CENTRAL BANKING · LECTURE 2

02

From latent beliefs to observable data.

Measuring Expectations.

Surveys, markets, central-bank projections, text, and the wedges that make each measure useful.

Fatih Kansoy
Central Banking · Lecture 2

Worcester College

Content

From latent beliefs to market prices, policy surprises, and causal identification.

Three empirical steps.

Start with fundamentals: define the expectation object, the instrument, and the wedge. Then read policy expectations from market prices and use high-frequency timing for identification.

02A	**Fundamentals** Latent beliefs, surveys, market-implied measures, central-bank projections, text, and measurement wedges.	$m_{k,t} = g_k(\theta_t) + w_{k,t} + \varepsilon_{k,t}$
02B	**Futures and asset prices** Fed funds futures, meeting-level probabilities, Kuttner surprises, target versus path news.	$f_{t,m} = 100 - F_{t,m}$
02C	**High-frequency identification** Event windows, asset-price responses, information shocks, and macro external instruments.	$\Delta_{\mathcal{W}} x_e$

02A

Latent beliefs, observed instruments.

Fundamentals.

Latent beliefs, measurement instruments, probability measures, and validation.

Agent, variable, horizon

Moment, probability measure, and wedge

Survey, market, central-bank, and text measures

Monetary Policy Works Through Expected Future Rates

Every core equation of modern macro is an expectations equation

CONSUMPTION EULER EQUATION

$$u'(c_t) = \beta\,(1 + r_t)\,\mathbb{E}_t[u'(c_{t+1})]$$

Households postpone spending based on what they expect consumption to be worth tomorrow. Current saving behaviour depends entirely on **expected future real returns**.

FISHER RELATION

$$r_t \approx i_t - \mathbb{E}_t[\pi_{t+1}]$$

The real rate — which drives investment and borrowing — is the nominal rate minus **expected inflation**. A central bank that cannot observe $\mathbb{E}_t[\pi_{t+1}]$ is flying blind.

NEW KEYNESIAN PHILLIPS CURVE

$$\pi_t = \kappa\,\widetilde{mc}_t + \beta\,\mathbb{E}_t[\pi_{t+1}]$$

Today's inflation is partly driven by **inflation expected tomorrow**. Price-setters are forward-looking; anchored expectations limit inflation persistence after shocks.

TERM STRUCTURE OF INTEREST RATES

$$i_t^{(n)} = \frac{1}{n}\sum_{j=0}^{n-1} \mathbb{E}_t[i_{t+j}] + \tau_t^{(n)}$$

A long rate is an average of expected short rates plus a term premium $\tau_t^{(n)}$. Forward guidance moves $\mathbb{E}_t[i_{t+j}]$ for $j \geq 1$ — without touching the overnight rate. **The language is the policy.**

Why Measurement Is Hard: The Latent-Variable Problem

Expectations are latent distributions; data are instrument-specific traces

FUNDAMENTAL OBSTACLE

The belief is hidden.

$$\theta_{a,t}^{(h)}(X)$$

Agent a's belief about X_{t+h} is a subjective distribution. We observe only traces left by surveys, prices, or language.

OBSERVED OBJECT

$$m_{k,t}^{(h)} = g_k\left(\theta_{a,t}^{(h)}(X)\right) + w_{k,t}^{(h)} + \varepsilon_{k,t}^{(h)}$$

$m_{k,t}^{(h)}$
Number produced by instrument k.

$g_k(\theta)$
Moment or transformation captured.

$w_{k,t}^{(h)}$
Structured wedge: not random noise.

ε
Sampling or measurement error.

01 Survey responses

Useful because they ask agents directly. Wedge: **wording, framing, rounding, priming, numeracy**.

02 Market prices

Useful because they update continuously and are traded. Wedge: **risk premia, liquidity, collateral, risk-neutral pricing**.

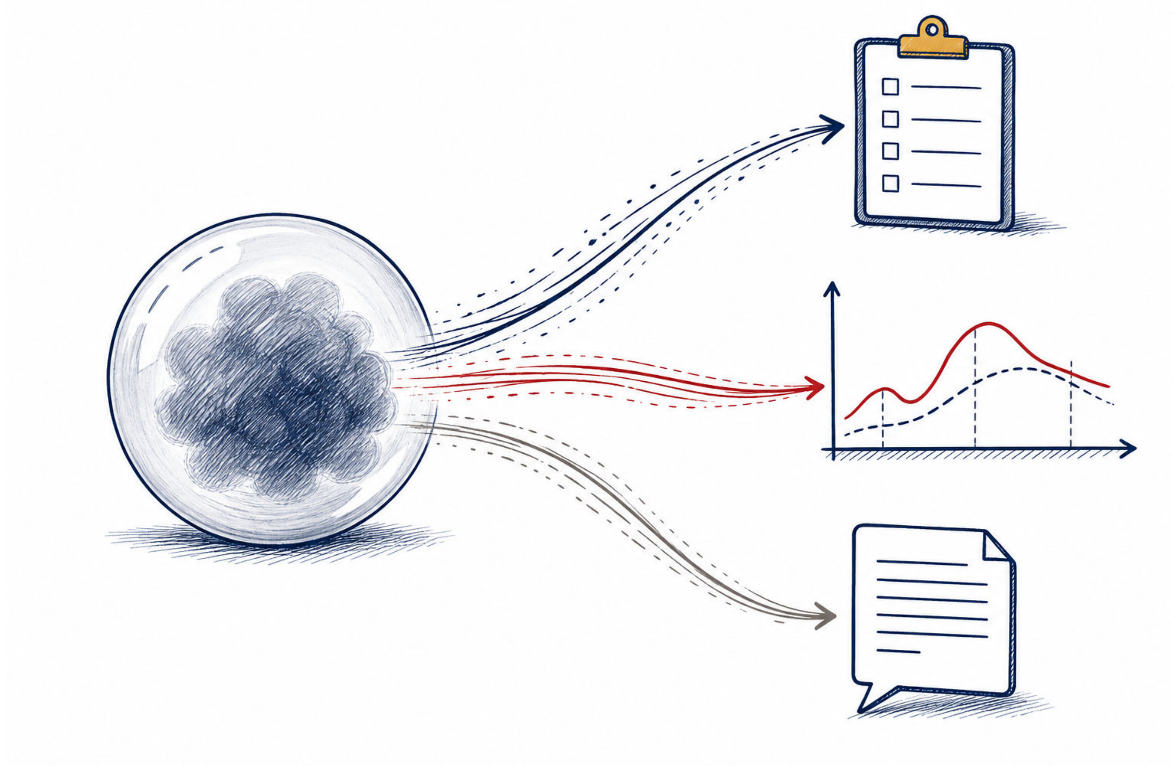
03 Textual traces

Useful for salience and tone. Wedge: **selection, strategic language, model extraction error, language drift**.

Lucas (1976) makes the point sharper: if agents revise expectations when the policy regime changes, then measurement is not a technical detail. It is the identification problem.

The Belief Is Hidden; Instruments Leave Different Traces

We never observe belief directly—we observe instrument-specific transformations of it



One latent belief, three observable traces.

MEASUREMENT MAP

A trace is not the belief itself

$$m_{k,t} = g_k(\theta_t) + w_{k,t} + \varepsilon_{k,t}$$

Each instrument selects a moment of the hidden distribution and adds its own structured wedge.

S **Survey**
Direct report, shaped by wording, framing, rounding, and numeracy.

M **Market**
Traded price, shaped by risk, liquidity, and risk-neutral pricing.

T **Text**
Language trace, shaped by selection, strategy, and extraction error.

Reading rule: compare the traces; do not treat them as duplicate observations.

Survey Measures — Households

The general public's inflation beliefs — measured but imperfectly

University of Michigan Survey of Consumers

POINT FORECAST

US · SINCE 1978 · MONTHLY

Asks: "By what percent do you expect prices to rise over the next 12 months?" Longest-running household series. Mass spikes at 0, 5, 10% reflect rounding as a signal of uncertainty (Binder 2017). Also collects 5-year expectations.

NY Fed Survey of Consumer Expectations (SCE)

DISTRIBUTIONAL

US · SINCE 2013 · MONTHLY, PANEL

Respondents assign probabilities to inflation bins — recovers individual means and uncertainty. Panel design tracks belief revision over time. Validated against spending data (CGW 2022).

BoE/Ipsos Inflation Attitudes Survey

QUALITATIVE

UK · SINCE 1999 · QUARTERLY

Asks about "prices in the shops generally." Qualitative balance statistic converted to a quantitative measure. Key input to the Monetary Policy Committee's deliberations on public credibility.

ECB Consumer Expectations Survey (ECB-CES)

DISTRIBUTIONAL + RCT

EURO AREA · SINCE 2020 · MONTHLY, PANEL

Newest major household survey. Panel structure and embedded information experiments (RCTs) allow causal identification. Distributional elicitation with HICP framing. Benchmark for ECB communication research.

Key design choices: wording (aggregate prices vs own costs), format (point vs distributional), horizon framing (cumulative vs average annual vs point-in-time). These determine what you measure — they are not interchangeable.

Survey Measures — Professional Forecasters

Expert predictions with distributional elicitation and long track records

Survey of Professional Forecasters (SPF)

PHILADELPHIA FED / ECB · US SINCE 1968

Longest-running professional survey in the US. Forecasters assign probabilities to inflation bins — the distributional format recovers uncertainty and disagreement. ECB SPF mirrors the structure for the euro area (since 1999).

Blue Chip Economic Indicators

WOLTERS KLUWER · US SINCE 1976

Compiles monthly forecasts from ~50 business economists at major financial institutions. Widely tracked by markets and policymakers as a near-term consensus gauge.

Livingston Survey

PHILADELPHIA FED · US SINCE 1946

The longest-running continuous expectations survey in existence. Bi-annual; economists at banks, industry, and government. Historical depth is essential for studying belief formation across monetary regimes.

BoE SEF / Consensus Economics

UK · ONGOING

BoE SEF polls external forecasters ahead of each MPC meeting. Consensus Economics collects projections from 30+ UK institutions — broad cross-section of professional opinion.

Why professionals differ from households

Incentive alignment
Professionals are paid to be accurate. Households are not.

Informational advantage
Access to real-time data, econometric models, and market intelligence.

Herding risk
Reputation incentives push forecasts toward consensus — a bias opposite to households' limited-attention bias.

Forecast accuracy
Ang, Bekaert & Wei (2007): Michigan and SPF both outperform the US term structure at forecasting inflation at 1-year horizons.

Mankiw, Reis & Wolfers (2003): Households, firms, and professionals differ on inflation by percentage points; the gap widens significantly in high-inflation episodes. The disagreement is systematic, not noise.

Market Measures — Inflation Expectations

Financial prices reveal risk-neutral expectations — not physical beliefs

BE

TIPS breakeven

UNITED STATES · CPI-U · BOND-MARKET COMPENSATION

$$\mathrm{BE}_t^{(n)} = i_t^{(n)} - i_{t,\mathrm{TIPS}}^{(n)} = \mathbb{E}_t^Q[\pi_{t,t+n}] + \lambda_t + \ell_t$$

Difference between nominal Treasury and TIPS yields. Available at 1y, 5y, and 10y horizons. **Limitation:** TIPS liquidity can distort the signal in stress episodes; the liquidity wedge ℓ_t is often countercyclical.

ILS

Zero-coupon inflation swaps

CPI / HICP · SWAP-MARKET COMPENSATION

$$\mathrm{ILS}_t^{(n)} \approx \mathbb{E}_t^Q[\pi_{t,t+n}] + \lambda_t$$

Fixed-rate payer receives realised CPI or HICP growth. Swaps avoid the TIPS liquidity premium and are central for anchoring assessment; the ECB tracks the **5y5y HICPxT swap**. Cleaner than breakevens, but less liquid in thin markets.

WHAT THE PRICE CONTAINS

Q **Risk-neutral expectation**
The market-implied distribution, not the average household or firm belief.

λ **Inflation risk premium**
Compensation for holding payoffs exposed to inflation states.

ℓ **Market-friction wedge**
Liquidity, collateral, segmentation, and balance-sheet constraints.

INSTRUMENTS BY JURISDICTION

US **United States**
TIPS breakevens; CPI-U swaps.

UK **United Kingdom**
ILG breakevens; RPI swaps with CPI/RPI wedge.

EA **Euro area**
HICPxT swaps; OAT/Bund breakevens.

Market Measures — Interest Rate Expectations

Futures and swaps price the expected path of the policy rate

FFF

Fed funds futures

US · CME · NEAR-TERM FOMC EXPECTATIONS

$$F_{t,m} = 100 - \mathbb{E}_t^Q\left[\bar{r}_m^{\,EFFR}\right]$$

Settles against the arithmetic *average* effective federal funds rate during the contract month. This is the cleanest market instrument for near-term Fed expectations and meeting-level target surprises.

OIS

Overnight index swaps

SOFR · SONIA · €STR · FULL POLICY-RATE CURVE

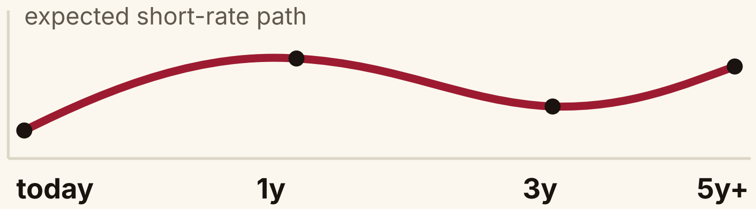
$$OIS_t^{(n)} = \frac{1}{n}\sum_{j=0}^{n-1} \mathbb{E}_t^Q[i_{t+j}] + \tau_t^{(n)}$$

Fixed leg of a swap against a compounded overnight rate. OIS curves read out the expected path of policy rates across tenors, with a term-premium component $\tau_t^{(n)}$.

Q

The object is a path

Not one rate: a sequence of expected future overnight rates.



INSTRUMENT BY HORIZON AND MOMENT

0-3m **Fed funds futures**
Current-month average EFFR; best for meeting probabilities and target surprises.

3m+ **SOFR futures**
Post-LIBOR instrument for longer dollar money-market expectations.

tails **Caps, floors, swaptions**
Recover the risk-neutral distribution: $\Pr^Q(i_{t+n} > \bar{i})$, not only the mean.

Whose Beliefs? Three Populations, Three Jurisdictions

"What do people expect?" has no single answer until you say *which people, in which jurisdiction*

POPULATION	UNITED STATES	UNITED KINGDOM	EURO AREA
Households PUBLIC BELIEFS	**Michigan MSC** (1978) NY Fed SCE (2013, panel)	**BoE/Ipsos** Attitudes (1999, qualitative)	**ECB-CES** (2020, panel, RCT-embedded)
Firms PRICING MARGINS	**Atlanta BIE** (own costs) Cleveland SoFIE	**BoE DMP** (2016, about 10,000 firms)	**Bundesbank**; Bank of Italy SIGE; Ifo
Professionals EXPERT FORECASTS	**Philadelphia SPF** (1968) Blue Chip; Livingston (1946)	**BoE SEF**; Consensus Economics	**ECB SPF** (1999)
Markets Q-MEASURE PRICES	**Fed funds / SOFR** futures TIPS breakevens; CPI swaps	**SONIA OIS**; ILG breakevens RPI inflation swaps	**€STR OIS**; HICPxT swaps OAT/Bund breakevens

Each cell is a different population, instrument, and sampling frame. Michigan, ILG breakevens, and ECB-CES do not measure the same economic object.

Three Sources, Three Wedges

Each family of measures has a characteristic error structure — endogenous to the instrument, not classical noise

SOURCE 01 Survey Responses

$$s_{i,t} = \theta_{i,t} + b(q_k, z_i) + r_{i,t} + \varepsilon_{i,t}$$

Wording and framing
"Prices in general" and "inflation in the economy" do not elicit the same belief.

Bin design and priming
Bins centred near target can create artificial clustering around 2%.

Rounding as signal
Responses at 0, 5, and 10% often reveal uncertainty, not simple error.

DO NOT AVERAGE BLINDLY
The wedge is structured by the instrument, so more observations do not make it disappear.

SOURCE 02 Market Prices

$$\mathbb{E}_t^Q[X] = \mathbb{E}_t^P[X] + \rho_t^X$$
$$\rho_t^X = \lambda_t + \ell_t + \chi_t$$

Risk premium λ_t
Compensation for bearing inflation or rate risk; time-varying, not a constant offset.

Liquidity wedge ℓ_t
Thin trading, stress episodes, and collateral constraints distort prices.

P versus Q
The gap between physical and risk-neutral beliefs is itself economically informative.

SOMETIMES THE WEDGE IS THE OBJECT
Risk premia, disagreement, salience, and attention are themselves central-banking variables.

SOURCE 03 Textual Traces

$$T_t = f(\theta_t, \text{strategy}_t) + \nu_t^{extract} + \nu_t^{select}$$

Extraction error
NLP scores depend on language, corpus, dictionary, model, and domain shift.

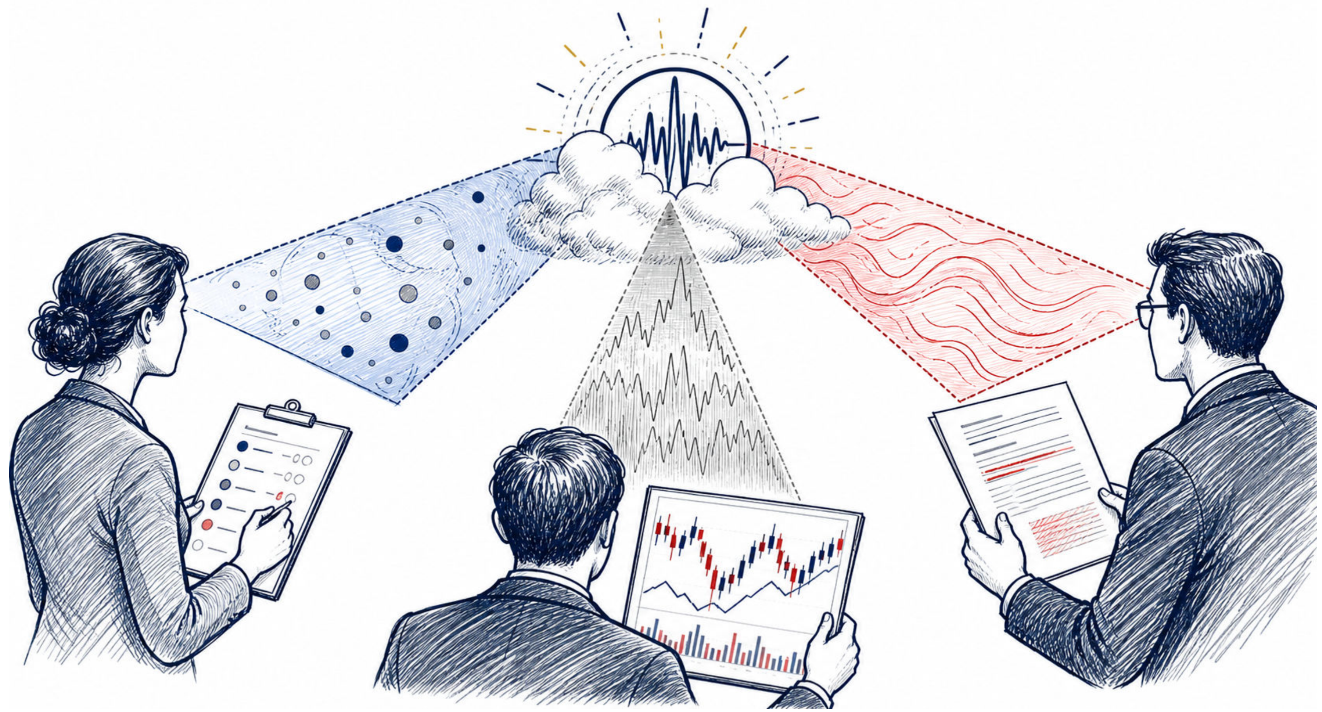
Selection bias
The people and institutions producing text are not a random sample.

Real-time advantage
Text can reveal attention and narrative shifts before surveys update.

TRIANGULATE
Use surveys, markets, and text together to separate belief movement from instrument movement.

Triangulation Separates Belief Movement from Instrument Movement

Three differently distorted views can reveal what is common—and what belongs to the instrument



The shared signal is viewed through three different wedges.

COMMON MOVEMENT

When all three move together

A broad shift is more plausibly a change in the underlying belief than a shock unique to one measurement technology.

DIAGNOSTIC DIVERGENCE

When one trace breaks away

Ask whether risk premia, question design, salience, selection, or language extraction moved instead.

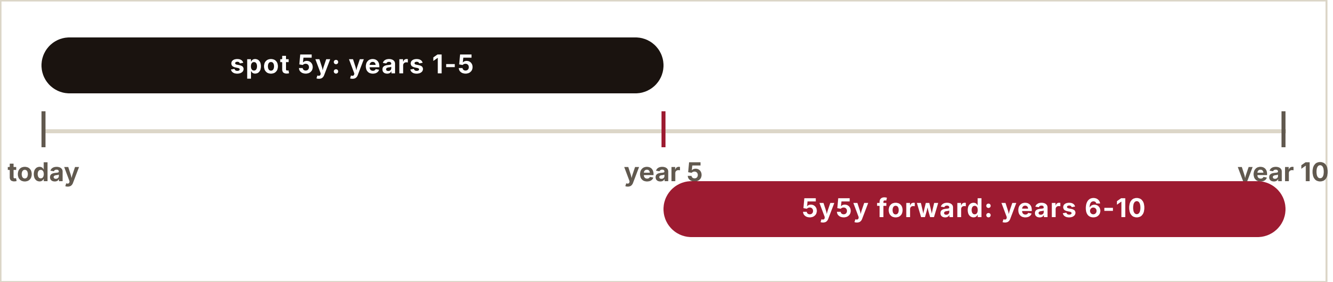
Triangulate—do not average blindly. Disagreement across measures is evidence about the wedge, not merely nuisance noise.

Which Horizon? Level vs Forward Rate

Two datasets can both report "5-year inflation expectations" and mean completely different things

What years are being averaged?

SAME LABEL, DIFFERENT OBJECT



SPOT AVERAGE

5-year level

$$\pi_t^{0,5} = \mathbb{E}_t\left[\frac{1}{5}\sum_{h=1}^{5}\pi_{t+h}\right]$$

Average expected inflation over the **next five years**. It includes near-term energy, food, tax, and supply shocks.

FORWARD WINDOW

5-year / 5-year

$$\pi_t^{5,5} = \mathbb{E}_t\left[\frac{1}{5}\sum_{h=6}^{10}\pi_{t+h}\right]$$

Expected inflation in **years six through ten**. It strips out the near-term shock and is the anchoring benchmark.

How to read 2021-22

Near-term measures surged because current CPI prints, energy prices, and supply disruptions entered the first few years.

5y5y measures moved less because they ask whether inflation is still expected to return near target after the shock.

Anchoring is a far-ahead statement. A high one-year or five-year level is not proof that the anchor has moved.

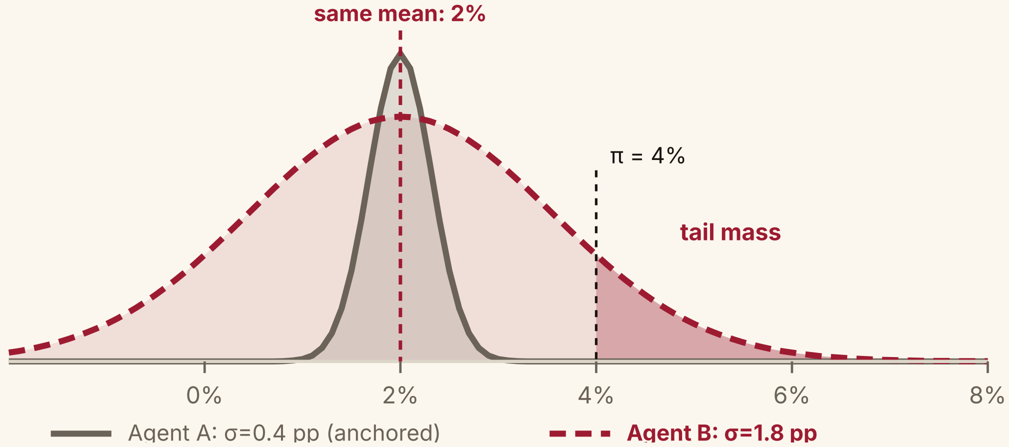
5Y5Y BENCHMARKS BY CENTRAL BANK

- Fed — **US:** 5y5y TIPS breakeven and CPI inflation swap.
- BoE — **UK:** 5y5y RPI swap, adjusted for the RPI-CPI wedge.
- ECB — **Euro area:** 5y5y HICPxT swap, central to anchoring assessment.

Which Moment? The Mean Can Hide the Tail

Anchoring is a property of the *full distribution*, not of the mean alone

SAME MEAN, DIFFERENT SHAPE — SAME POLICY RATE, DIFFERENT ECONOMY



Agent A: anchored

$\mathbb{E}[\pi] = 2\%$

Uncertainty	$\sigma = 0.4$ pp
Right tail	$\Pr[\pi > 4\%] < 1\%$

Beliefs remain concentrated around the target; pricing and wage demands stay anchored.

Agent B: tail risk

$\mathbb{E}[\pi] = 2\%$

Uncertainty	$\sigma = 1.8$ pp
Right tail	$\Pr[\pi > 4\%] \approx 13\%$

Same mean, but much more mass in high-inflation states; policy faces credibility risk.

Mean-only measurement gives the wrong comfort.

Both agents report the same expected inflation. But Agent B has higher **uncertainty** and a visible **right tail**. Anchoring is therefore a statement about the distribution, not only its centre.

TWO TAIL EPISODES IN RECENT HISTORY

Euro area, 2014–15: deflation risk

Option-implied $\Pr^{Q}[\pi < 0]$ on HICPxT rose sharply while the mean 5y5y inflation swap moved only modestly. The tail probability was the early warning signal.

US / UK, 2021–22: upside inflation risk

Option-implied $\Pr^{Q}[\pi > 4\%]$ surged before survey *means* fully adjusted. The distribution moved first; point forecasts lagged the risk signal.

Practical implication: point forecasts are incomplete. Distributional surveys and options-implied densities are needed to measure anchoring.

Central Bank-Based Measures

Official projections are measurement objects, conditioning assumptions, and communication tools

01 Federal Reserve "Dot Plot"

SEP · US · SINCE 2012

$$\tilde{i}^{CB}_{t+h} = \text{median}_j(i^{*,CB}_{j,t+h})$$

SEP reports each FOMC participant's fed-funds forecast for the next three years and the longer run.

Median dot is the focal summary; **dispersion** is internal disagreement.

Individual reaction functions, not a committee forecast. Strategic reporting matters.

02 ECB Survey of Professional Forecasters

EA · SINCE 1999

$$P_{t,h}(\pi \in B_b) = \frac{1}{N_t}\sum_i p_{i,b,t,h}$$

Quarterly survey for HICP inflation, GDP growth, and unemployment.

Collects point and distributional forecasts at 1y, 2y, and 5y horizons.

Data infrastructure, not central-bank beliefs; 5y horizon tracks anchoring.

03 Monetary Policy / Inflation Reports

BOE · ECB · OTHER MAJOR CBS

$$\widehat{X}^{staff}_{t+h} = E^{staff}_t[X_{t+h} \mid \text{paths}]$$

Staff projections are conditional on assumed paths for rates, exchange rates, fiscal policy, energy prices, and the model.

A gap versus market expectations reveals committee-market disagreement.

Different conditioning assumptions can explain different forecasts.

PROJECTION AS SIGNAL AND INSTRUMENT

The forecast can change the outcome it forecasts.

$$\theta^P_{a,t+} = (1-\alpha_a)\theta^P_{a,t-} + \alpha_a \widehat{X}^{CB}_{t+h}$$

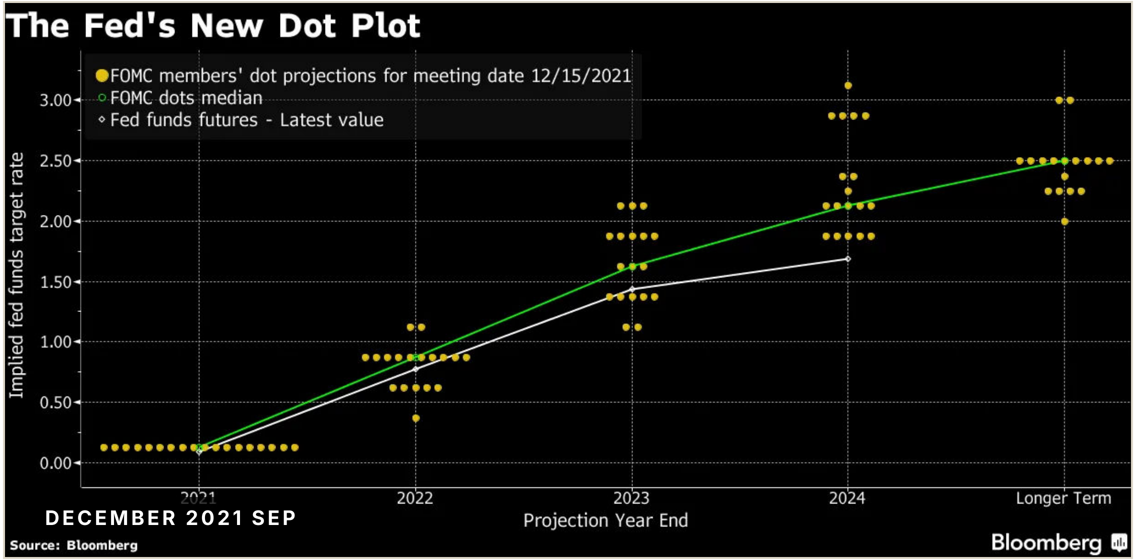
Central-bank projections do not merely *describe* committee or staff beliefs. They can **move private-sector expectations** toward the policy-consistent path. The central bank is both forecaster and actor.

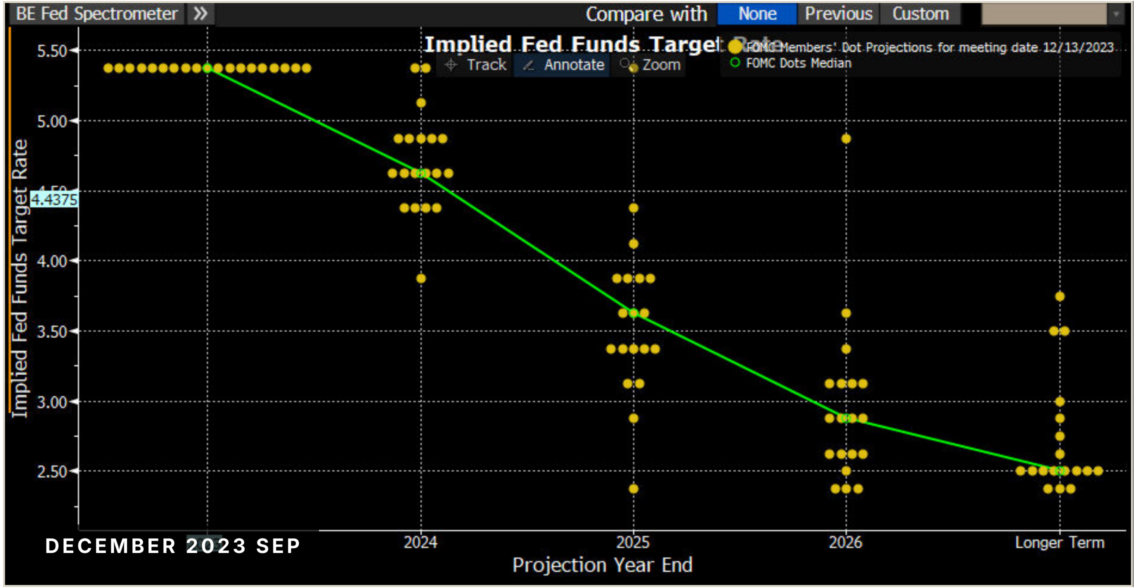
HOW TO USE THESE MEASURES

1. **Forward guidance effectiveness**
   Compare market-implied rate paths with the dot-plot median before and after press conferences.
2. **Internal disagreement**
   Dispersion of dots or SPF forecasters reveals the distribution of policy or expert beliefs.
3. **Communication errors**
   Persistent MPR or Inflation Report errors reveal model or reaction-function biases.

Dot Plot and Market-Implied Policy Path

FOMC dots show individual policy-rate assessments; futures prices summarize the market-implied path.





The dots are individual FOMC assessments of appropriate policy; futures prices are market-implied policy paths. Gaps between them reflect disagreement about the reaction function, risk compensation, or both.

Alternative & Composite Measures

Use them to triangulate the latent signal, not to replace surveys or markets

COMMON SIGNAL EXTRACTION

Composite indices filter many noisy measures into one latent expectations component.

$$m_{k,t} = \lambda_k f_t + u_{k,t}, \qquad f_t = \rho f_{t-1} + \eta_t$$

The Fed's Common Inflation Expectations index is the canonical example: a principal-component composite of **21 survey and market-based indicators** across agents and horizons.

WHY?	No single measure is wedge-free. Cross-series correlation identifies the signal shared across instruments.
LIMITATION	High-variance series and structural breaks, including COVID and the 2021 inflation surge, can distort loadings.
POLICY USE	Distinguish idiosyncratic movement in one series from a broad shift in inflation anchoring.

Best practice: alternatives do not replace surveys or markets. They are leading indicators and cross-validation tools when surveys lag or market prices are distorted by liquidity and premia.

TEXT-BASED MEASURES

Salience, tone, source, and narrative

NLP applied to central-bank minutes, news articles, earnings calls, and social media can extract high-frequency inflation attention.

$$\frac{\#\{\text{inflation terms}\}}{\#\{\text{all terms}\}}$$

Central-bank text	Beige Books and FOMC minutes can be classified as supply-driven or demand-driven inflation language.
Earnings calls	Frequency of "inflation" and "costs" tracks firm-side inflation pressure and survey-based firm expectations.
News sentiment	Baker-Bloom-Davis EPU and inflation-specific newspaper indices are high-frequency but extraction-model dependent.

GOOGLE TRENDS ANALYSIS

Real-time public salience

$$Google_t(\text{“inflation”})$$

Search intensity for "inflation," "price rises," and "cost of living" can lead survey releases and correlate with Michigan or SCE at weekly frequencies.

Risk: attention, not beliefs.

MODEL-BASED DECOMPOSITIONS

Separate expectation from premium

$$BE_t^{(n)} = E_t^P[\pi] + IRP_t + LP_t$$

No-arbitrage and factor models combine yields, swaps, surveys, and inflation data to split expectations from premia.

Risk: model-dependent.

Applications Across User Groups

The same instruments serve different analytical purposes depending on who is asking

CB Central Banks

Monitor anchoring · Calibrate communication · Design forward guidance

Anchoring assessment
Track whether long-run 5y5y measures remain near target across populations. Divergence between household and market expectations signals a credibility gap.

Forecast conditioning
MPR projections use survey and market measures to discipline near-term paths and identify where private-sector views diverge from official forecasts.

RCT-based experiments
ECB-CES and BoE DMP embed information treatments to causally identify how communication moves expectations and subsequent decisions.

FM Financial Markets

Asset allocation · Hedging · Trading monetary policy

Rate path trading
OIS curves and futures imply the market-consensus expected rate path. Post-FOMC deviations drive fixed-income, FX, and equity strategies.

Inflation hedging
TIPS, ILG, and HICPxT swaps hedge real purchasing power. The breakeven is simultaneously a hedge instrument and an expectations signal.

Policy surprise extraction
High-frequency changes in futures prices around FOMC windows isolate policy surprises for event-study regressions.

CO Corporations

Borrowing decisions · Price-setting · Investment planning

Borrowing cost planning
Firms with variable-rate debt or upcoming bond issuance use OIS and SOFR futures to project funding costs over 1–3 year horizons.

Wage and cost indexation
Expected inflation informs multi-year wage bargaining and supply-contract pricing, especially for energy, food, and commodity inputs.

Capital expenditure decisions
Long-run real rate expectations, derived from Fisher decomposition, determine the hurdle rate for investment appraisal.

AR Academic Researchers

Causal identification · Model validation · Policy evaluation

Lucas-critique-robust estimation
Expectation measures replace model-implied expectations in structural equations, allowing identification without imposing rational expectations.

Disagreement and heterogeneity
Cross-sectional dispersion in SPF, SCE, and ECB-CES tests models of information frictions, sticky information, and rational inattention.

RCT causal chains
Information experiments in SCE, ECB-CES, and BoE DMP estimate how beliefs affect spending, hiring, and price-setting.

Should We Trust Surveys? Four Pillars of Validation

Forecast accuracy · Behaviour prediction · Administrative data · Randomised controlled trials

01 Forecast accuracy

Ang, Bekaert & Wei (2007) · UK and EA evidence confirms

Michigan consumer surveys and the Philadelphia SPF both outperform the US nominal yield curve and time-series models in out-of-sample 1-year inflation forecasting. Professional surveys dominate at short horizons; market measures add value at longer horizons.

> **Test:** compare RMSE and out-of-sample predictive content against AR, VAR, and term-structure benchmarks.

Surveys are not dominated by financial prices; they contain independent information.

02 Stated plans predict behaviour

Coibion, Gorodnichenko & Kumar · Bunn et al.

In a large-scale NZ firm survey, 97% of managers who said they intended to change prices did so; 98% who stated no change made none. BoE DMP results are nearly identical. Household spending intentions also predict later purchases in scanner data.

> **Test:** regress realised prices, purchases, hiring, or investment on prior stated expectations and plans.

Survey responses are not cheap talk; they predict costly, real decisions.

03 Alignment with administrative data

CGW · CGR · Albrizio et al.

Household spending plans align with scanner-data purchases. Firm employment and investment intentions match HR and capital-expenditure records. Earnings-call sentiment co-moves with survey-based firm expectations.

> **Test:** link survey microdata to independent scanner, bank-account, HR, investment, or text records.

Survey measures gain credibility when they line up with hard external records.

04 RCT causal chain

CGR firms · CGW households · ECB-CES, DMP experiments

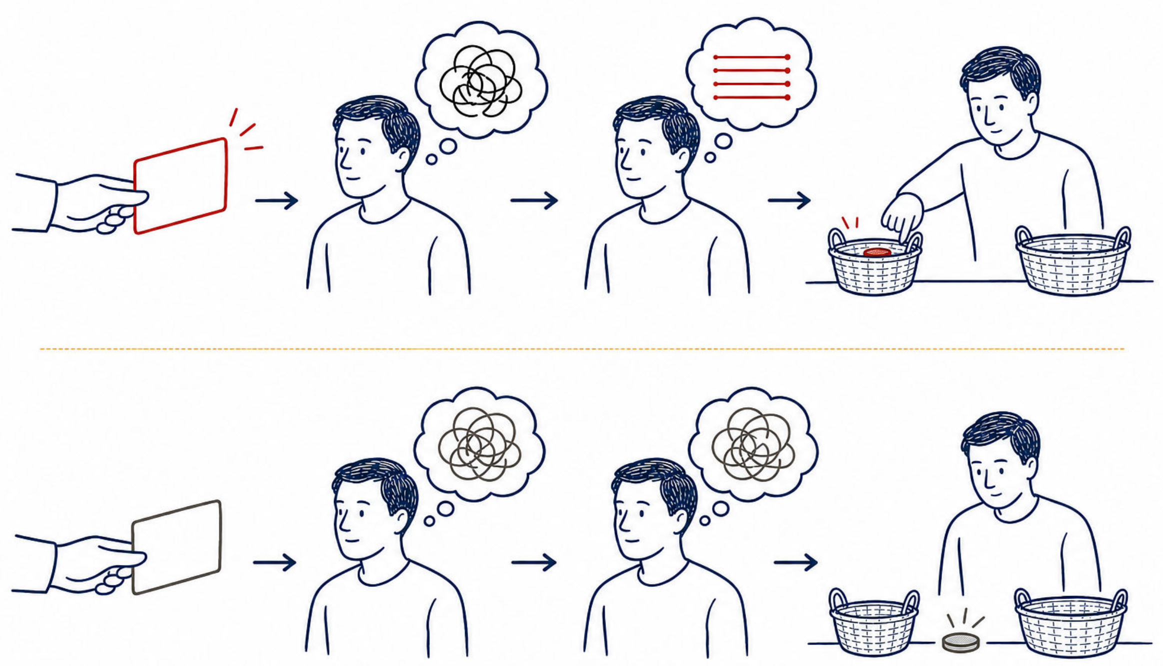
Information treatments randomly assigned within survey samples shift stated beliefs. Those shifted beliefs then change stated and realised decisions: hiring, investment, spending, and price-setting.

> **Test:** identify the causal chain from information → belief → action without selection bias.

Beliefs are causally effective; moving them can move economic behaviour.

From Information to Beliefs to Action

Random assignment turns survey validation into a causal test rather than a correlation



Treatment shifts information; the control branch holds the comparison fixed.

RCT CAUSAL CHAIN

Information → belief → action

Randomly vary the information shown inside the survey. First verify that beliefs move; then measure whether spending, hiring, investment, or price-setting changes.

1. **First stage**
   The treatment changes the stated expectation relative to control.
2. **Behavioural response**
   The induced belief revision changes a real or stated decision.
3. **Validation**
   A causally effective response is harder to dismiss as cheap talk.

Identification: random assignment breaks the selection link between prior beliefs and treatment.

SUBSECTION 02B

Fed funds futures and asset prices

Futures and asset prices.

Using fed funds futures and other asset prices as measures of expected policy, inflation, uncertainty, and risk.

Monthly futures contract to meeting expectation

Kuttner target surprise

Target, path, and market-wedge interpretation

02B

Prices, paths, surprises.

Fed Fund Futures: What They Are

Derivative instruments whose settlement is uniquely tied to realised overnight Fed policy

INSTRUMENT

Cash-settled CME future

A tradable price today for a rate realised over a future contract month.

→

SETTLEMENT OBJECT

Monthly average EFFR

Average of daily effective federal funds rates across all calendar days.

→

PRICE CONVENTION

IMM index

$F_{t,m} = 100 - \bar{r}^{Q}_{t,m}$

DEFINITION

Cash-settled futures contracts traded on the **CME Group** since 1988, formerly CBOT. Settlement is determined by the **arithmetic average of daily EFFR values** over the entire contract month — not by any single day's rate and not by the FOMC target range.

PRIMARY USES IN PRACTICE

Market expectations

Real-time window into where traders believe the Fed will set rates.

Interest-rate hedging

Banks, asset managers, and corporations hedge short-term borrowing costs.

Academic identification

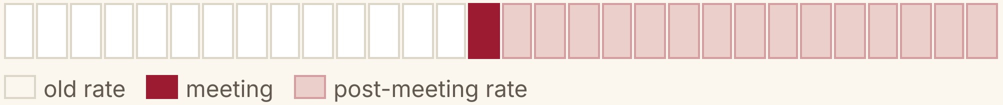
Kuttner (2001) uses FFF to isolate the unanticipated policy component.

Unlike a standard interest-rate future that settles on a point-in-time rate, FFF settle on the **monthly average**. The timing of an FOMC decision within the month determines its settlement weight.

CONTRACT ESSENTIALS

EXCHANGE **CME Group**	SETTLEMENT **Cash only**
NOTIONAL **USD 5m**	DELIVERY **Monthly**
PRICING **100 - R**	MIN TICK **1/2 bp**

READING THE PRICE REQUIRES THE MEETING DATE



A futures price is not enough. To infer the expected policy move, we must know how many days in the contract month are governed by the old rate and how many by the post-meeting rate.

Effective Federal Funds Rate

Volume-weighted median of overnight federal funds transactions, computed daily by the New York Fed

POST-2016 RULE: FIND THE RATE WHERE CUMULATIVE TRANSACTION VOLUME CROSSES 50%

$$\sum_{i=1}^{k-1} v_i < \frac{1}{2}\sum_{i=1}^{n} v_i \leq \sum_{i=1}^{k} v_i$$

Order transactions from lowest to highest rate. Accumulate volumes. The EFFR is the transaction rate r_k at which cumulative volume first reaches the half-way point.

WORKED EXAMPLE: VOLUME CROSSING

Total volume is USD 100B, so the half-way point is USD 50B. The third transaction pushes cumulative volume past that threshold.

5.30%
USD 10B
cum. 10B

5.32%
USD 15B
cum. 25B

5.33%
USD 30B
cum. 55B ← EFFR

5.34%
USD 20B
cum. 75B

5.36%
USD 25B
cum. 100B

50% threshold

EFFR = 5.33%, because this is the first rate where cumulative volume exceeds USD 50B.

SAME EXAMPLE IN TABLE FORM

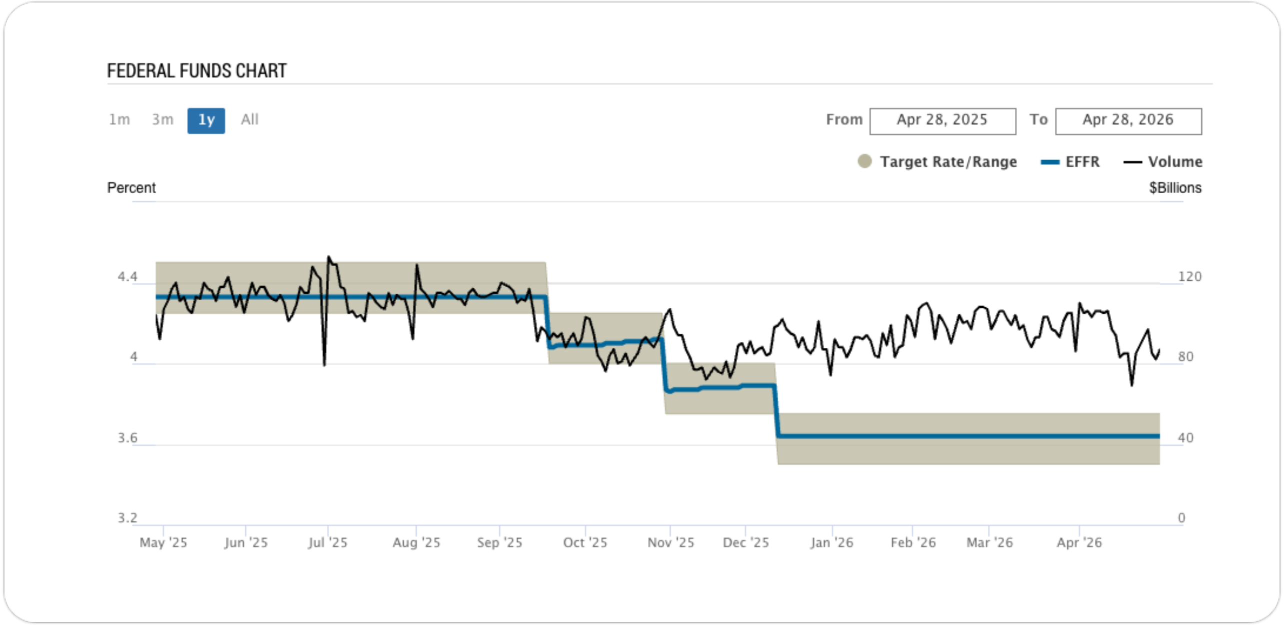
#	RATE	VOLUME	CUMULATIVE
1	5.30%	USD 10B	USD 10B
2	5.32%	USD 15B	USD 25B
3	**5.33%**	**USD 30B**	**USD 55B ← median**
4	5.34%	USD 20B	USD 75B
5	5.36%	USD 25B	USD 100B

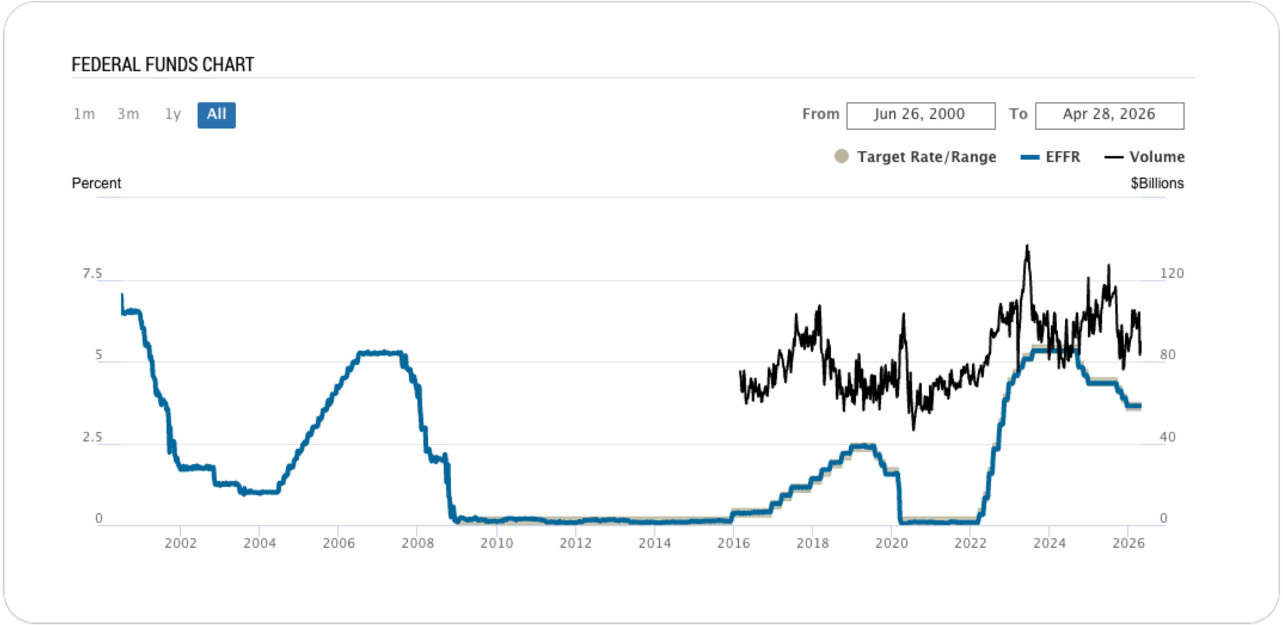
PRE-2016: VOLUME-WEIGHTED MEAN

$$\mathrm{EFFR}_{\text{pre-2016}} = \frac{\sum_{i=1}^{n} r_i v_i}{\sum_{i=1}^{n} v_i}$$

WHY THIS MATTERS FOR FUTURES

The Fed switched to the median because the mean is sensitive to outlier trades. The EFFR is the settlement object for fed funds futures, so its construction matters before interpreting the futures price as an expectation of Federal Reserve policy.





Source: **Federal Reserve Bank of New York, Effective Federal Funds Rate**

Fed Fund Futures Contract Specifications

The IMM index convention and tick value — precision matters for hedging and P&L

FUTURES QUOTE

94.50

IMM index price for a contract month

→

DECODE THE QUOTE

100 – 94.50

subtract price from 100

→

IMPLIED AVERAGE EFFR

5.50%

market-implied monthly average rate $R_{t,m}$

IMM INDEX PRICE CONVENTION

$$F_{t,m} = 100 - R_{t,m}$$

$R_{t,m}$ is the implied arithmetic average EFFR for month m. A higher futures price means a lower expected rate; a trader expecting a rate cut buys futures.

DIRECTION RULE $F \uparrow \Rightarrow R \downarrow$ | $F \downarrow \Rightarrow R \uparrow$

TICK SIZE AND DOLLAR VALUE

Minimum fluctuation is 0.5 basis point. The $1/12$ factor converts the annualised quote into roughly one month of exposure.

TICK VALUE

USD 20.835

FULL BP VALUE

USD 41.67

Tick Value = (USD 5,000,000 × 0.00005) / 12 = **USD 20.835**

PRICE-TO-RATE CONVERSION

FUTURES PRICE	IMPLIED AVG. EFFR
94.25	5.75%
94.50	5.50%
94.75	5.25%
95.00	5.00%
95.25	4.75%

MULTIPLE CONTRACT MONTHS

Consecutive monthly contracts form a market-implied path. Adjacent months are the raw material for meeting-level extraction on the next slides.

MAY	JUN	JUL	SEP	DEC
5.50	5.35	5.20	4.95	4.70

More information: CME 30-Day Federal Funds futures

The Settlement Formula

Settlement is the arithmetic average of daily EFFR over all calendar days in the contract month

INPUT

Daily EFFR values

1	2	3	...	N-1	N

One settlement input for every calendar day in the contract month.

→

ARITHMETIC AVERAGE

$$\bar{r}_{\text{month}} = \frac{1}{N} \sum_{i=1}^{N} \text{EFFR}_i$$

Every calendar day has the same weight, $1/N$, even when the EFFR is carried forward from the previous business day.

→

FINAL SETTLEMENT PRICE

$$\text{Final} = 100 - \bar{r}_{\text{month}}$$

At expiration, the realised monthly average replaces the market expectation embedded in the futures price.

CALENDAR-DAY CONVENTION

MON	TUE	WED	THU	FRI	SAT	SUN
5.33	5.33	5.58	5.58	5.58	5.58	5.58
published	published	published	published	published	carry Fri	carry Fri

BUSINESS DAYS Use the EFFR published for that date. The observation enters the monthly average once.

WEEKENDS / HOLIDAYS No new EFFR is published. Settlement carries forward the previous business day's rate.

WHY IT MATTERS A rate change before a weekend can enter the settlement average several times. The futures price therefore depends on the calendar, not only on the policy decision.

PER-DAY SETTLEMENT WEIGHT

1 / N

The contract does not weight business days only. It averages over all calendar days in the delivery month.

3.57% one day in February, $N = 28$

3.23% one day in a 31-day month

BEFORE FINAL SETTLEMENT

$$F_{t,m} \approx 100 - \mathbb{E}_t^{Q}[\bar{r}_{\text{month}}]$$

The traded futures price is a risk-neutral Q-measure object. The final settlement price is mechanical once all daily EFFR inputs are known.

Why Timing Within the Month Matters

The same 25 bp hike has a different settlement impact depending on the meeting date

GENERAL FORMULA FOR A SINGLE RATE CHANGE

$$\bar{r}_{\text{month}} = \frac{(d-1)r_{\text{pre}} + (N-d+1)r_{\text{post}}}{N}$$

Meeting on day d of an N-day month. Days $1, \ldots, d-1$ run at r_{pre}; days $d, \ldots, N$ run at r_{post}.

$$\omega_{\text{post}} = \frac{N-d+1}{N}$$

$$\Delta F = -\omega_{\text{post}} \Delta r$$

OLD-RATE DAYS

d − 1

Calendar days before the meeting stay at r_{pre}.

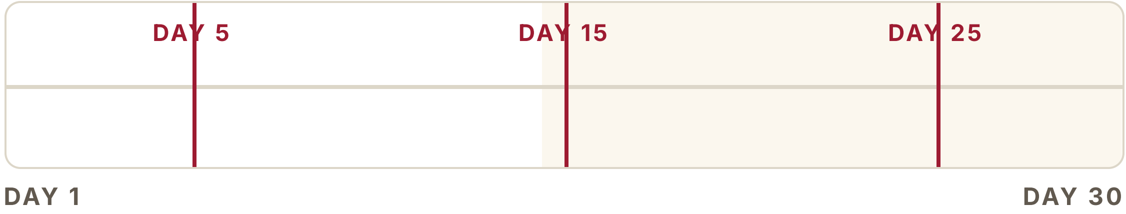
NEW-RATE DAYS

N − d + 1

Meeting day through month-end carry r_{post}.

Sign: because $F = 100 - R$, a positive rate surprise lowers the futures price. Reading a futures price as “the market expects $x\%$” is only direct when there is no FOMC meeting in the contract month.

A 30-DAY MONTH: WHERE DOES THE MEETING FALL?



DAY 5

86.7%

26 of 30 days carry the post-meeting rate.

DAY 15

53.3%

Just over half the month is affected.

DAY 25

20.0%

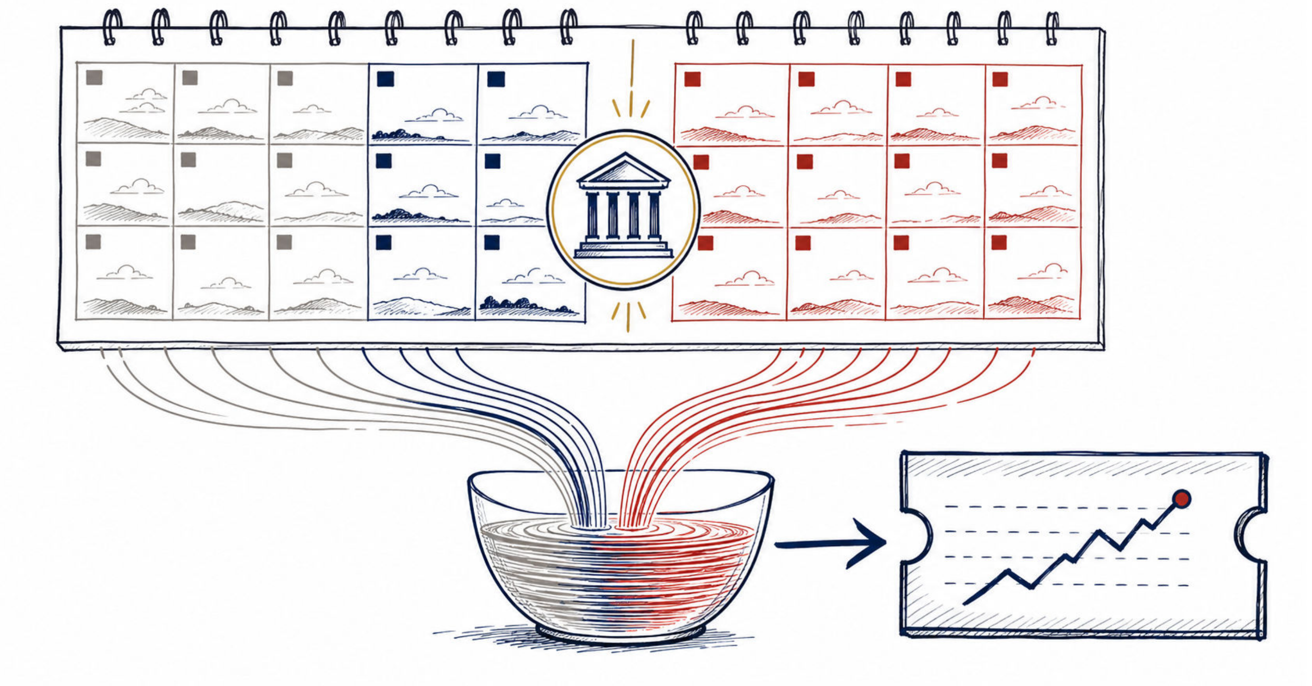
Only the final 6 days enter at the new rate.

BOUNDARY CASES

MEETING DAY	Ω_{POST}	INTERPRETATION
1	**30/30 = 100%**	**Full month at new rate**
30	1/30 = 3.3%	Single-day effect

Meeting Timing Changes the Contract's Monthly Average

The policy move may be identical, but the contract weight depends on how many calendar days remain



Calendar days flow into one settlement-month average.

CALENDAR-WEIGHTED CONTRACT

The meeting date determines exposure

$$\bar{r}_m = \omega_{\text{pre}} r_{\text{pre}} + \omega_{\text{post}} r_{\text{post}}$$

For a meeting on day d of an N-day month, the post-meeting weight is $\omega_{\text{post}} = (N - d + 1)/N$.

INTERPRETATION

Early meeting, larger monthly footprint

An early-month decision affects many daily observations; a late-month decision affects only a few. The image deliberately imposes no sign on the policy move or futures response.

Do not read the quote before checking the calendar.
Contract timing is part of the measurement equation.

Worked Example: Mid-Month Hike

FOMC hikes 25 bp on day 15 of a 30-day month; pre-meeting EFFR is 5.10%

INPUTS

30 calendar days N

15 meeting day d

5.10% pre-meeting EFFR

5.35% post-hike EFFR

CALENDAR SPLIT

DAYS 1-14
5.10%

DAYS 15-30
5.35%

The meeting day itself is counted in the post-meeting block, so 16 of 30 days carry the higher rate.

WEIGHTED-AVERAGE CALCULATION

OLD-RATE BLOCK
14 × 5.10 = 71.40

NEW-RATE BLOCK
16 × 5.35 = 85.60

TOTAL
157.00

$$\bar{r}_{\text{month}} = \frac{157.00}{30} \approx 5.233\%$$

RESULT

MONTHLY AVERAGE
5.233%

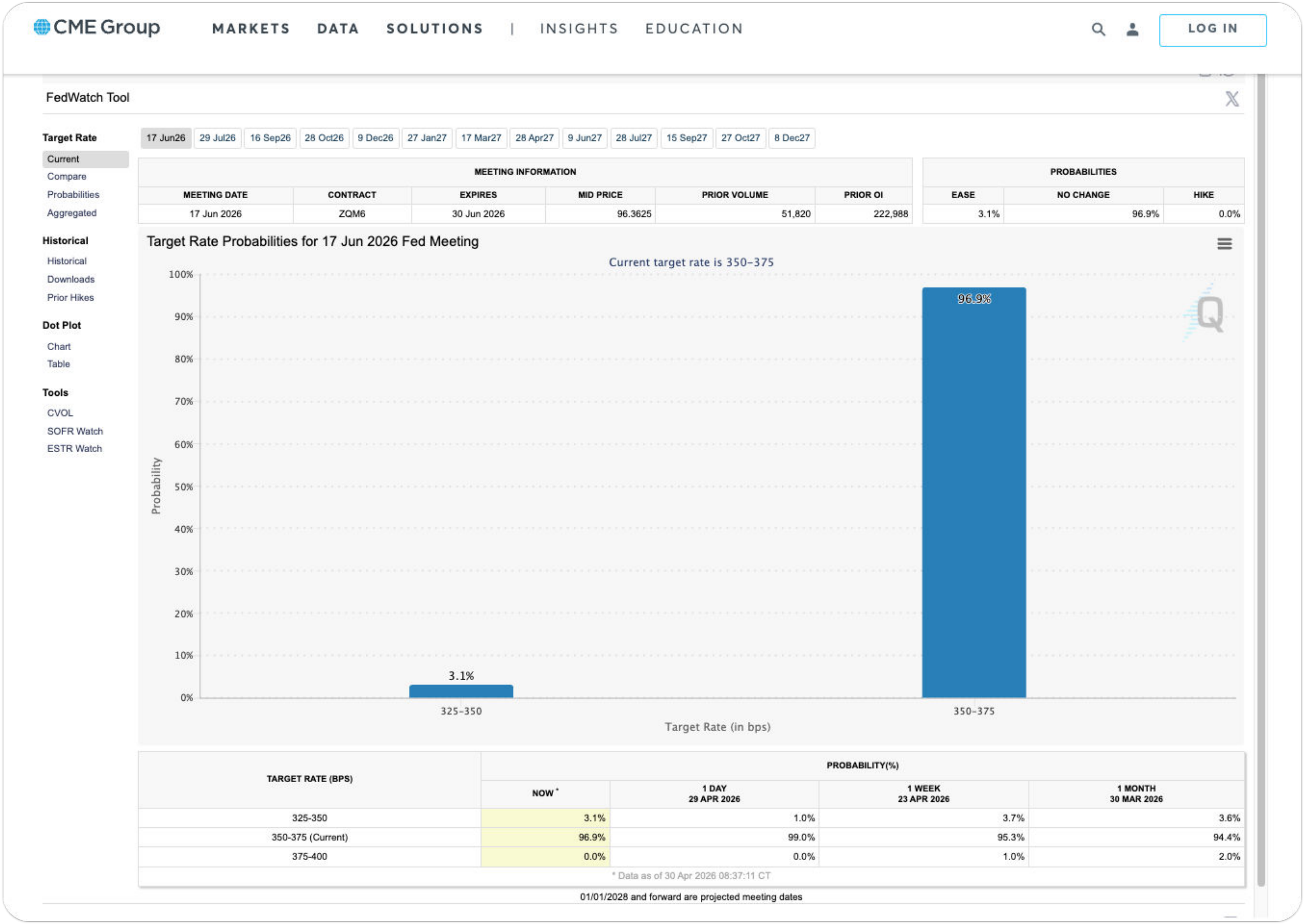
SETTLEMENT PRICE
94.767

$$\text{Settlement} = 100 - 5.233 = 94.767$$

SAME HIKE, DIFFERENT MEETING DATE

MEETING TIMING	$\bar{R}$	SETTLEMENT
Meeting on day 1	5.350%	94.650
Meeting on day 15	**5.233%**	**94.767**
Meeting on day 25	5.133%	94.867
No meeting	5.100%	94.900

Implication: the policy action is the same +25 bp hike, but the futures contract records a different monthly average because the calendar changes the weight on r_{post}.



Source: **CME FedWatch Tool**

Extracting FOMC Meeting Expectations

Two contracts bracket a meeting; one weighted-average equation recovers the expected post-meeting rate

EXTRACTION ALGORITHM

1. **Read the pre-meeting rate**
   Use f_0, the contract ending before the FOMC meeting, as an approximation to r_{pre}.
2. **Use the meeting-month average**
   The contract containing the meeting gives f_1, a weighted average of old-rate and post-meeting days.
3. **Solve for the post-meeting rate**
   Invert the weighted-average equation to recover r_{post}, then compute $\Delta r = r_{\text{post}} - r_{\text{pre}}$.

WEIGHTED-AVERAGE PRICING RELATIONSHIP

$$f_1 = \frac{d-1}{N} r_{\text{pre}} + \frac{N-d+1}{N} r_{\text{post}}$$

$$r_{\text{post}} = \frac{N f_1 - (d-1) r_{\text{pre}}}{N-d+1}$$

NUMERICAL EXAMPLE

30
days in month N

15
meeting day d

5.10%
pre-meeting rate

5.23%
meeting-month rate f_1

SOLVE

$$r_{\text{post}} = \frac{30(5.23) - 14(5.10)}{16} = \frac{85.5}{16} \approx 5.34\%$$

POST-MEETING RATE
5.34%

IMPLIED MOVE
+24 bp

SPECIAL CASE: NO MEETING

$$\bar{r}_{\text{month}} = f_1 \implies f_1 = r_{\text{expected constant}}$$

If $r_{\text{pre}} = r_{\text{post}}$, no decomposition is needed.

Implied FOMC Probabilities

If markets price only discrete 25 bp moves, the implied rate change identifies a risk-neutral probability

TWO-OUTCOME MODEL: HIKE VERSUS HOLD

HIKE
+25 bp

Occurs with risk-neutral probability P_h^Q.

HOLD
0 bp

Occurs with probability $1 - P_h^Q$.

$$P_h^Q = \frac{E_t^Q[\Delta r]}{25\text{ bp}} = \frac{r_{\text{post}} - r_{\text{pre}}}{25\text{ bp}}$$

NUMERICAL EXAMPLE

IMPLIED MOVE **+24 bp** → HIKE SIZE **25 bp** → PROBABILITY **96%**

Interpretation: the contract prices almost, but not quite, a full 25 bp hike.

Q-MEASURE VERSUS P-MEASURE

$$P_{\text{hike}}^Q = P_{\text{hike}}^P + \lambda_t$$

The futures-implied probability is risk-neutral. During calm periods $\lambda_t \approx 0$; during stress episodes the gap between market-implied and physical probabilities can be economically meaningful.

WHEN THE DISCRETE ASSUMPTION BREAKS DOWN

With three outcomes $(-25, 0, +25)$, one futures contract gives one equation but multiple unknown probabilities.

Options
Recover a fuller Q-distribution from option prices.

Assumption
Impose a logit or trinomial tree structure.

More prices
Use SOFR options and contracts around FOMC dates.

Monetary Policy Surprise

Kuttner (2001): the workhorse measure of the unanticipated component of FOMC decisions

DEFINITION IN A TIGHT ANNOUNCEMENT WINDOW

$$TS_t = \frac{N}{N-d+1}\Delta f_t = -\frac{N}{N-d+1}\Delta F_t$$

F_t is the futures price and $f_t = 100 - F_t$ is the futures-implied rate. The scale factor converts a monthly-average price change into an overnight-rate surprise.

OBSERVED MOVE

Δf_t

×

GROSS-UP FACTOR

$N/(N-d+1)$

$TS_t > 0$

Surprise tightening: the Fed hiked more or cut less than priced in.

$TS_t < 0$

Surprise easing: the Fed cut more or hiked less than expected.

$TS_t = 0$

The action was fully anticipated by markets.

The surprise is not the policy action itself. It is the action relative to the market's prior expectation.

WHY A NARROW WINDOW IDENTIFIES POLICY NEWS

In a narrow window around the FOMC statement, scheduled macro news is held fixed, the Fed cannot react to within-window market moves, and risk-premium changes are plausibly small.

KUTTNER (2001)	Anticipated policy moves have little effect; surprises move bond yields strongly.
GÜRKAYNAK, SACK & SWANSON	Two factors: target surprise and path surprise. Guidance moves the path.
NAKAMURA & STEINSSON	High-frequency surprises can instrument monetary policy in structural macro models.

Predictive Power and Limitations

Strong at short horizons; risk premia and structural breaks dominate beyond six months

FORECAST-ERROR TEST

$$FE_{t,h} = r_{t+h}^{EFFR} - f_{t,h}$$

If futures are unbiased risk-neutral forecasts, $E_t[FE_{t,h}] = 0$. Persistent errors reveal premia, bias, or regime shifts.

WHAT THE FUTURES RATE CONTAINS

$$f_{t,h} = E_t^P[r_{t+h}^{EFFR}] + \lambda_{t,h}$$

At very short horizons, $\lambda_{t,h}$ is often small. At longer horizons, policy-risk compensation becomes part of the price.

FORECAST PERFORMANCE BY HORIZON

Horizon	Mean absolute error	Rating
1-3 months	5-10 bp	STRONG
3-6 months	15-30 bp	MODERATE
6-12 months	30-60 bp	WEAK
> 12 months	> 60 bp	VERY WEAK

SHORT-HORIZON STRENGTH

For the next few meetings, futures are usually close to the market-implied policy path because little time remains for new macro news.

CYCLE ASYMMETRY

FFF historically underpredict rate increases before tightening cycles and overpredict cuts before easing cycles. The 2022-23 cycle is the recent example.

STRUCTURAL BREAKS

Beyond six months, risk premia and institutional breaks matter. April 2023 marks the Eurodollar-to-SOFR conversion break for long-run dollar-rate studies.

Summary: Key Equations

The six equations that turn a futures price into policy expectations and surprises

01 QUOTE TO IMPLIED RATE

$$F_t = 100 - \bar{r}_t^Q$$

The contract price is quoted as 100 minus the market-implied monthly average EFFR.

02 SETTLEMENT AVERAGE

$$\text{Settle} = 100 - \frac{1}{N}\sum_{i=1}^{N} r_i^{EFFR}$$

Settlement is mechanical: the calendar-day average of realised EFFR in the contract month.

03 MEETING EXTRACTION

$$r_{\text{post}} = \frac{N f_1 - (d-1) r_{\text{pre}}}{N - d + 1}$$

Use the day count to separate known pre-meeting days from expected post-meeting days.

04 BINARY FOMC PROBABILITY

$$P_{\text{hike}}^Q = \frac{r_{\text{post}} - r_{\text{pre}}}{25\text{ bp}}$$

If the only outcomes are hold or +25 bp, the expected move maps into a risk-neutral probability.

05 KUTTNER TARGET SURPRISE

$$TS_t = \frac{N}{N-d+1}\Delta f_t = -\frac{N}{N-d+1}\Delta F_t$$

Scale the event-window futures move by the share of the month affected by the decision.

06 EXPECTATION PLUS WEDGE

$$f_{t,h} = E_t^P[r_{t+h}] + \lambda_{t,h}$$

The futures-implied rate is closest to a physical expectation when the policy-risk premium is small.

Mechanics: price quote, settlement rule, and day count determine what the contract mechanically measures.

Economics: probabilities and surprises are useful only after interpreting the Q-measure wedge.

High-frequency identification.

Using event-time price changes to identify monetary-policy news and its asset-market effects.

Why low-frequency regressions fail

Event windows and contamination

Target surprises as empirical instruments

02C

Timing as identification.

The Core Identification Challenge

Monetary policy and financial markets form a simultaneous system

LOW-FREQUENCY STRUCTURAL SYSTEM

$$\Delta i_t = \beta \Delta r_t + \gamma z_t + \varepsilon_t$$

policy reaction function

$$\Delta r_t = \alpha \Delta i_t + \delta z_t + \eta_t$$

market response function

Δi_t is policy news; Δr_t is the asset-price or yield response. The confounder is z_t: macro-financial news that moves both policy expectations and markets.

OBJECT OF INTEREST

α

The causal effect of monetary-policy news on asset prices. Low-frequency regressions do not isolate it.

WHY OLS FAILS

$$\hat{\alpha}_{\text{OLS}} \neq \alpha, \qquad \text{Cov}(\Delta i_t, \eta_t) \neq 0$$

Simultaneity

Markets affect policy and policy affects markets.

Omitted variables

Macro news z_t drives both policy and markets.

Anticipation

Markets move before the announcement at daily or monthly frequency.

IDENTIFICATION MOVE

Use a narrow event window around the announcement so that z_t is fixed, the policy decision cannot react to within-window market moves, and the observed price change is closer to monetary-policy news.

Quantifying the OLS Bias

The policy-rate regressor contains the very shocks we want to exclude

MATRIX FORM OF THE STRUCTURAL SYSTEM

$$\begin{pmatrix} 1 & -\beta \\ -\alpha & 1 \end{pmatrix} \begin{pmatrix} \Delta i_t \\ \Delta r_t \end{pmatrix} = \begin{pmatrix} \gamma \\ \delta \end{pmatrix} z_t + \begin{pmatrix} \varepsilon_t \\ \eta_t \end{pmatrix}$$

α is the causal market response to policy news. β is the policy reaction to market conditions.

REDUCED-FORM POLICY REGRESSOR

$$\Delta i_t = \frac{1}{1-\alpha\beta} \left[\varepsilon_t + \beta\eta_t + (\gamma + \beta\delta) z_t\right]$$

ε_t

monetary-policy news

$\beta\eta_t$

market shock fed back into policy

$(\gamma + \beta\delta) z_t$

common macro-financial news

OLS ESTIMAND UNDER INDEPENDENT SHOCKS

$$\operatorname{plim} \hat{\alpha}_{\text{OLS}} = \alpha + \frac{(1-\alpha\beta)\left[\beta\sigma_\eta^2 + \delta(\gamma+\beta\delta)\sigma_z^2\right]}{\sigma_\varepsilon^2 + \beta^2\sigma_\eta^2 + (\gamma+\beta\delta)^2\sigma_z^2}$$

Desired variation

ε_t is the shock we want: unexpected monetary-policy news.

Market feedback

If $\beta \neq 0$, the policy-rate change contains η_t, the market shock in the outcome equation.

Common news

If z_t moves both policy and markets, OLS confounds information effects with policy effects.

OLS Bias: Channels and Event-Window Logic

The estimator is close to causal only when monetary-policy news dominates market shocks and common news

OLS COEFFICIENT

$$\hat{\alpha}_{OLS} = \frac{\operatorname{Cov}(\Delta i_t, \Delta r_t)}{\operatorname{Var}(\Delta i_t)} = \frac{(\beta\delta+\gamma)(\alpha\gamma+\delta)\sigma_z^2 + \alpha\sigma_\varepsilon^2 + \beta\sigma_\eta^2}{(\beta\delta+\gamma)^2\sigma_z^2 + \sigma_\varepsilon^2 + \beta^2\sigma_\eta^2}$$

BIAS RELATIVE TO THE CAUSAL RESPONSE

$$\hat{\alpha}_{OLS} - \alpha = (1-\alpha\beta)\frac{\beta\sigma_\eta^2 + \delta(\beta\delta+\gamma)\sigma_z^2}{\sigma_\varepsilon^2 + \beta^2\sigma_\eta^2 + (\beta\delta+\gamma)^2\sigma_z^2}$$

Simultaneity

$$\beta \neq 0, \qquad \sigma_\eta^2 > 0$$

Asset-market shocks enter the policy-rate regressor because the central bank reacts to market conditions.

Common News

$$\sigma_z^2 > 0, \qquad \delta(\beta\delta+\gamma) \neq 0$$

Macro-financial news z_t moves both expected policy and the asset price, so OLS mixes policy effects with information effects.

Event Time

$$\sigma_\varepsilon^2 \gg \sigma_\eta^2, \qquad \sigma_\varepsilon^2 \gg \sigma_z^2$$

A narrow FOMC window raises the signal-to-noise ratio: policy news is measured while other shocks are less likely to arrive.

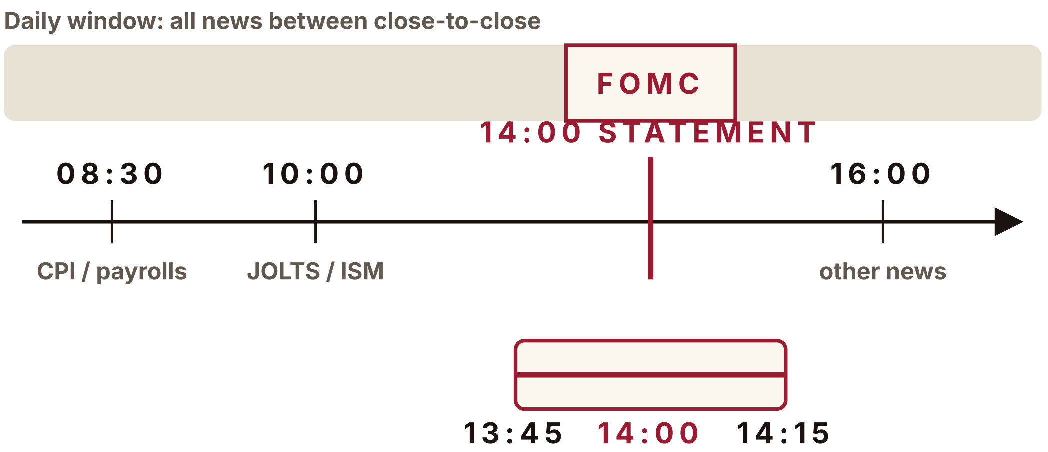
$$\frac{\sigma_\varepsilon^2}{\sigma_\eta^2} \to \infty, \qquad \frac{\sigma_\varepsilon^2}{\sigma_z^2} \to \infty \quad \Longrightarrow \quad \hat{\alpha}_{OLS} \to \alpha$$

The one-day window is usually too wide: CPI releases, labour-market news, growth announcements, earnings, and risk-premium shifts can all move asset prices. High-frequency event studies use timing to make the non-policy components small, rather than assuming they are small.

The High-Frequency Identification Approach

Policy decisions are announced at a known moment; narrow the window until only one arrow remains

TIMING IS THE INSTRUMENT



narrow window targets the announcement

EVENT-TIME CHANGE

$$\Delta_{\mathcal{W}} A_{j,e} = A_{j,\tau^+} - A_{j,\tau^-}$$

POLICY SURPRISE

$$TS_e = \Delta_{\mathcal{W}} f_e$$

REGRESSION AND CONDITION

$$\Delta_{\mathcal{W}} A_{j,e} = \alpha_j + \beta_j TS_e + u_{j,e}$$

$$\mathrm{Cov}(TS_e, u_{j,e}) = 0$$

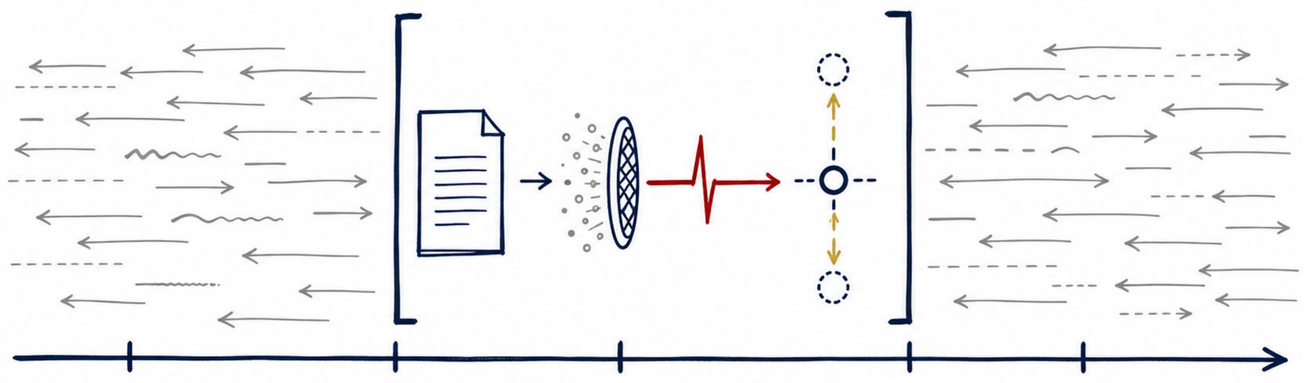
WHAT MUST BE TRUE INSIDE $\mathcal{W}$

1. **No new macro news**
   scheduled z_t is fixed inside the window
2. **No policy feedback**
   the decision cannot react to within-window market moves
3. **No fast wedge movement**
   risk and liquidity premia are approximately stable

Daily moves mix several shocks. Intraday windows work because information timing is sharper than confounder timing.

A Narrow Event Window Leaves One Dominant Arrow

Timing raises the signal-to-noise ratio by excluding news that arrives outside the announcement window



Many arrows outside the bracket; one policy-news pulse inside it.

HIGH-FREQUENCY MOVE

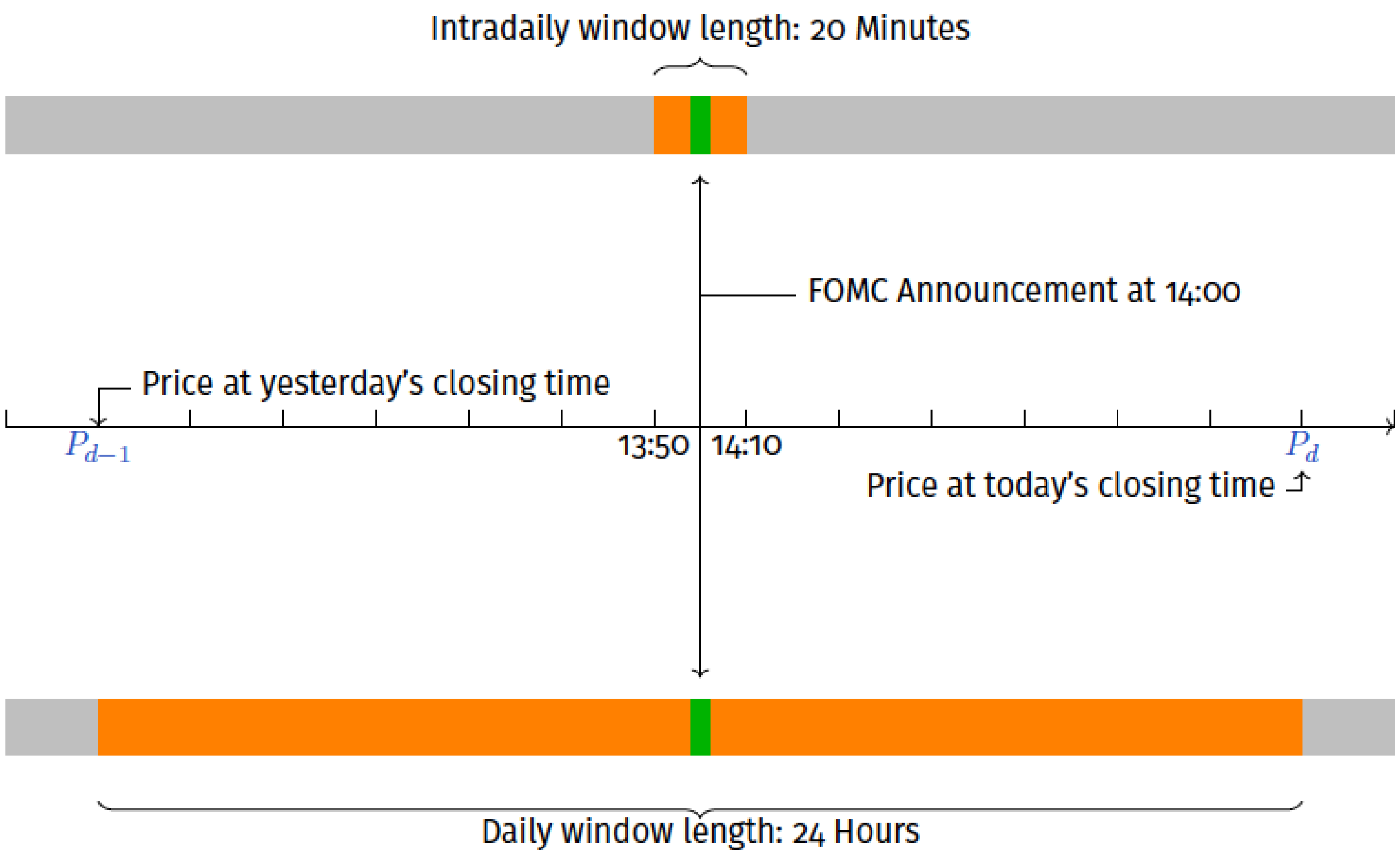
Shrink the window around the timestamp

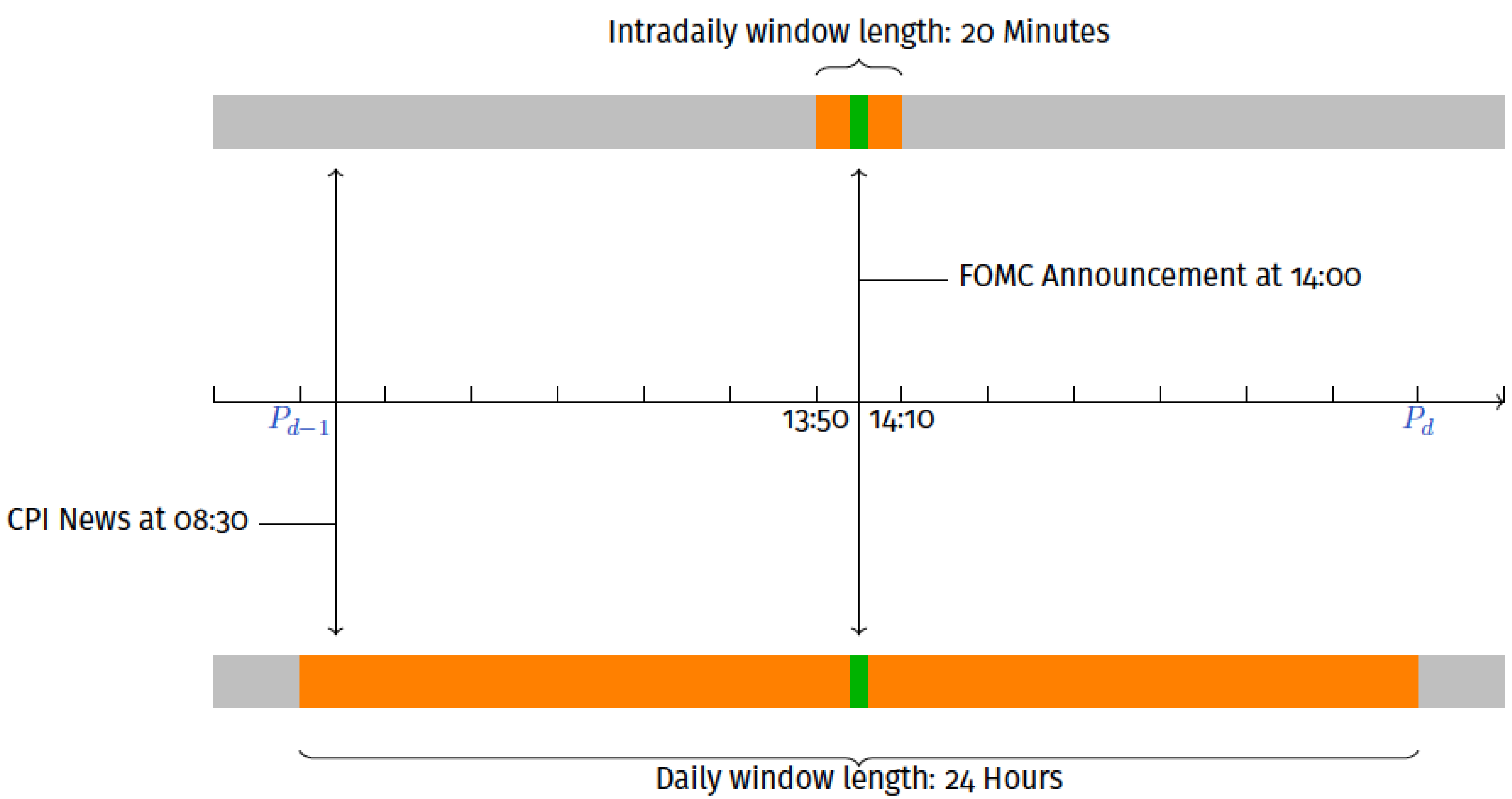
$$\Delta_{\mathcal{W}} A_e = \alpha + \beta\, TS_e + u_e$$

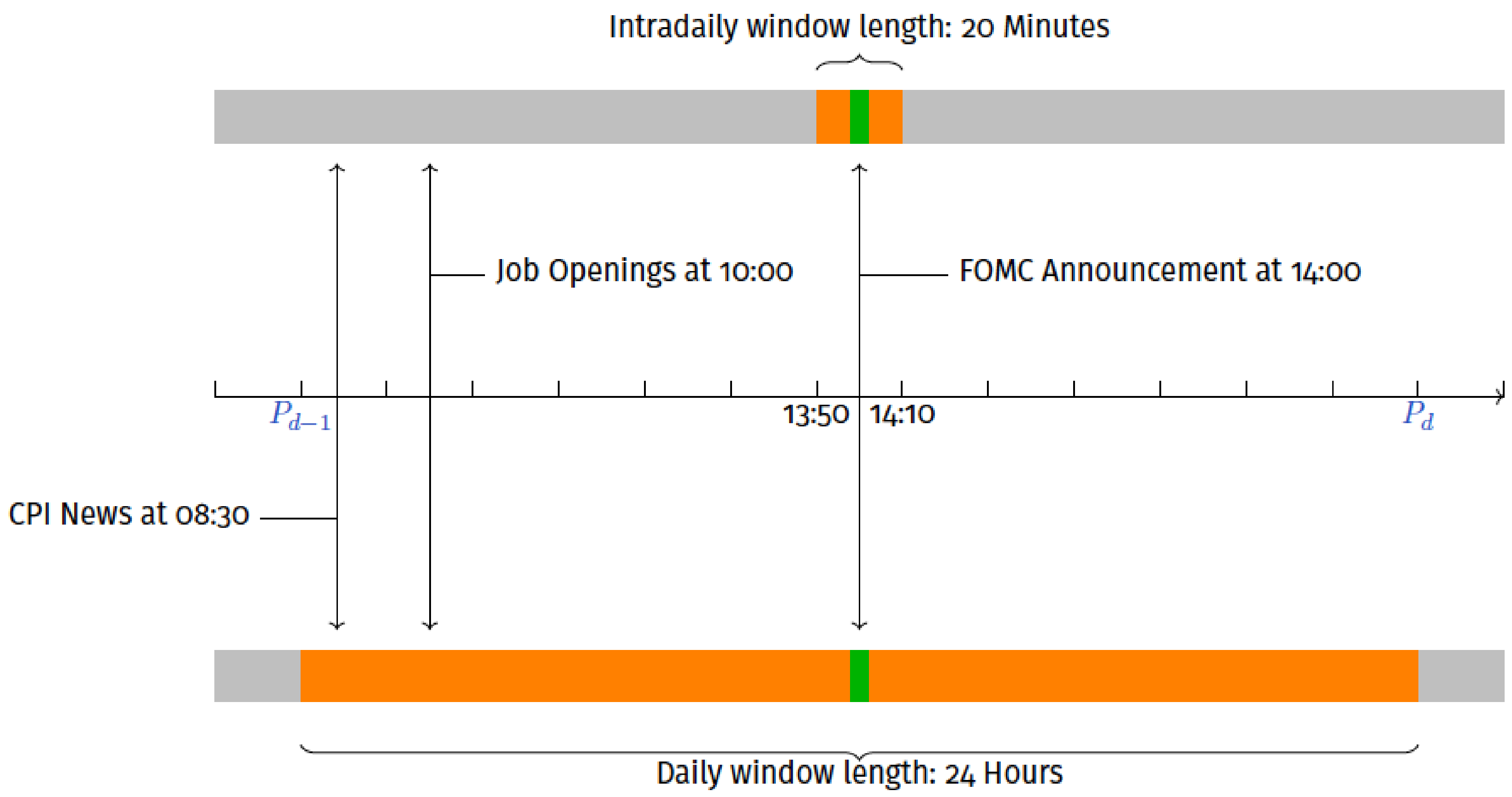
The surprise TS_e and asset response $\Delta_{\mathcal{W}} A_e$ are measured over the same narrow event window $\mathcal{W}$.

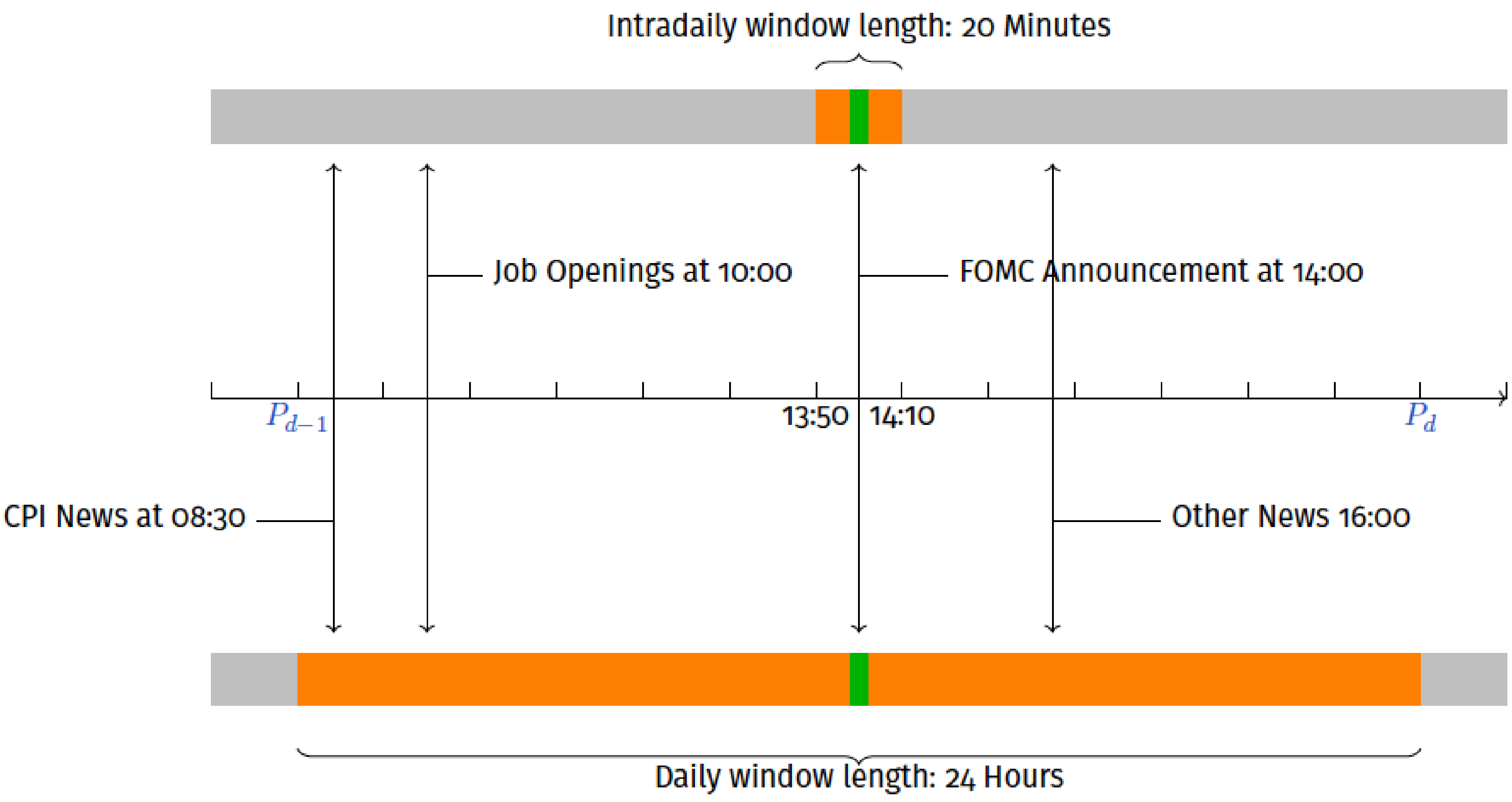
1. **Macro news is fixed**
   No scheduled data release enters inside the window.
2. **No policy feedback**
   The announced decision cannot react to the within-window market move.
3. **Stable fast wedges**
   Risk and liquidity premia do not jump for unrelated reasons.

Sign-neutral: identification isolates the arrow; it does not predetermine the asset response.

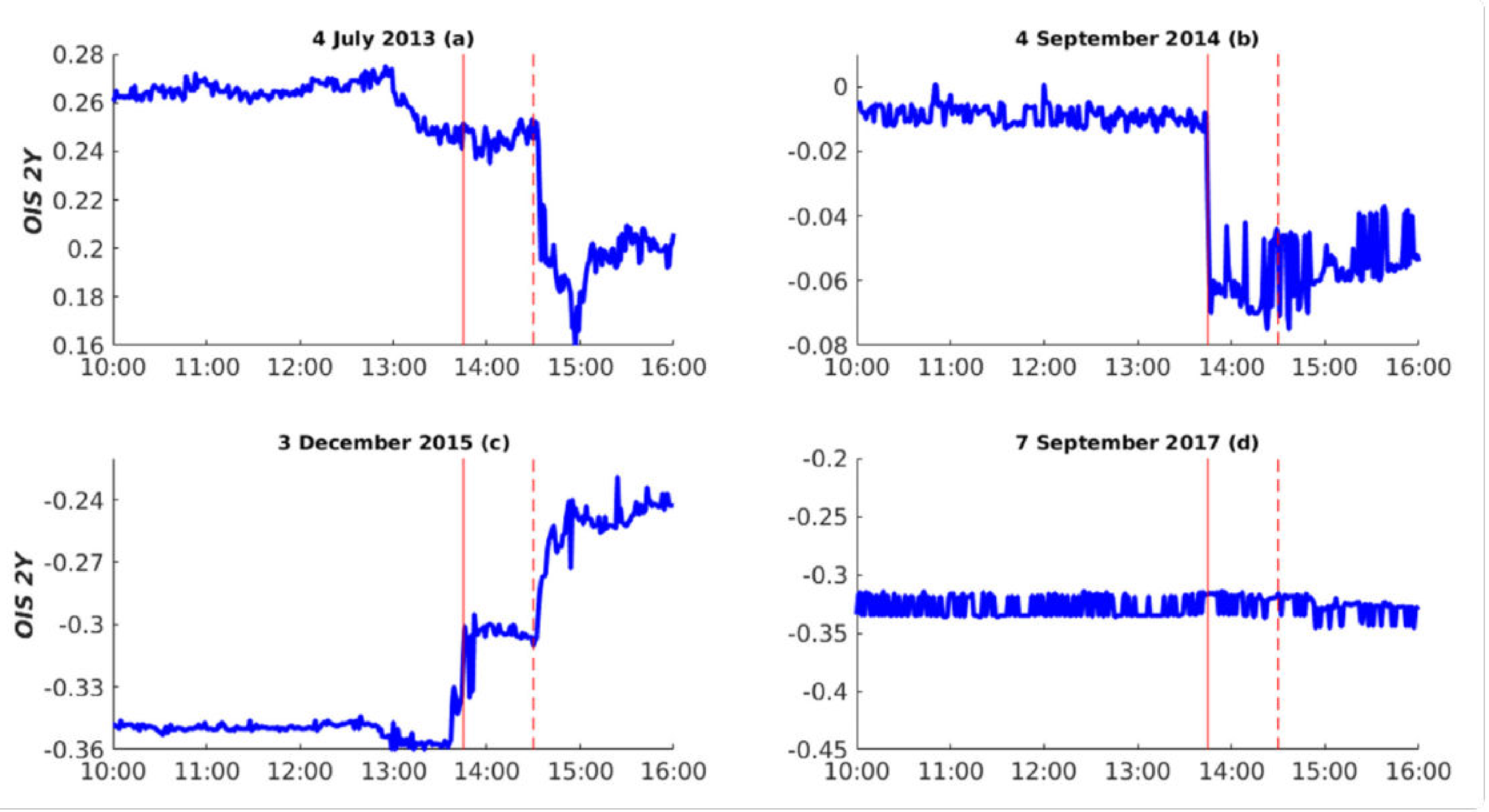

Intradaily window length: 20 Minutes
FOMC Announcement at 14:00
Price at yesterday's closing time
P_{d-1}
13:50
14:10
P_d
Price at today's closing time
Daily window length: 24 Hours

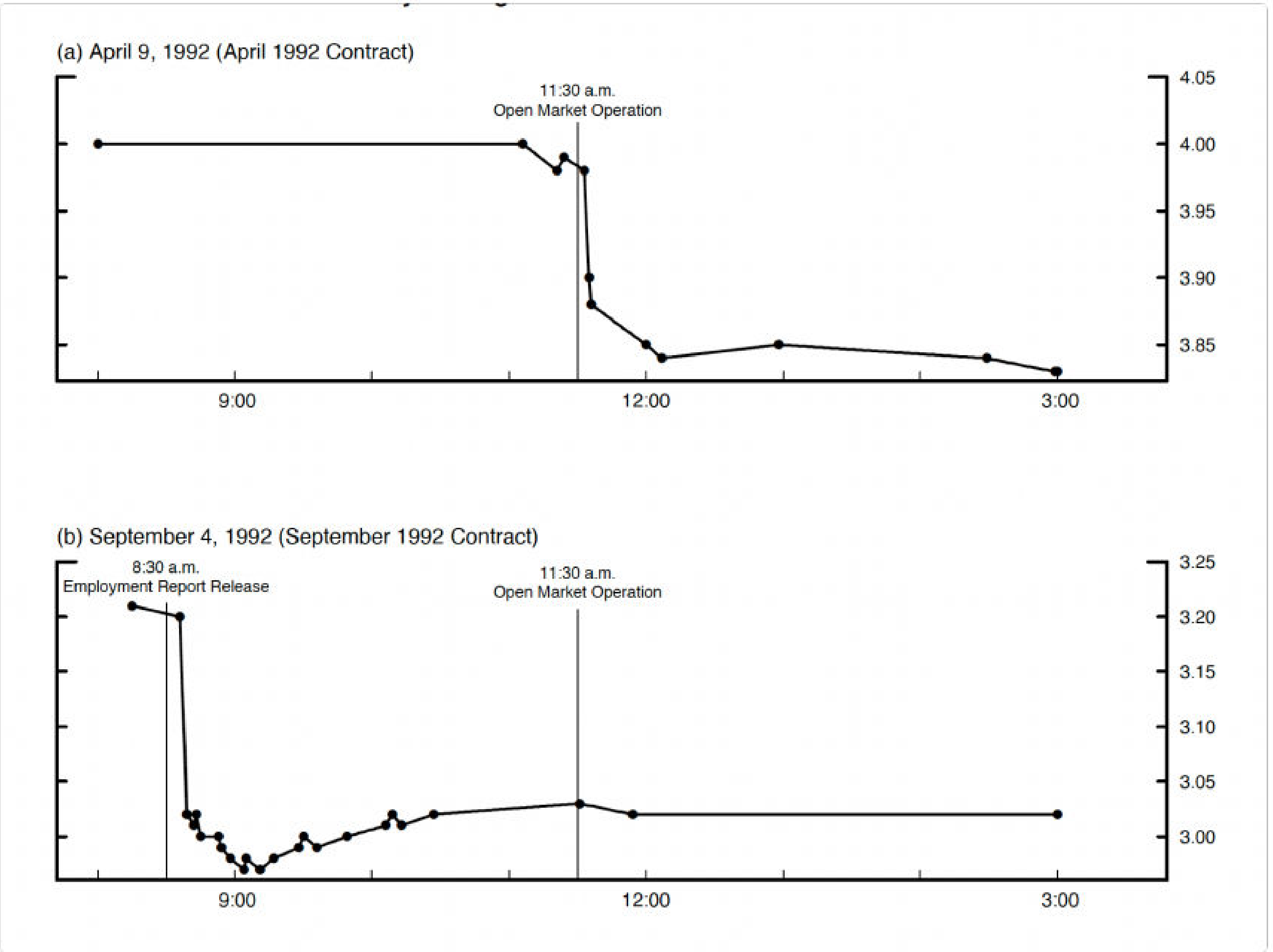

Intradaily window length: 20 Minutes
FOMC Announcement at 14:00
P_{d-1}
13:50
14:10
P_d
CPI News at 08:30
Daily window length: 24 Hours


Intradaily window length: 20 Minutes
Job Openings at 10:00
FOMC Announcement at 14:00
P_{d-1}
13:50
14:10
P_d
CPI News at 08:30
Daily window length: 24 Hours


Intradaily window length: 20 Minutes
Job Openings at 10:00
FOMC Announcement at 14:00
P_{d-1}
13:50
14:10
P_d
CPI News at 08:30
Other News 16:00
Daily window length: 24 Hours


AMZN US Equity
94) Suggested Charts
96) Actions
97) Edit
Intraday Price Chart
Range 1 04/29/2025 - 04/29/2025 04:00 - 20:00 Overnight Lst Trd/Lst P: Local CCY Key Events
1D 3D 1M 6M YTD 1Y 5Y Max Tick
+ Related Data
Add Data
Edit Chart
Track Annotate News Zoom
Last Price 183.0000
Close on 04/28 187.7000
High on 04/29 04:00 189.0000
Average 187.7139
Low on 04/29 09:07 182.8900
189.0000
188.0000
187.0000
186.0000
185.0000
184.0000
183.0000
-4.7000
-2.50%
05:00
06:00
07:00
08:00
09:00
29 Apr 2025
10:00
11:00
12:00
13:00
14:00
15:00
29 Apr 2025
17:00
18:00
19:00
20:00
29 Apr 2025


4 July 2013 (a)
4 September 2014 (b)
3 December 2015 (c)
7 September 2017 (d)
OIS 2Y
OIS 2Y
0.28
0.26
0.24
0.22
0.2
0.18
0.16
0
-0.02
-0.04
-0.06
-0.08
-0.24
-0.27
-0.3
-0.33
-0.36
-0.2
-0.25
-0.3
-0.35
-0.4
-0.45
10:00
11:00
12:00
13:00
14:00
15:00
16:00


(a) April 9, 1992 (April 1992 Contract)
11:30 a.m.
Open Market Operation
4.05
4.00
3.95
3.90
3.85
9:00
12:00
3:00
(b) September 4, 1992 (September 1992 Contract)
8:30 a.m.
Employment Report Release
11:30 a.m.
Open Market Operation
3.25
3.20
3.15
3.10
3.05
3.00
9:00
12:00
3:00

Choosing the Event Window

Narrower windows strengthen identification but amplify microstructure noise and require tick-level data

INTRADAY MEASUREMENT

$$TS_d = \frac{D}{D-d}\left[-\left(ff_{\tau+\Delta\tau} - ff_{\tau-\Delta\tau}\right)\right]$$

τ is the exact announcement time; $\tau - \Delta\tau$ and $\tau + \Delta\tau$ are just before and just after.

DAILY MEASUREMENT

$$TS_d = \frac{D}{D-d}\left[-\left(ff_d - ff_{d-1}\right)\right]$$

Daily prices are easy to obtain, but the close-to-close change includes every other shock on the announcement day.

WINDOW TRADE-OFF

30 minutes
BEST ISOLATION

GAINS	minimal contamination from other news
COSTS	microstructure noise; may miss delayed interpretation

2-3 hours
DIGESTION WINDOW

GAINS	captures statement, press conference, and interpretation
COSTS	higher chance of overlapping market news

Daily
BROAD COVERAGE

GAINS	easy replication and more assets available
COSTS	weakest identification; includes all daily news

PRACTICAL RULE Use a 30-minute intraday window as the baseline, then report robustness for 60-minute, press-conference, and daily windows. Window choice is an identification assumption, not a formatting choice.

Pre-Meeting Futures Rate: Decomposition

The current-month futures rate is a weighted average of known past days and uncertain future days

PRE-ANNOUNCEMENT FUTURES RATE

$$ff_{d_0-1,t} = \frac{d_0}{D_0} r_0 + \frac{D_0 - d_0}{D_0} E_{d_0-1}(r_1) + \eta_{d_0-1,t}$$

Known calendar days plus the expected post-meeting rate for the remaining days.

POST-ANNOUNCEMENT FUTURES RATE

$$ff_{d_0,t} = \frac{d_0}{D_0} r_0 + \frac{D_0 - d_0}{D_0} r_1 + \eta_{d_0,t}$$

The expectation $E_{d_0-1}(r_1)$ is replaced by the realised post-meeting rate r_1.

CALENDAR WEIGHTS INSIDE THE MONTH

KNOWN COMPONENT	UNCERTAIN COMPONENT
$\frac{d_0}{D_0} r_0$	$\frac{D_0 - d_0}{D_0} E(r_1)$

The announcement only changes the uncertain part of the monthly average. The known part is already locked in by past calendar days.

Already happened

Days through d_0 are governed by r_0. This component is known and does not move at the announcement.

Still uncertain

Remaining days depend on the post-meeting rate. The announcement resolves this expectation.

EXAMPLE: DAY 15 OF A 30-DAY MONTH

$$ff_{14,t} = \frac{15}{30} r_0 + \frac{15}{30} E_{14}(r_1) + \eta_{14}$$

Exactly half the month is already determined and half remains in expectation. The FOMC announcement moves only the uncertain half.

The decomposition is not algebra for its own sake. It tells us why a mid-month surprise must be scaled up: the futures contract is a monthly average, while the policy surprise is an overnight-rate innovation.

Deriving the Target Surprise

Subtract pre- from post-announcement futures rates; the known component cancels

DIFFERENCE PRE AND POST

01

$$\Delta f_{d_0,t} = \frac{D_0 - d_0}{D_0}\left[r_1 - E_{d_0-1}(r_1)\right] + \Delta\eta_{d_0,t}$$

The known component $\frac{d_0}{D_0} r_0$ appears in both futures rates, so it drops out of the event-window change.

ISOLATE THE OVERNIGHT-RATE SURPRISE

02

$$r_1 - E_{d_0-1}(r_1) = \frac{D_0}{D_0 - d_0}\Delta f_{d_0,t}$$

This uses the event-window approximation $\Delta\eta_{d_0,t} \approx 0$: the risk-premium wedge is assumed not to move inside the window.

CANCELLATION

Only the remaining $D_0 - d_0$ days are affected by the announcement. The known part of the monthly average cannot move.

STEP 3: KUTTNER TARGET SURPRISE

$$TS_{d_0,t} = \frac{D_0}{D_0 - d_0}\Delta f_{d_0,t} = -\frac{D_0}{D_0 - d_0}\Delta F_{d_0,t}$$

$TS > 0$

Surprise tightening: the futures price falls and the implied rate rises.

$TS < 0$

Surprise easing: the futures price rises and the implied rate falls.

$TS = 0$

The action was already priced before the announcement.

The Scaling Factor: Intuition and Limits

A mid-month hike shows up in only half the monthly average, so we gross up the signal

SCALING FACTOR

$$\phi = \frac{D_0}{D_0 - d_0} = \frac{1}{\omega_{\text{post}}}$$

The current-month contract averages over the whole month. A policy surprise affects only the remaining days, so the observed futures move is mechanically attenuated.

INTUITION: DAY 15 OF A 30-DAY MONTH

ALREADY PRICED	AFFECTED BY NEWS
15 days	**15 days**

$$\Delta f = \omega_{\text{post}} \Delta r \quad \Rightarrow \quad TS = \frac{\Delta f}{\omega_{\text{post}}} = \phi \Delta f$$

WORKED EXAMPLE

$$\phi = \frac{30}{30 - 15} = 2, \qquad TS = 2 \times 12.5 = 25 \text{ bp}$$

A 25 bp post-meeting surprise moves the monthly average by only $25 \times 15/30 = 12.5$ bp. The scale-up recovers the overnight-rate surprise.

SCALING FACTOR BY MEETING DAY

DAY	AFFECTED DAYS	Φ	READING
1	29	1.03	Tiny scale-up
5	25	1.20	Early-month meeting
15	**15**	**2.00**	**Signal doubles**
25	5	6.00	Noise amplified
30	0	Undefined	Switch contracts

LIMIT

$$\phi > 5$$

Late in the month, a small quote error or risk-premium move becomes a large measured policy surprise.

Use the next-month contract instead of amplifying current-month noise.

The Late-Month Problem and its Solution

When only one or two days remain, current-month scaling turns small quote noise into large fake surprises

CURRENT-MONTH CONTRACT

Only one affected day remains

φ=31

$$\phi = \frac{31}{31-30} = 31$$

30 PRICED DAYS | 1

The announcement changes only one day in the current-month settlement average.

NEXT-MONTH CONTRACT

The full following month is affected

φ=1

$$TS_{d_0,t} = -\Delta F^1_{d_0,t} = -\left(F^1_{d_0,t} - F^1_{d_0-1,t}\right)$$

ENTIRE FOLLOWING MONTH AFFECTED

No gross-up is needed because the contract is already fully exposed to the new rate.

1 bp
quote noise, stale price, or risk-premium movement

×31

31 bp
false target surprise after current-month scaling

Operational rule: for late-month meetings, switch to the next-month futures contract rather than multiplying current-month noise by a large ϕ.

What the switch fixes: mechanical gross-up noise. **What it does not fix:** liquidity and risk-premium wedges still have to be checked.

The Empirical Framework: Kuttner (2001)

A one-equation model with one clean result: anticipated moves have zero market impact; surprises do not

THE EMPIRICAL MODEL

$$R_{i,d} = \alpha + \beta_1 TS_d + \varepsilon_{i,d}$$

$R_{i,d}$
Yield change on asset i on FOMC day d.

TS_d
Unexpected component inferred from fed funds futures.

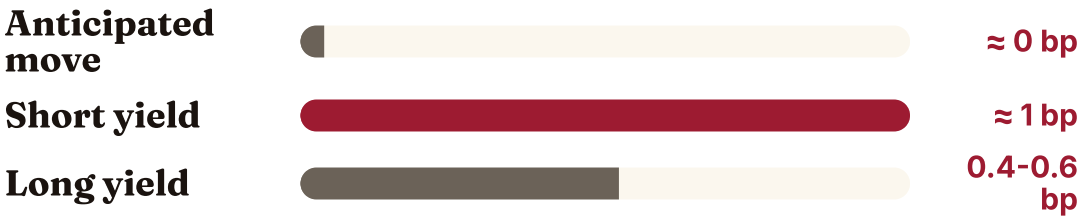
β_1
Immediate asset response to a one-bp surprise.

ANTICIPATED VERSUS UNANTICIPATED

$$\Delta i_d = \underbrace{TS_d}_{\text{unexpected}} + \underbrace{(\Delta i_d - TS_d)}_{\text{anticipated}}$$

Under efficient markets, the anticipated component is already embedded in yields before the meeting. The event-day movement should load on TS_d, not on the expected part of Δi_d.

KUTTNER RESULT: RESPONSE PER 1 BP TIGHTENING SURPRISE



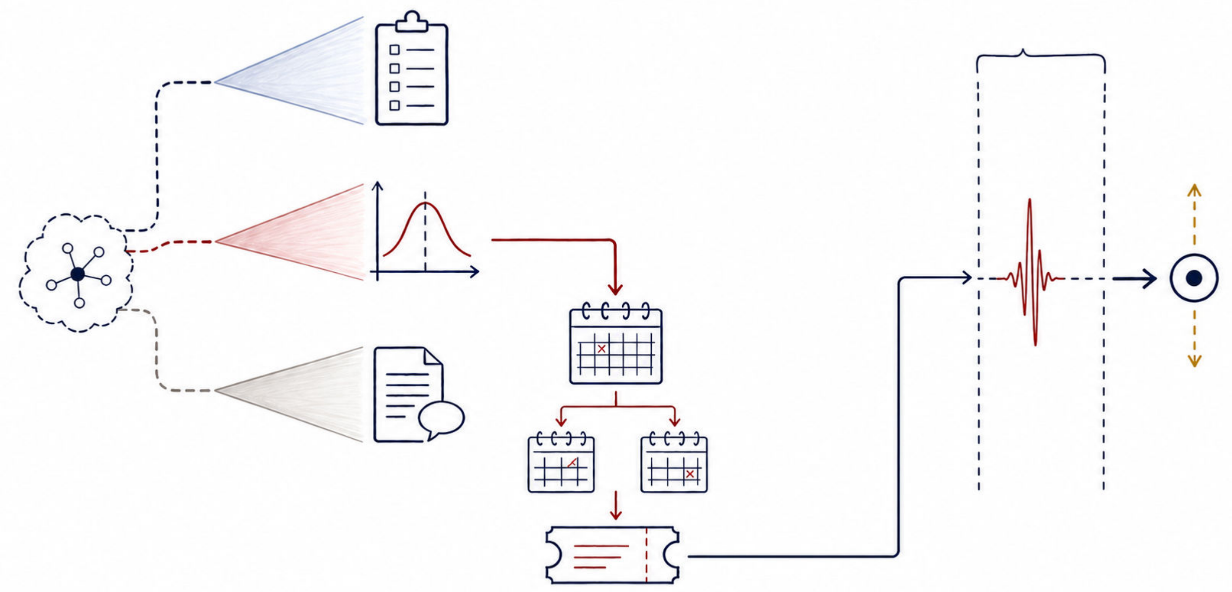
The regression rejects the idea that rate changes matter mechanically. What matters is the revision relative to market expectations.

WHY LATER PAPERS EXTEND THE FRAMEWORK

GSS (2005)	Adds target and path surprises; longer yields mostly respond to path news.
NAKAMURA-STEINSSON	High-frequency surprises also shift macro forecasts, pointing to central-bank information effects.
SINGLE-FACTOR LIMIT	A target surprise alone explains little variance in longer-maturity yields.

Signals, Wedges, and Identification

The full empirical chain—and the branch restriction that keeps the estimand coherent



Survey, market, and text measure belief; only the market branch enters the futures-based surprise estimator.

SYNTHESIS

Measure, interpret, identify

1. **Latent belief**
   Choose the agent, variable, horizon, moment, and probability measure.
2. **Observable signals**
   Interpret survey, market, and text traces with their own wedges.
3. **Market estimator**
   Apply calendar weighting to the futures branch, then measure the event-window surprise.
4. **Asset response**
   Estimate the sign and magnitude from the data; do not build either into the diagram.

Branch discipline: surveys and text can triangulate the hidden belief, but they never feed the futures settlement or high-frequency estimator.

Measuring *Expectations.*

02/

Fatih Kansoy
Central Banking · Lecture 2

SIGNALS · WEDGES · IDENTIFICATION