{\text{expectation error}}$$

- Empirics based on survey expectations:

$$rx_{t+n}^{(n)} = \underbrace{f_t^{(n)} - S_t^{(n)}}_{\text{term premium: TP}} + \underbrace{S_t^{(n)} - i_{t+n}}_{\text{expectation error: EE}}$$

- Survey-implied TP observable ex ante at t, EE observable ex post at $t + n$

Data: money market derivatives

- Fed Funds (FF) Futures prices from Chicago Board of Trade
  - Long FF Futures: Receive fixed rate, pay the Effective Fed Funds Rate (EFFR)
  - Active trading in contracts with $n = 1, ..., 6$ months to maturity
  - Sample period: 11/1990 to 11/2018
- Overnight Index Swaps (OIS) quotes from Bloomberg
  - Swap fixed for floating overnight rate (EFFR in the US)
  - Long OIS: Receive fixed swap rate, pay floating
  - Focus on contracts with $n = 3, 6, 9, 12$ months to maturity
  - Sample period: 12/2001 to 07/2019
- Both: sample end-of-month to get series with fixed horizon n

▸ Details on Blue Chip survey ▸ FF Futures return details ▸ OIS return details

Data: surveys

- Short-rate expectations from the Blue-Chip survey of professional forecasters
    - Forecast variable: quarterly averages of the EFFR
    - Monthly frequency
    - Construct $n = 3, 6, 9, 12$ months forecast horizons
    - Survey responses collected during the last week of each month. We treat them as end-of-month values
- To match FF futures with quarterly survey forecasts, we average over the three months of a quarter
    - e.g., for $t =$ December, we average of $n =$ January, $n =$ February, $n =$ March
- No averaging for OIS as forecast horizons match exactly those of surveys

▸ Details on the Blue Chip survey ▸ Matching FF Futures and OIS horizons with surveys ▸ More details on OIS and surveys

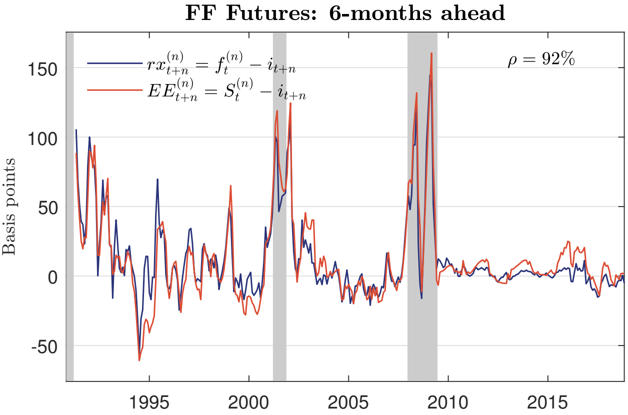
Excess return decomposition

$$\underbrace{rx_{t+n}^{(n)}}_{\text{excess return}} = \underbrace{f_t^{(n)} - S_t^{(n)}}_{\text{term premium}} + \underbrace{S_t^{(n)} - i_{t+n}}_{\text{expectation error}}$$

	FF Futures		Overnight Index Swaps			
$n =$	3	6	3	6	9	12
Panel A: Mean Estimates						
Excess return	5.92	12.17	3.58	7.57	12.27	17.87
	(3.57)	(2.77)	(2.06)	(1.52)	(1.51)	(1.54)
Term premium	-1.09	-0.15	-2.36	-2.44	-3.36	-4.81
	(-1.01)	(-0.09)	(-2.91)	(-1.66)	(-1.55)	(-1.67)
Expectation error	7.00	12.31	5.94	10.02	15.63	22.67
	(2.82)	(2.53)	(2.64)	(1.92)	(1.89)	(2.01)
Panel B: Variance Decomposition						
Term premium	-0.07	-0.02	-0.13	0.00	0.04	0.05
Expectation error	1.07	1.02	1.13	1.00	0.96	0.95

Return decomposition with quarterly data

Excess returns and expectation errors



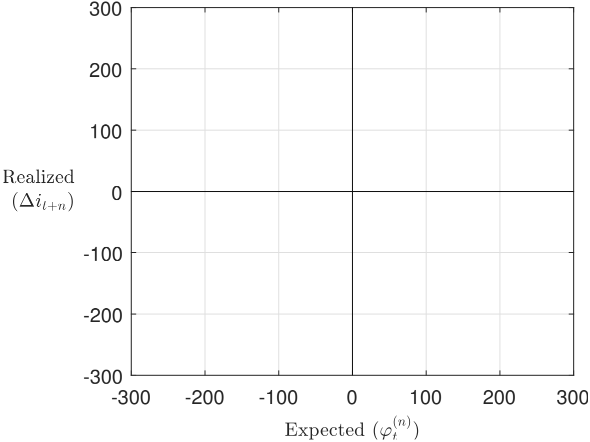
‣ Excess returns and survey-implied term premia

Diagnosing expectation errors and excess returns

Findings so far:

- Excess returns fully accounted for by expectation errors, while term premia are small and negatively correlated/uncorrelated with future excess returns
- But, why do expectation errors occur?
- Take a closer look at properties of short-rate forecasts implicit in FF futures and OIS and implications for excess returns, in particular
  - Over-/underestimation of future short rates
  - Asymmetries: rising vs falling rates, positive vs negative money market term spread

Predictions vs Realizations



$\Delta i_{t+n} = i_{t+n} - i_t$ is the short rate change from t to $t+n$. $\varphi^{(n)} = f_t^{(n)} - i_t$ is the term spread. We show FF Futures 6-months contract here. Axis units are in basis points.

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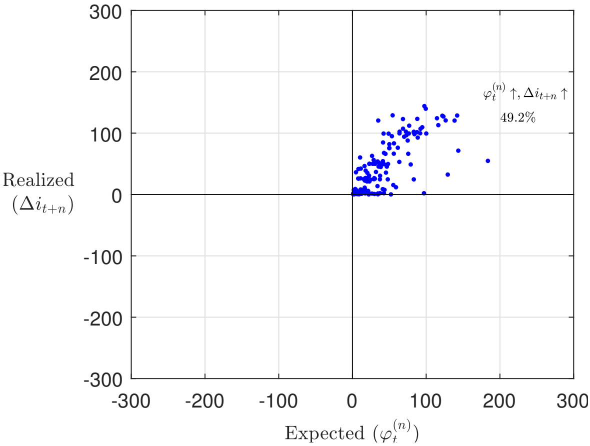

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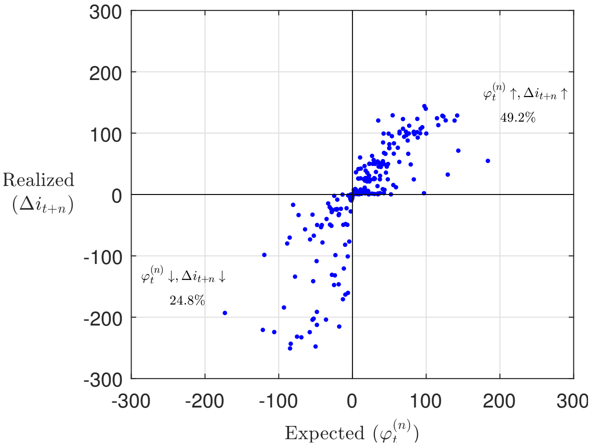

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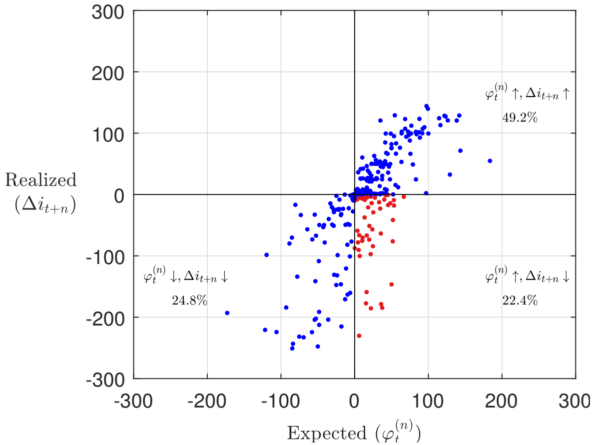

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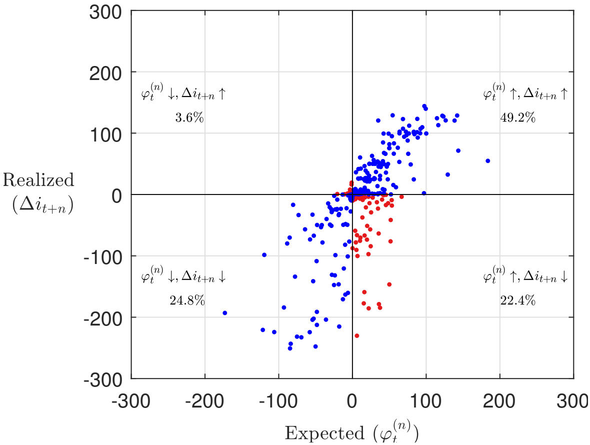

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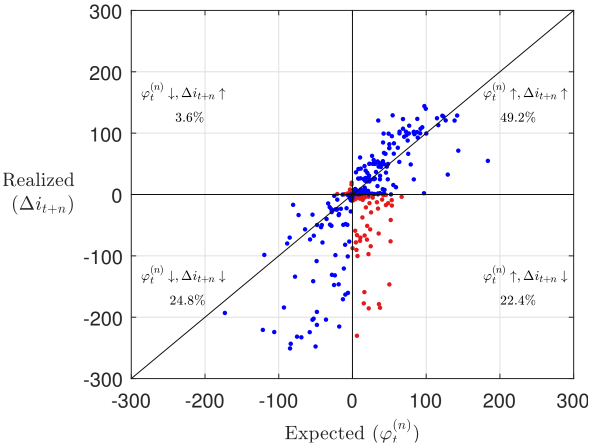

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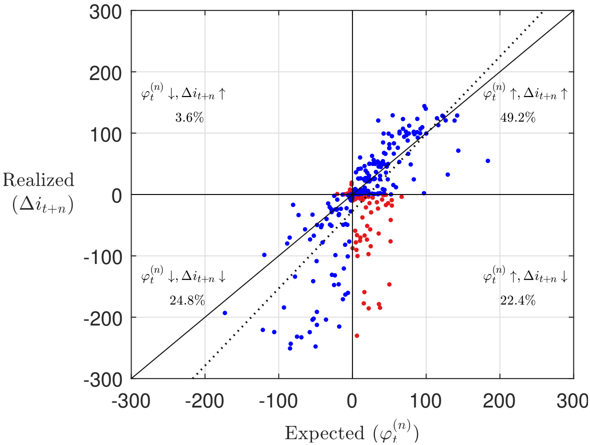

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▸ Number of unexpected rate changes ▸ Underestimating changes by 50 bps or more

Expectations hypothesis tests

	FF Futures		Overnight Index Swaps			
$n =$	3	6	3	6	9	12
Panel A: $\Delta i_{t+n} = \alpha^{(n)} + \beta^{(n)} \varphi_t^{(n)} + \varepsilon_{t+n}^{(n)}$						
$\beta^{(n)}$	1.25	1.42	1.14	1.24	1.34	1.40
$t_{\{\beta^{(n)}=0\}}$	(17.31)	(12.38)	(13.25)	(9.61)	(8.24)	(6.86)
$t_{\{\beta^{(n)}=1\}}$	(3.46)	(3.64)	(1.67)	(1.87)	(2.11)	(1.97)
R^2	0.75	0.71	0.68	0.63	0.60	0.55
Panel B: $rx_{t+n}^{(n)} = \theta^{(n)} + \delta^{(n)} \varphi_t^{(n)} + \eta_{t+n}^{(n)}$						
$\delta^{(n)}$	-0.25	-0.42	-0.14	-0.24	-0.34	-0.40
$t_{\{\delta^{(n)}=0\}}$	(-3.49)	(-3.64)	(-1.65)	(-1.91)	(-2.05)	(-2.00)
R^2	0.11	0.18	0.03	0.06	0.09	0.09

- Underestimation: 1% prediction is followed by 1.42% realization (example: 6-mth FF Futures)
- Accounting identity: coefficient determined by deviation from EH, $1 - \beta^{(n)} = \delta^{(n)}$
  - ⋆ Underestimating short rates changes $\rightarrow$ excess return predictability, $1 - 1.42 = -0.42$
  - ⋆ Sign on $\delta^{(n)}$ not consistent with time-varying risk premium interpretation

Asymmetry in short rate forecasts

	FF Futures		Overnight Index Swaps			
$n =$	3	6	3	6	9	12
Panel A: $\Delta i_{t+n} = \alpha^{(n)}_{POS} 1_{\{\varphi^{(n)}_t > 0\}} + \beta^{(n)}_{POS} \varphi^{(n)}_t 1_{\{\varphi^{(n)}_t > 0\}} + \alpha^{(n)}_{NEG} 1_{\{\varphi^{(n)}_t \leq 0\}} + \beta^{(n)}_{NEG} \varphi^{(n)}_t 1_{\{\varphi^{(n)}_t \leq 0\}} + \tilde{\varepsilon}^{(n)}_{t+n}$						
$\beta^{(n)}_{POS}$	1.00	1.04	1.14	1.19	1.21	1.18
$t_{\{\beta^{(n)}_{POS}=1\}}$	-0.05	0.26	0.85	0.93	0.80	0.64
$\beta^{(n)}_{NEG}$	1.25	1.36	1.13	1.25	1.48	1.85
$t_{\{\beta^{(n)}_{NEG}=1\}}$	(2.71)	(2.17)	(1.01)	(1.24)	(1.79)	(2.17)
R^2	0.75	0.67	0.69	0.64	0.62	0.58
Panel B: $rx^{(n)}_{t+n} = \theta^{(n)}_{POS} 1_{\{\varphi^{(n)}_t > 0\}} + \delta^{(n)}_{POS} \varphi^{(n)}_t 1_{\{\varphi^{(n)}_t > 0\}} + \theta^{(n)}_{NEG} 1_{\{\varphi^{(n)}_t \leq 0\}} + \delta^{(n)}_{NEG} \varphi^{(n)}_t 1_{\{\varphi^{(n)}_t \leq 0\}} + \tilde{\eta}^{(n)}_{t+n}$						
$\delta^{(n)}_{POS}$	0.00	-0.04	-0.14	-0.19	-0.21	-0.18
$t_{\{\delta^{(n)}_{POS}=0\}}$	(0.04)	(-0.26)	(-0.93)	(-0.92)	(-0.85)	(-0.62)
$\delta^{(n)}_{NEG}$	-0.25	-0.36	-0.13	-0.25	-0.48	-0.85
$t_{\{\delta^{(n)}_{NEG}=0\}}$	(-2.68)	(-2.22)	(-1.06)	(-1.25)	(-1.74)	(-2.17)
R^2	0.10	0.10	0.04	0.08	0.12	0.14

- Asymmetry: augment predictive regressions by the sign of term spread
  - ⋆ Upward-sloping: curve predicts short rates consistent with expectations hypothesis
  - ⋆ Downward-sloping: curve underestimates rate cuts $\longrightarrow$ predicts positive excess returns

Excess returns and the Fed reaction function

- How does the monetary policy stance relate to excess returns?

  ⟶ Excess returns correlate with short rate deviations from the Taylor rule

- Learning about the Fed reaction function as a driver of non-zero expectation errors

  → Revisions to expectations, $RV_t^{(n)} = (S_t^{(n)} - S_{t-1}^{(n)})$, predict future expectation errors

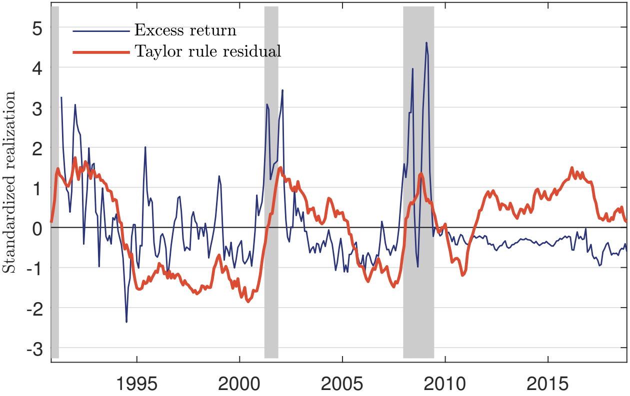
  → Verify based on approach put forth by Coibion & Gorodnichenko (2015)

- Emerging literature suggests Fed considers financial conditions when setting policy rate

  → Example: "Fed put", i.e. the Fed eases monetary policy to cushion poor stock returns (Cieslak and Vissing-Jorgensen, 2017)

  → If the Fed reacts unexpectedly to deteriorating financial conditions, these should predict excess returns

Monetary policy stance and excess returns



We compute the Taylor rule residual as $\psi_{t+n}^{\text{Taylor}} = \hat{i}_{t+n}^{\text{Model}} - i_{t+n}$, where the model-implied short rate is based on vintage data on inflation and unemployment

▸ Table of correlations and details on Taylor rule

Learning about the reaction function

$n =$	3	6	9	12
Panel A: $i_{t+n} - S_t^{(n)} = \omega^{(n)} + \kappa^{(n)} RV_t^{(n)} + \xi_{t+n}^{(n)}$				
$\kappa^{(n)}$	0.12	0.23	0.38	0.50
	(2.57)	(3.16)	(3.69)	(2.99)
R^2	0.05	0.09	0.15	0.15
$1/(1+\kappa^{(n)})$	0.89	0.81	0.72	0.67
Panel B: $i_{t+n} - S_t^{(n)} = \omega_{POS}^{(n)} 1_{\{RV_t^{(n)}>0\}} + \kappa_{POS}^{(n)} RV_t^{(n)} 1_{\{RV_t^{(n)}>0\}} + \omega_{NEG}^{(n)} 1_{\{RV_t^{(n)}\leq 0\}} + \kappa_{NEG}^{(n)} RV_t^{(n)} 1_{\{RV_t^{(n)}\leq 0\}} + \tilde{\xi}_{t+n}^{(n)}$				
$\kappa_{POS}^{(n)}$	0.13	0.20	0.34	0.54
	(0.81)	(0.87)	(1.06)	(0.74)
$\kappa_{NEG}^{(n)}$	0.05	0.16	0.33	0.51
	(0.78)	(1.69)	(2.49)	(2.66)
R^2	0.08	0.11	0.15	0.15

- $RV_t^{(n)} = (S_t^{(n)} - S_{t-1}^{(n)})$ is the update in forecast between t and $t-1$ for the short rate at $t+n$
- Information rigidities: $\kappa^{(n)} \neq 0$ shows that investors gradually update their expectations
- Asymmetry: $\kappa_{NEG}^{(n)} \neq 0$ shows that investors are too slow to revise down their expectations

Financial conditions as a non-anticipated reaction function ingredient?

William Dudley (2017):

The Importance of Financial Conditions in the Conduct of Monetary Policy

"The importance and complexity of financial conditions also underscore the need for caution in following any mechanical monetary policy rule."

"For example, the most well-known rule—the Taylor Rule—does not explicitly take financial conditions into account in terms of its monetary policy prescription."

"Because the interactions can shift between financial conditions and the economic outlook—as well as between financial conditions and the federal funds rate—the absence of financial conditions in this rule can cause it to perform poorly as a guide for monetary policy."

Predicting excess returns using the stock market

	FF Futures		Overnight Index Swaps			
$n =$	3	6	3	6	9	12
Panel A: $rx_{t+n}^{(n)} = \alpha^{(n)} + \beta^{(n)} rx_t^{\text{S\&P500}} + \epsilon_{t+n}^{(n)}$						
$\beta^{(n)}$	-0.87	-1.58	-0.82	-1.30	-1.79	-2.37
	(-4.13)	(-4.21)	(-3.40)	(-3.03)	(-2.73)	(-2.58)
R^2	0.05	0.05	0.06	0.05	0.04	0.04

- Magnitudes: 10% drop in stock prices raises, e.g., OIS 12-month excess returns by 23.7 basis points
- Robust to controlling for employment growth (real time data), corporate bond and Treasury yield spread, NBER recessions, and to out-of-sample evaluation
- Identical results for survey expectation errors as well as using the CFNFC index as predictor

Out-of-sample results | Predicting survey errors with stock returns

Asymmetries: positive vs negative stock returns as excess return predictors

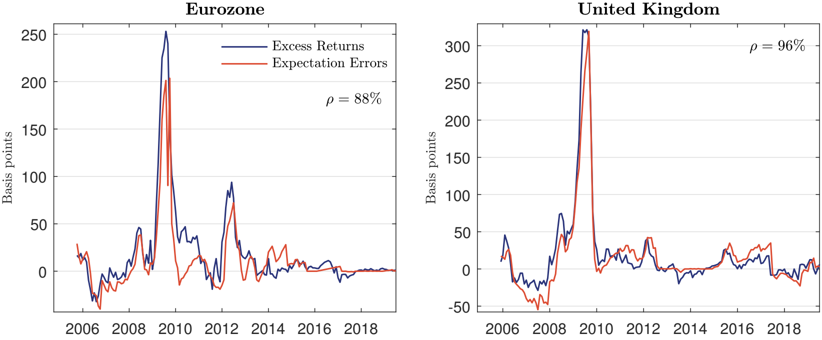
$$rx^{(n)}_{t+n} = \alpha^{(n)}_{POS} + \beta^{(n)}_{POS} rx^{\text{S\&P500}}_t 1_{\{rx^{\text{S\&P500}}_t > 0\}} + \alpha^{(n)}_{NEG} + \beta^{(n)}_{NEG} rx^{\text{S\&P500}}_t 1_{\{rx^{\text{S\&P500}}_t \leq 0\}} + \gamma^{(n)} \text{NBER}_t + \varepsilon_{t+n},$$

	FF Futures		Overnight Index Swaps			
$n =$	3	6	3	6	9	12
$\beta^{(n)}_{\text{POS}}$	-0.17	-0.81	-0.25	-0.56	-0.61	-0.60
	(-0.45)	(-1.11)	(-0.84)	(-1.04)	(-0.81)	(-0.60)
$\beta^{(n)}_{\text{NEG}}$	-1.24	-1.81	-0.89	-1.11	-1.45	-2.13
	(-3.29)	(-2.48)	(-2.10)	(-1.38)	(-1.18)	(-1.25)
$\gamma^{(n)}$	20.23	36.82	16.71	32.90	50.57	64.65
	(5.08)	(3.93)	(3.86)	(3.17)	(2.90)	(2.47)
R^2	0.21	0.20	0.17	0.19	0.21	0.20

International evidence: mean excess return

	Overnight Index Swaps			
$n =$	3	6	9	12
Australia	0.00	2.06	6.28	12.13
	(0.00)	(0.67)	(1.24)	(1.59)
Canada	1.14	4.66	8.96	8.11
	(1.55)	(2.00)	(1.89)	(0.88)
Eurozone	3.57	8.24	13.76	19.94
	(2.64)	(2.41)	(2.38)	(2.43)
United Kingdom	3.45	7.79	13.18	19.62
	(1.44)	(1.58)	(1.70)	(1.79)
Japan	0.52	1.10	2.00	2.93
	(1.34)	(1.58)	(1.86)	(1.55)
Switzerland	2.93	6.30	11.03	15.29
	(1.53)	(1.60)	(1.85)	(2.01)

International evidence: EE and excess return correlations



Figures show realized excess returns to OIS with 12-months to maturity against the short-rate expectation error over the same horizon. Survey expectations are from Reuters Central Bank Polls.

International: correlations table

International evidence: predicting excess returns using stock returns

		Overnight Index Swaps			
$n =$		3	6	9	12
Australia	$\beta^{(n)}$	-0.48	-1.37	-2.34	-3.40
		(-1.42)	(-2.00)	(-2.27)	(-2.57)
	R^2	0.01	0.03	0.04	0.05
Canada	$\beta^{(n)}$	-0.66	-1.43	-2.00	-2.55
		(-3.84)	(-3.45)	(-2.91)	(-2.42)
	R^2	0.08	0.08	0.06	0.04
Eurozone	$\beta^{(n)}$	-0.36	-1.26	-2.01	-2.79
		(-1.81)	(-3.05)	(-3.18)	(-3.35)
	R^2	0.02	0.06	0.06	0.07
United Kingdom	$\beta^{(n)}$	-1.55	-2.57	-3.23	-3.93
		(-4.70)	(-4.37)	(-3.89)	(-3.85)
	R^2	0.09	0.08	0.07	0.07
Japan	$\beta^{(n)}$	-0.08	-0.13	-0.17	-0.22
		(-1.91)	(-1.87)	(-1.70)	(-1.83)
	R^2	0.02	0.02	0.02	0.02
Switzerland	$\beta^{(n)}$	-0.77	-1.05	-1.31	-1.89
		(-3.07)	(-2.41)	(-2.03)	(-2.35)
	R^2	0.05	0.04	0.03	0.04

The table shows slope coefficients from regressions of OIS excess returns on stock market returns in each currency area

Key take-aways

- Revisit expectations hypothesis in the money market and use survey data to study why FF futures and OIS are biased predictors of the short-rate
  - ⋆ Term premia play negligible role and are negative on average
  - ⋆ Instead, excess returns largely stem from expectation errors
  - → Interpretation: over the past three decades, the Fed eased more aggressively than investors had anticipated
- Strong asymmetries in the predictive accuracy of FF futures and OIS
  - ⋆ Accurate forecasts of rate hikes (expectations hypothesis holds)
  - ⋆ But, biased forecast of rate cuts because of underestimation/conservatism
- Results consistent with view that market participants are learning about the Fed reaction function in an environment of uncertainty
  - ⋆ Positive excess returns when monetary policy stance loose (according to Taylor rule)
  - ⋆ Negative stock returns historically emerge as a powerful predictor of excess returns
  - → Suggests slow-updating about financial conditions as reaction function ingredient

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Appendix: Matching OIS and surveys

◂ Back

- Blue-Chip surveys refer to forecasts of the arithmetic average EFFR and does not accurately match the compounding that takes place in an OIS
- However, we cannot simply compound survey expectations as the expectation of a compounded variable is not the same as the compounded expectation (Jensen's inequality)
- Proceed by using unadjusted surveys for OIS in the main paper, despite difference between simple and compounded expectations
- But TP and EE estimates for OIS are of similar magnitude to FF Futures of similar maturities (where there is no issue with compounding) $\rightarrow$ difference between simple and compounded overnight rates is negligible

  $\longrightarrow$ For a 3-mth OIS, a 2% interest rate translates into 2.005% when compounded daily over 3 months

Appendix: Details on Blue Chip survey

◂ Back

- Survey consists of about 45 professional forecasters from leading financial institutions
- The survey is conducted each month: responses are collected during the last week of the month and published on the first business day of the following month

  ⟶ For this reason, we treat the forecasts published in a given month as the end-of-month expectation of the prior month.

- Participants are asked to predict the average (as opposed to end-of-period) effective federal funds rate during each quarter of the year. Horizons are up to 5 quarters ahead
- To get time series of fixed-horizon forecasts, we linearly interpolate survey forecasts

  ⟶ Example: the 3-mth ahead forecast as observed on the last day of February consists of 2/3 times the forecast for Q1 (average EFFR for January, February and March), and 1/3 times the forecast for Q2 (average EFFR for April, May and June)

Appendix: Matching forecast horizons

Back

- For Federal Funds Futures we compute average returns $n = 3, 6$ months,

$$\overline{rx}^{(n)}_{t,t+n} = \frac{1}{n}\sum_{i=1}^{n} f^{(i)}_t - \frac{1}{n}\sum_{i=1}^{n} i^{FF}_{t+i} \tag{1}$$

- We decompose excess returns into EE and TP by adding and subtracting the survey expectation $S^{(n)}_t$ from the right-hand side of the above equation and re-arranging,

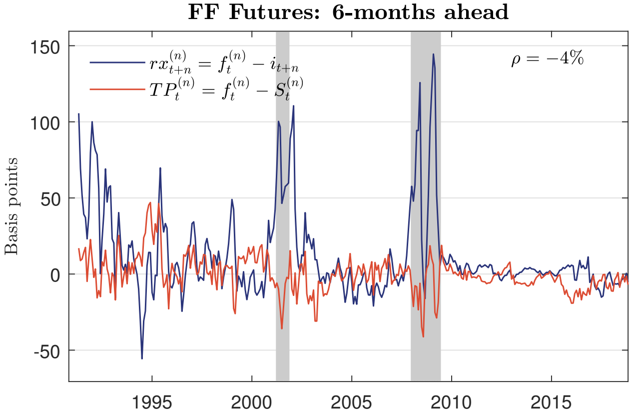
$$\overline{rx}^{(n)}_{t,t+n} = \underbrace{S^{(n)}_t - \frac{1}{n}\sum_{i=1}^{n} i^{FF}_{t+i}}_{\text{expectation error}} + \underbrace{\frac{1}{n}\sum_{i=1}^{n} f^{(i)}_t - S^{(n)}_t}_{\text{term premium}}, \tag{2}$$

- Perform the same decomposition for OIS, but because survey and OIS forecast horizons match exactly, there is no need to average

$$rx^{(n)}_{t,t+n} = \underbrace{S^{(n)}_t - i^{OIS}_{t,t+n}}_{\text{expectation error}} + \underbrace{f^{(n)}_t - S^{(n)}_t}_{\text{term premium}}, \tag{3}$$

Appendix: Excess returns and term premia

Back



Appendix: Number of unexpected rate changes

◂ Back

$n =$	Short Rate Hike		Short Rate Cut	
	Anticipated	Surprise	Anticipated	Surprise
	Panel A: Federal Funds Futures			
1	83.7 %	16.3 %	64.2 %	35.8 %
2	89.9 %	10.1 %	65.2 %	34.8 %
3	91.4 %	8.6 %	60.6 %	39.4 %
4	91.9 %	8.1 %	57.1 %	42.9 %
5	92.0 %	8.0 %	55.8 %	44.2 %
6	93.1 %	6.9 %	52.6 %	47.4 %
	Panel B: Overnight Index Swaps			
3	90.6 %	9.4 %	53.1 %	46.9 %
6	95.2 %	4.8 %	49.4 %	50.6 %
9	95.0 %	5.0 %	44.6 %	55.4 %
12	97.5 %	2.5 %	40.0 %	60.0 %

The table shows how many times a market participants correctly predicted the direction of short rate changes as a fraction of the total number of realized hikes and cuts.

Appendix: Underestimating changes by 50 bps or more

Back

$n =$	Short Rate Hike		Short Rate Cut	
	Overestimate	Underestimate	Overestimate	Underestimate
Threshold: 50 basis points				
Panel A: Federal Funds Futures				
1	0.0 %	0.0 %	0.0 %	1.0 %
2	0.0 %	0.0 %	0.0 %	7.9 %
3	0.0 %	0.6 %	0.0 %	19.6 %
4	1.3 %	0.6 %	0.0 %	28.3 %
5	1.2 %	3.7 %	0.0 %	36.8 %
6	3.1 %	3.7 %	1.2 %	36.6 %
Panel B: Overnight Index Swaps				
3	0.0 %	0.0 %	0.0 %	4.7 %
6	0.0 %	0.0 %	0.0 %	17.5 %
9	0.0 %	0.0 %	0.0 %	24.3 %
12	0.0 %	3.4 %	0.0 %	37.5 %

The table shows how many times a correctly predicted hikes/cuts underestimated the magnitude of the change by 50 or more basis points as a fraction of either the total number of correctly predicted hikes or cuts.

Appendix: Monetary policy stance and excess returns

Back

	Federal Funds Futures		Overnight Index Swaps			
$n =$	3	6	3	6	9	12
$\rho\left(\psi_{t+n}^{\text{Taylor}}, rx_{t+n}^{(n)}\right)$	0.19	0.30	0.06	0.13	0.21	0.25
	[0.00]	[0.00]	[0.38]	[0.07]	[0.00]	[0.00]
$\rho\left(\psi_{t+n}^{\text{Taylor}}, \text{EE}_{t+n}^{(n)}\right)$	0.28	0.41	0.19	0.28	0.37	0.40
	[0.00]	[0.00]	[0.01]	[0.00]	[0.00]	[0.00]

The table reports correlations between Taylor rule residuals and excess returns (expectation errors). *p*-values in parentheses. We estimate an augmented Taylor rule each month by regressing the short rate on vintage data on inflation and unemployment:

$$\hat{i}_{t+n}^{\text{Model}} = \hat{\alpha}_{t+n} + \hat{\beta}_{t+n} u_{t+n} + \hat{\gamma}_{t+n} \pi_{t+n}$$

For robustness rely on approach by Evans et al. (1998) that assumes a set of structural relations between short rate and fundamentals.

$$\hat{i}_{t+n}^{\text{Model}} = r + \pi_{t+n} + \frac{1}{2} \times \text{okun} \times (u^* - u_{t+n}) + \frac{1}{2} \times (\pi_{t+n} - \pi^*)$$

π_{t+n} is average inflation rate over the last year, *okun* refers to Okun's law, u_{t+n} is the unemployment rate, u^* is the natural rate of unemployment and π^* is the target inflation rate. For parameter values, we follow Evans et al. (1998) and set $r = 2\%, u^* = 6\%, \pi^* = 2\%$, and $okun = 3$.

Appendix: Excess return decomposition with quarterly data

◂ Back

	FF Futures		Overnight Index Swaps			
$n =$	3	6	3	6	9	12
Panel A: Mean Estimates						
Excess return	6.41	12.97	3.81	7.96	12.68	18.10
	(3.00)	(2.80)	(1.38)	(1.44)	(1.43)	(1.47)
Term premium	-0.55	0.97	-1.34	-1.21	-2.21	-3.67
	(-0.67)	(0.60)	(-1.80)	(-0.58)	(-0.74)	(-1.00)
Expectation error	6.96	12.00	5.15	9.17	14.89	21.77
	(3.52)	(2.51)	(1.78)	(1.69)	(1.82)	(1.89)
Panel B: Variance Decomposition						
Term premium	-0.09	0.01	-0.14	0.00	0.05	0.07
Expectation error	1.09	0.99	1.14	1.00	0.95	0.93

Appendix: International evidence - correlations table

Back

$n =$	3	6	9	12
Eurozone	0.35	0.75	0.85	0.88
	[0.00]	[0.00]	[0.00]	[0.00]
United Kingdom	0.93	0.96	0.96	0.96
	[0.00]	[0.00]	[0.00]	[0.00]
Switzerland	0.69	0.82	0.85	0.86
	[0.00]	[0.00]	[0.00]	[0.00]

The table reports the correlation coefficient between excess returns to OIS and expectation errors from Reuters Central Bank Polls. $p-$values in brackets.

Appendix: Predicting Expectation Errors with Stock Excess Returns

◂ Back

	FF Futures		Overnight Index Swaps			
$n =$	3	6	3	6	9	12
Panel A: $\text{EE}_{t+n}^{(n)} = \alpha^{(n)} + \beta^{(n)} rx_t^{\text{S\&P500}} + \epsilon_{t+n}^{(n)}$						
$\beta^{(n)}$	-1.07	-1.87	-1.30	-1.82	-2.38	-2.99
	(-4.32)	(-4.51)	(-4.30)	(-3.83)	(-3.41)	(-3.18)
R^2	0.05	0.06	0.09	0.08	0.07	0.07
Panel B: $\text{EE}_{t+n}^{(n)} = \alpha^{(n)} + \beta^{(n)} rx_t^{\text{S\&P500}} + \gamma^{(n)}\text{Employment Growth}_t + \epsilon_{t+n}^{(n)}$						
$\beta^{(n)}$	-1.06	-1.86	-1.30	-1.83	-2.39	-3.01
	(-4.32)	(-4.58)	(-4.44)	(-3.89)	(-3.50)	(-3.22)
$\gamma^{(n)}$	-2.30	-4.38	-1.13	-1.80	-3.09	-5.09
	(-1.66)	(-1.56)	(-0.76)	(-0.64)	(-0.68)	(-0.83)
R^2	0.08	0.10	0.10	0.09	0.09	0.09

Appendix: FF Futures return details

◂ Back

- Long position in FF futures contract: receive fixed rate and pay based on the floating short-rate
- Fixed and floating leg payments calculated based on a $5 million deposit and the 360 quoting convention: the notional is used to compute the daily payments made by each leg and is never exchanged between the parties
- Importantly, FF futures are settled against variation in the short-rate over the target month n (a future time interval) and not the path of the rate from t to $t+n$
- Excess return on a *long* position:

$$rx_{t+n}^{(n)} = f_t^{(n)} - i_{t+n},$$

- $i_{t+n} = 1/k \sum_{j=1}^{k} r_j$ denotes the average short-rate over month $t+n$. Specifically, r_j is the EFFR observed on day j, denoted as an annual percentage rate, and k is the total number of days in the target month.
- Focus on the differential between annual rates, rather than specific dollar amounts

Appendix: OIS return details I/II

Back

- Overnight index swaps are OTC-traded fixed-for-floating swaps.
- Similarly to FF Futures, an investor long OIS will receive the fixed swap rate and pay floating based on variations in the short-rate
- While FF futures settle against the simple average short-rate over target month n, OIS settle against the compounded *path* of the short-rate from contract inception t until maturity $t+n$, where interest accrues over this interval on an actual/360 basis
- $f_t^{(n)}$: OIS rate observed on the last day of month t, which settles against the path of short-rates from t to $t+n$
- q: number of days in this interval.

Appendix: OIS return details II/II

◂ Back

- At maturity, fixed and floating leg payments are exchanged. For a notional of \$5,000,000, the long OIS investor realizes the amount $5,000,000 \times (q/360 \times f_t^{(n)} - [\prod_{j=1}^{q}(1 + r_j/360) - 1])$, where r_j is the daily overnight rate observed on day j and denoted as an annual percentage rate. The fixed leg pays simple interest while the variable leg rate includes compounding.

- For comparability to FF futures, we move the conversion term $q/360$ outside the parenthesis by multiplying the variable leg rate by the annualizing factor $360/q$. As such, we define excess returns to OIS as the difference between the annual percentage rate of the fixed and floating legs, where the latter rate is compounded over the number of days in the contract q and subsequently annualized

$$rx_{t+n}^{(n)} = f_t^{(n)} - i_{t+n},$$

- where $i_{t+n} = [\prod_{j=1}^{q}(1 + r_j/360) - 1] \times 360/q$, r_j is the short-rate on day j, and q is the total number of days in the contract

Appendix: Out-of-sample results

◂ Back

	FF Futures		Overnight Index Swaps			
$n =$	3	6	3	6	9	12
S&P500	5.26	5.97	1.39	3.07	3.88	5.95
	[0.01]	[0.00]	[0.01]	[0.01]	[0.01]	[0.01]
Employment growth	-5.25	-12.45	-2.48	-9.42	-18.28	-22.13
	[0.29]	[0.20]	[0.43]	[0.65]	[0.51]	[0.20]
Corporate bond spread	-8.04	-12.84	-7.70	-7.59	-3.17	6.75
	[0.32]	[0.75]	[0.91]	[0.83]	[0.31]	[0.14]
Term spread	-1.49	-2.79	-1.05	-3.42	-4.81	-2.35
	[0.72]	[0.75]	[0.59]	[0.83]	[0.90]	[0.77]

The table reports the Campbell and Thompson (2008) R^2_{OOS} statistic for predicting excess returns using different predictors. Square brackets give the Clark and West (2007) $p-$values from the test of equal predictive accuracy with the EH benchmark. We use an expanding window of observations to estimate parameters, where the initial estimation window contains five years of data.