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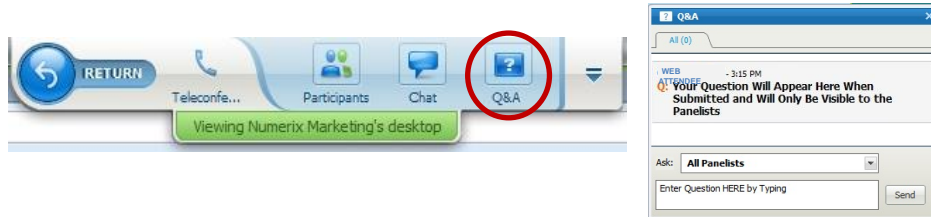**http://linkd.in/MarkHadley**   **http://linkd.in/JimJockle**

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**#OIS #Bootstrap
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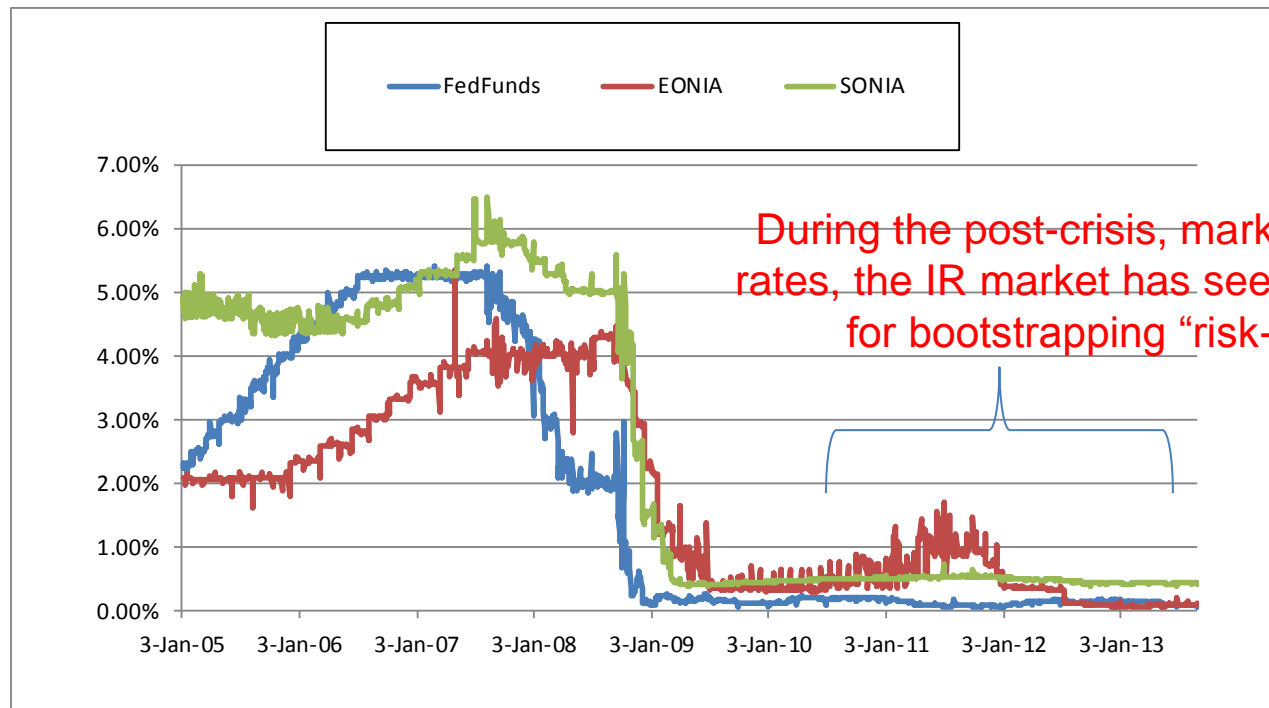- **Contact Us If You're Having Difficulties**
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Motivation: Recent History of Overnight Rates

- Over the last several years, to expedite the global economic recovery, central banks have aimed for near-zero overnight rates

- The last time the developed world saw tightening monetary policy was back in 2005-2006. This was **before** the market had adopted OIS discounting and the dual-curve framework

During the post-crisis, marked by record-low rates, the IR market has seen a paradigm shift for bootstrapping "risk-free" curves

Motivation: The Near-Term Future of Overnight Rates

- When the Fed begins tapering, the short end of the OIS curve will steepen to reflect the market's expectations of a tightening money supply

- Markets have endured tightening monetary policies before, but this time the OIS curve will be the central object of interest for discounting in derivatives valuations

- So when the FedFunds target finally inches above <25bps for the first time in years, what can we expect?

Overview

- Describe two enhancements to the current widely-used OIS bootstrapping methodology:
    - anchoring the curve interpolation at FOMC meeting dates, which is when the FedFunds rate actually changes
    - including seasonality factors when FedFunds is known to peak

- Discuss implementation details of an interpolation method that accommodates these empirical quirks

- Assess the impact of this new interpolation method on:
    - Fed Funds predictions
    - Valuation and Greeks of short-tenor overnight rate derivatives
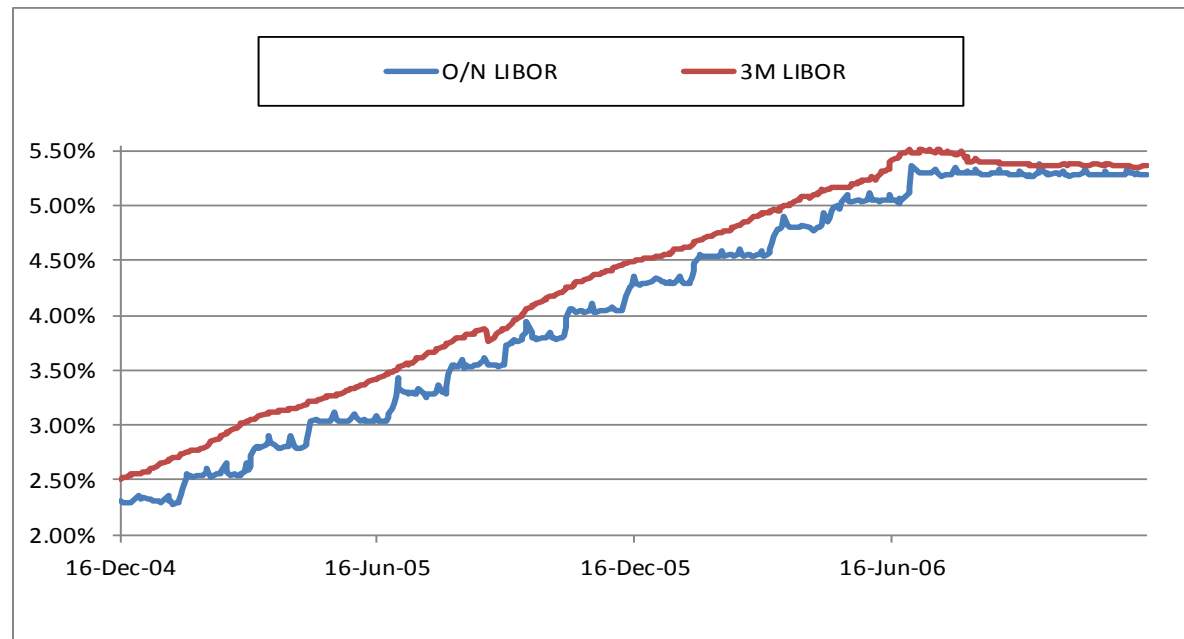
Meeting Dates

Turn Effects

EMPIRICAL QUIRKS IN OVERNIGHT RATES

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Overnight Rates

- Overnight rates like FedFunds and longer-tenor rates like LIBOR have fundamentally different dynamics

- The overnight rate follows a noticeably jumpy and step-wise motion

Target Rate and Meeting Dates

- The **timing** of these jumps coincides with FOMC meeting dates
- The **level** of these jumps coincides with the FOMC targets and are increments of 25bps
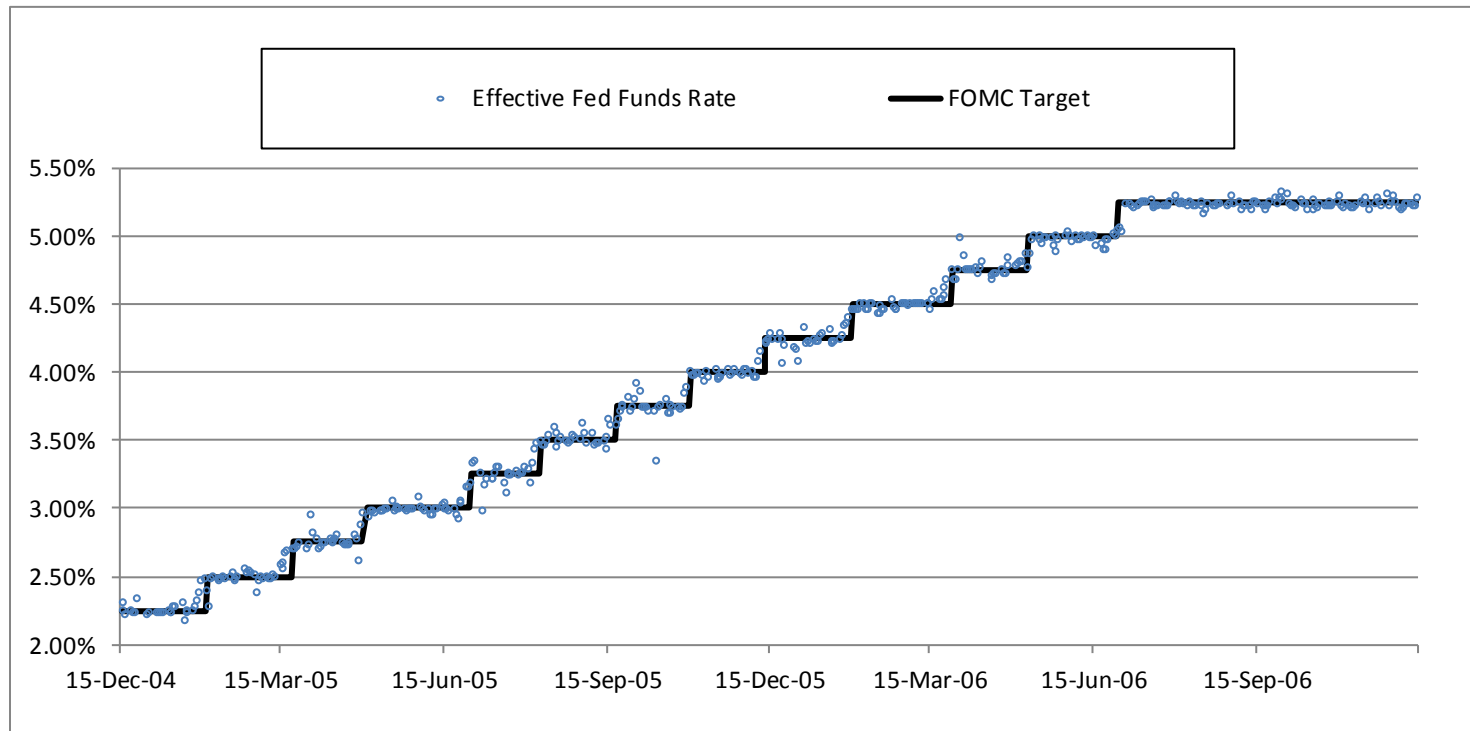
Calendar Effects

- Overnight rates also have many predictable calendar effects:
    - Taxes: year-end and quarter-end turns
    - Payroll: mid and month-end
    - Weekends and holidays
    - Reserve maintenance periods(every other Wednesday in US)

- A quick Google search will provide you with a rich literature on such effects:
    - Griffiths and Winters. Day-of-the-Week Effects in FedFunds Rates. 1995.
    - Hamilton. The Daily Market for Fed Funds. *Journal of Political Economy.* 1996.
   - Prati et al. Overnight Interbank Market: Evidence from the G7. 2001.

Meeting-dated interpolation

Interpolation with turn effects

IMPLEMENTATION DETAILS

Traditional OIS Interpolation

- Traditional interpolation schemes are anchored by the tenors (maturities) of the OIS (FedFund Futures) instruments used in the bootstrapping procedure
- Traditional schemes also tend to favor "smooth" forward curves, eg cubic/shape-preserving splines

Typical Overnight Rate Instruments

OIS FFF OIS
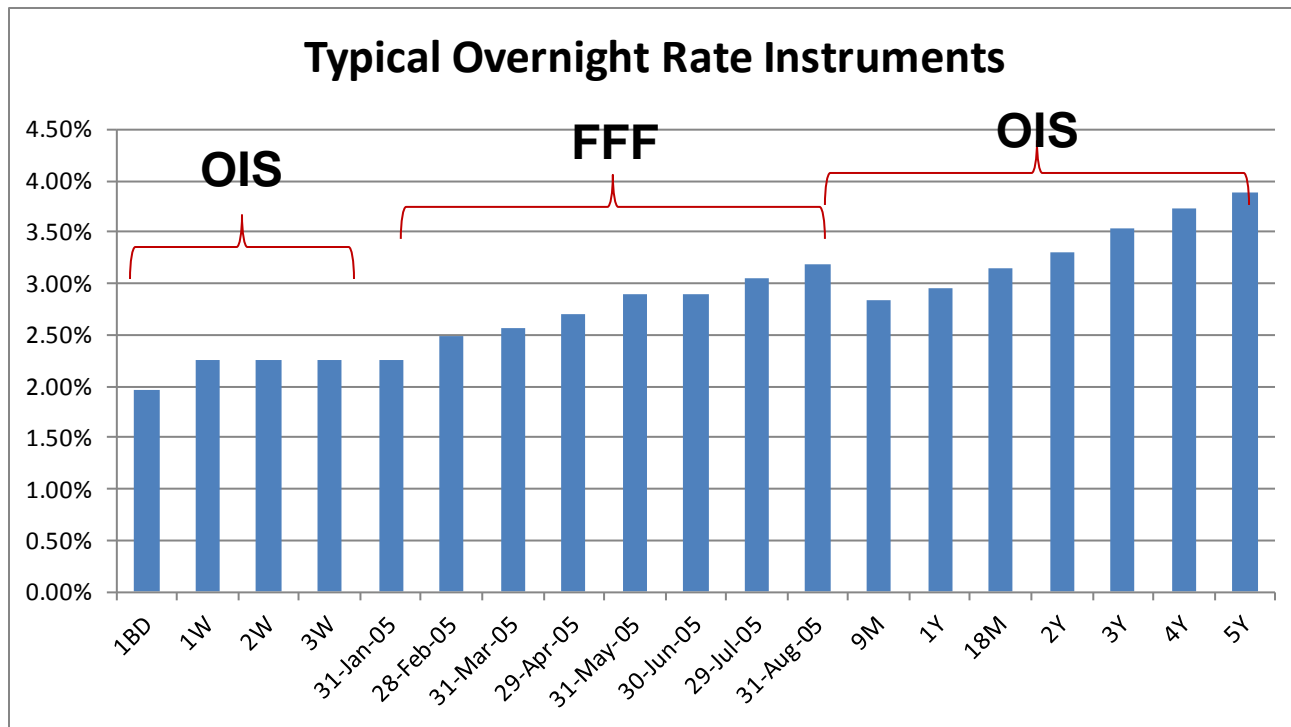
Meeting-Dated Interpolation: A Short-Cut

Date	Discount Factor
03-Jan-2005	1
1-Feb-05	0.998198313
22-Mar-05	0.994811604
3-May-05	0.991705576
30-Jun-05	0.98702702
20-Sep-05	0.980144487
1-Nov-05	0.976497457
13-Dec-05	0.97279712
31-Jan-06	0.968382389
28-Mar-06	0.963204084
10-May-06	0.959136202
29-Jun-06	0.954349707
8-Aug-06	0.950504628
20-Sep-06	0.946342614
25-Oct-06	0.942937203
12-Dec-06	0.938241611

- Bootstrap the curve in the traditional way from Overnight Index Swaps and/or Fed Fund Futures

- Evaluate its discount factors at the meeting dates. Scheduled meeting dates are known 2-3 years in advance for most central banks

- Pass these dates and factors into a custom curve object with log-linear interpolation on the discount factors

Comparing the Interpolation Methods (1)

- The interpolation method provides a more realistic projection of overnight rates (below)
- The differences are more material for steeper forward curves, but dissipate beyond a year where the curve flattens
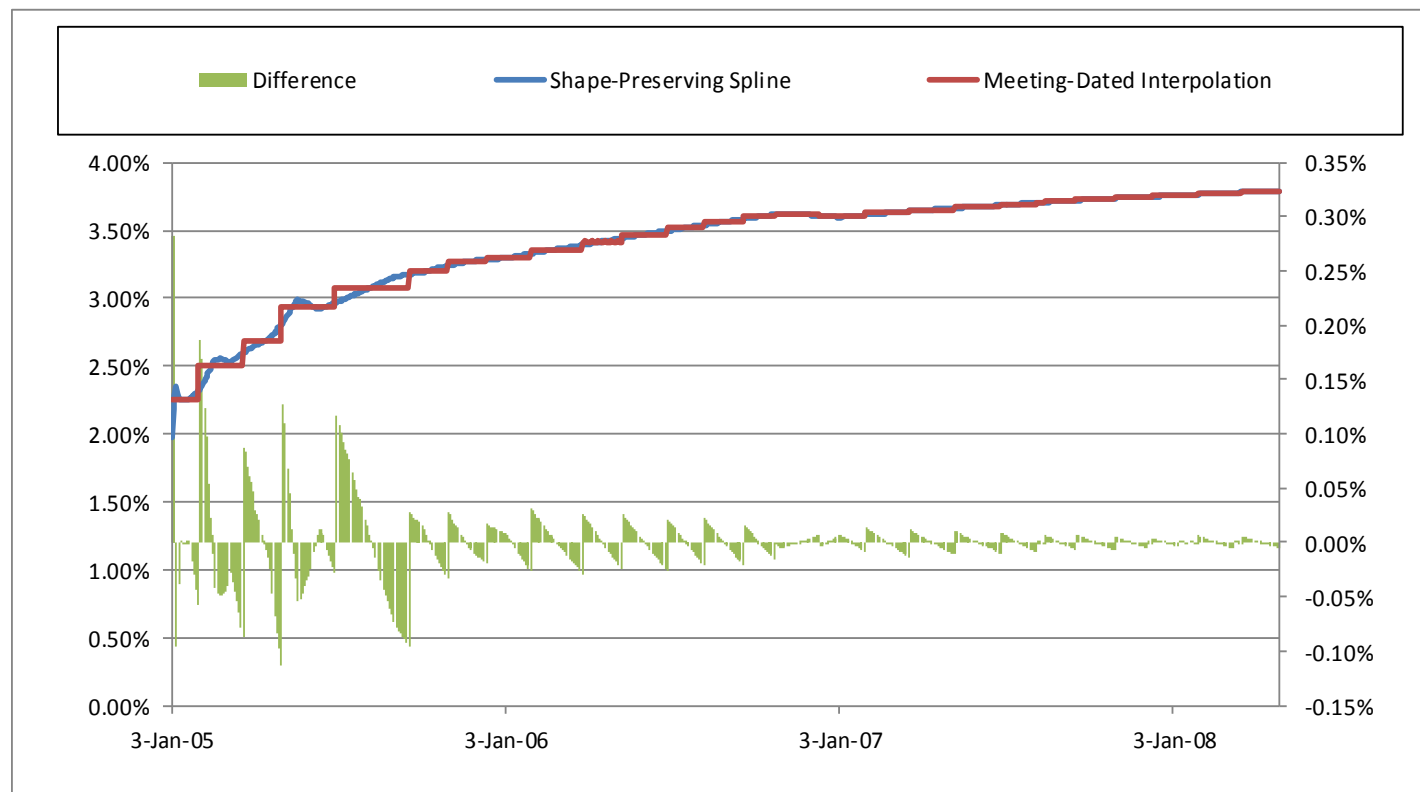
Interpolation with Calendar Effects

- Here, the user provides a set of meeting dates AND a table of seasonality factors

- The target rate, T, is assumed constant between meeting dates. The overnight rate, R, is the sum of the target and a known (user-defined) seasonality component, S. f() is the day-count fraction.

$$R_t = T_{M_{i-1}} + S_t$$

$$\frac{P(M_{i-1})}{P(M_i)} = \prod_{t=M_{i-1}}^{M_i} (1 + f(t) * R_t)$$

- The Ts are bootstrapped: they are solved for numerically and iteratively. It's a one-dimensional solver, so performance is fast

- Evaluate the daily discount factors and pass them into a custom curve object, which can be used downstream

Comparing the Interpolation Methods (2)

- Here we see spikes where the user inputs seasonality factors for the overnight rate

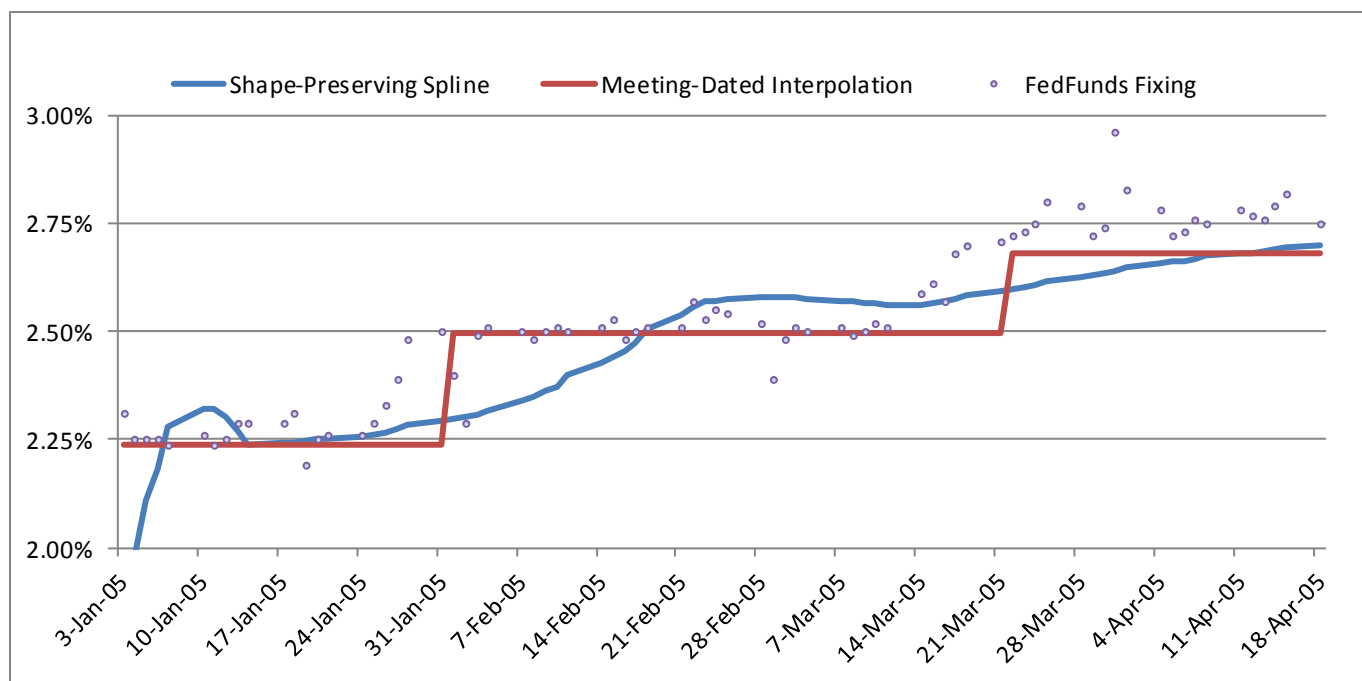- Overnight rates neighboring the spike are lowered ever so slightly to compensate
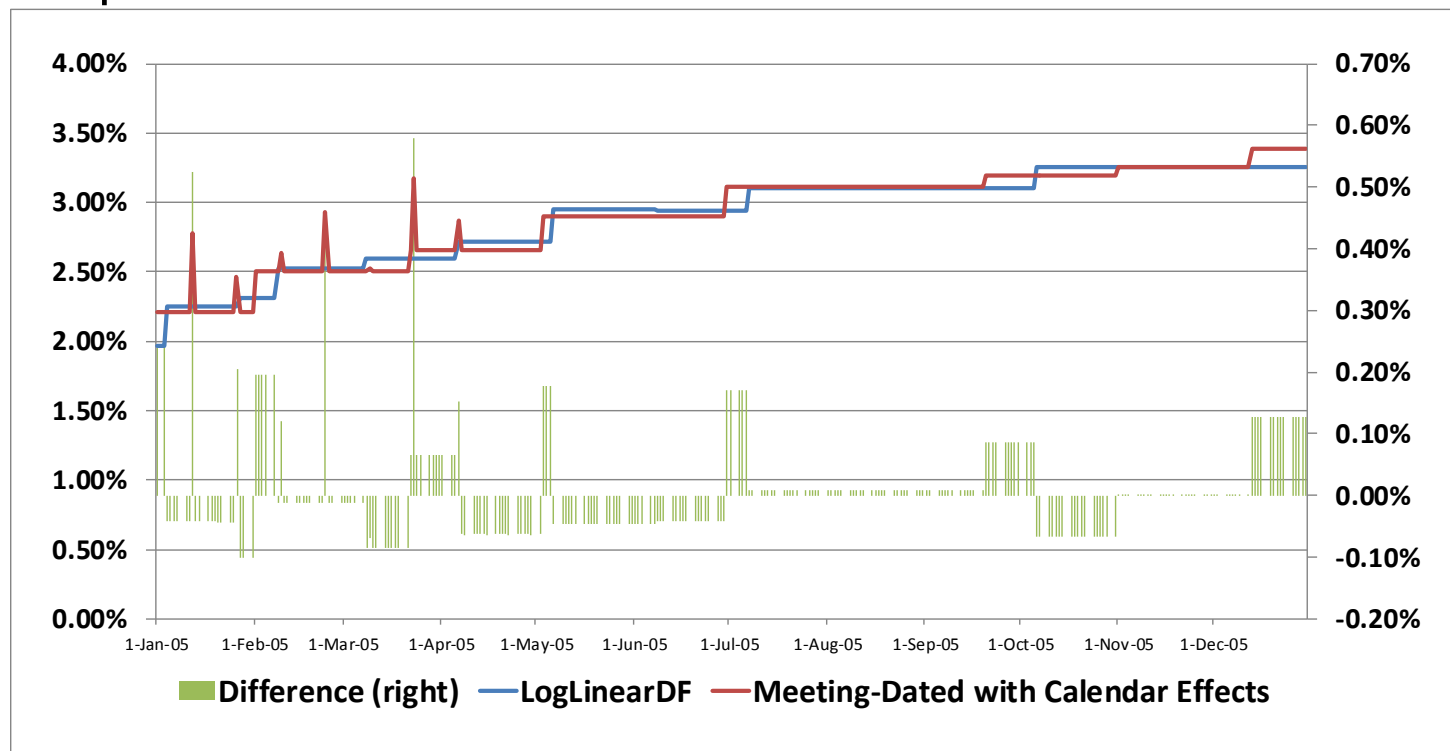
Improved Fed Funds forecasts

Valuations of short-dated IR derivatives

IMPACT

Better Forecasts for Fed Funds Rate

Overnight Rate Derivatives (Linear)

- The charts below show valuation differences as a % of notional for OISs with tenors varying out to 2Y. One valuation uses log-linear interpolation and the other uses meeting-dated interpolation.

- The differences in interpolation are apparent where the curve is steep as in Jan2005 (left); not so much where the curve is flat as in Jan2012 (right)

PV(Meeting-Dated-Inerpolation) – PV(LogLinear Interpolation) vs Maturity
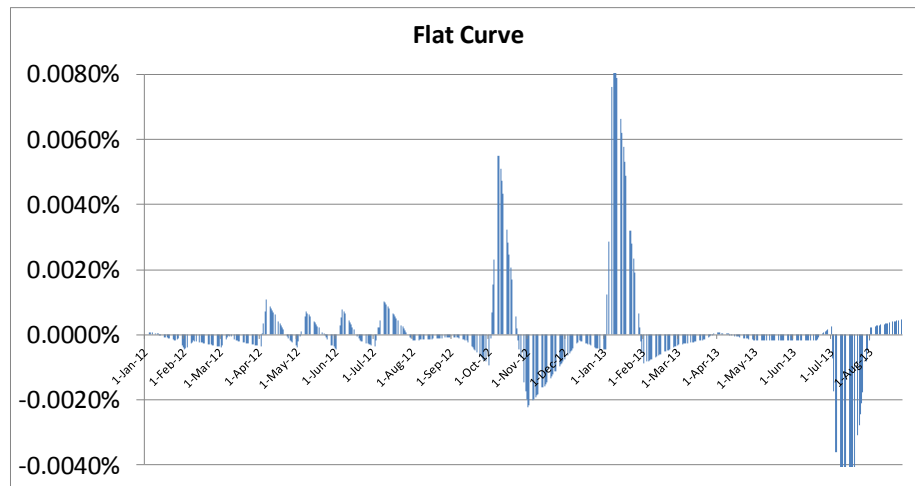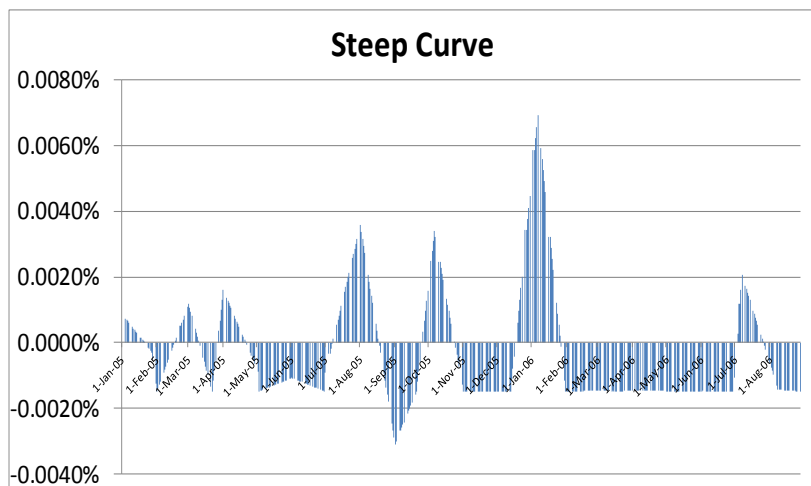
**0.60bps may seem small, but FedFund Futures tick at 0.25bps**

Overnight Rate Derivatives (Non-linear)

- Yield curves bootstrapped with the meeting-dated interpolation method can be passed down to stochastic rate models for valuation of non-linear overnight rate derivatives

- And Monte Carlo paths have the same "step-wise" dynamic at the announced meeting dates

Monte Carlo Paths for Fed Funds
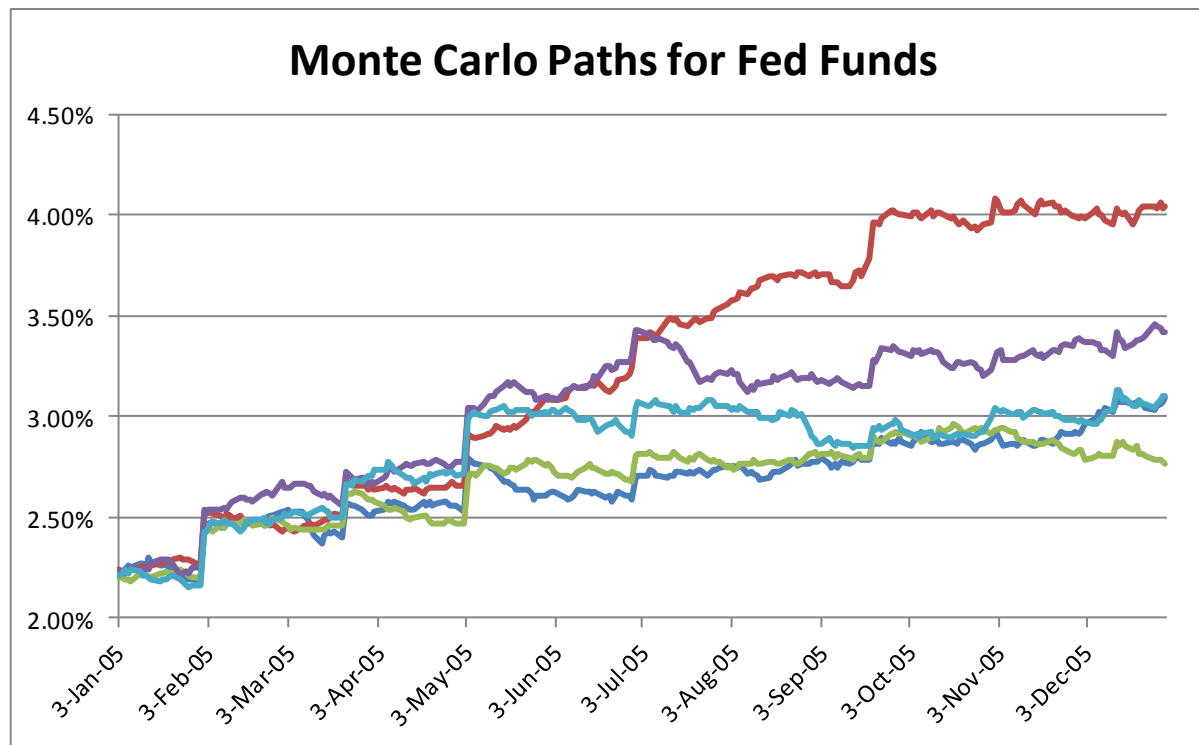
Impact on Dual Curve

- A discounting curve based on meeting-dated interpolation doesn't result in a materially different 3M LIBOR projection
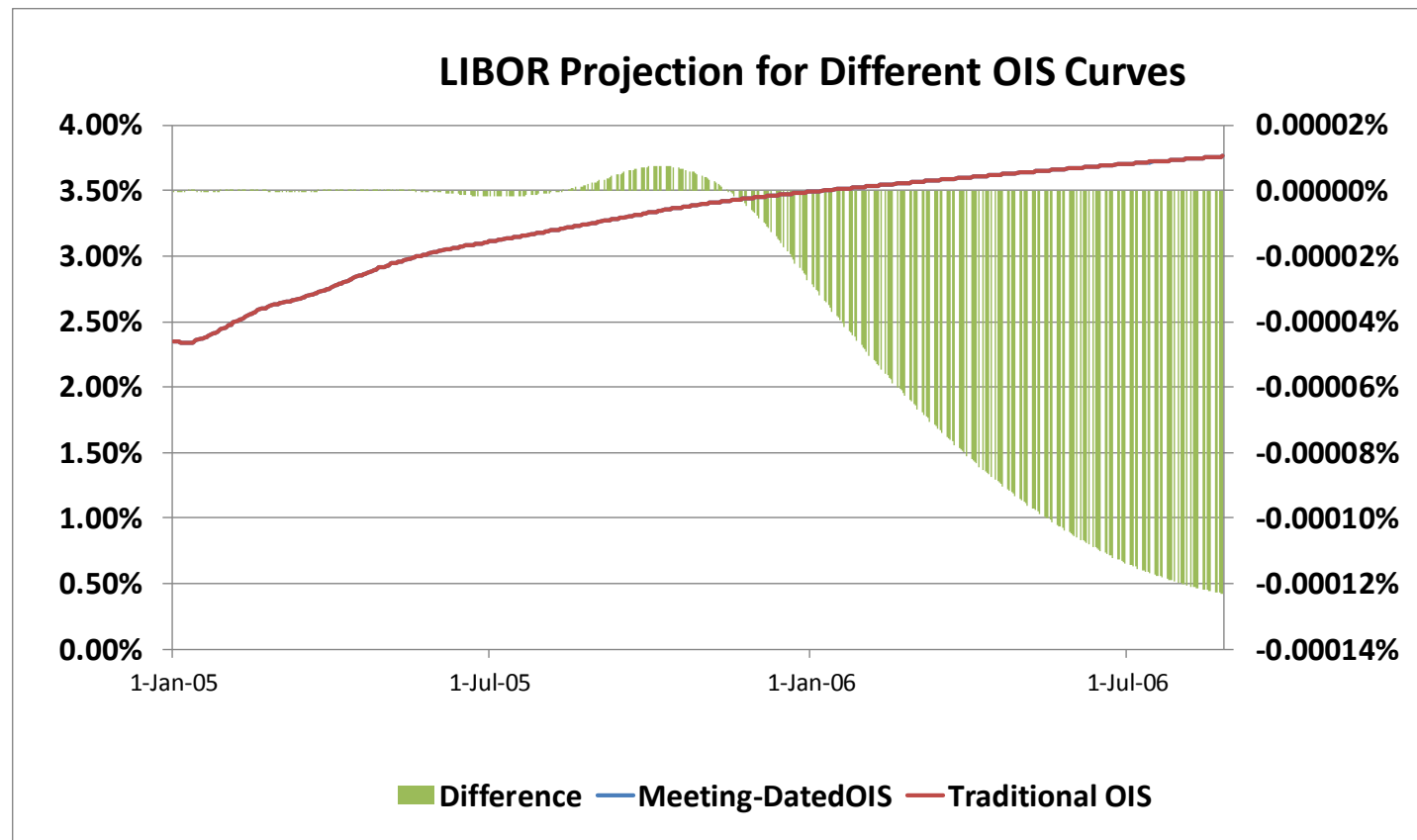
Meeting-dated interpolation only has material impact on discounting near-term cash flows.

Conclusion

- Overnight rates have unique dynamics due to central bank policy and calendar effects

- These dynamics will have a more pronounced impact as rates rise

- Meeting-dated interpolation is easily implemented; interpolation with turn effects is do-able with a fast solver

- Impacts are material for valuation/hedging of overnight rate derivatives

Q&A

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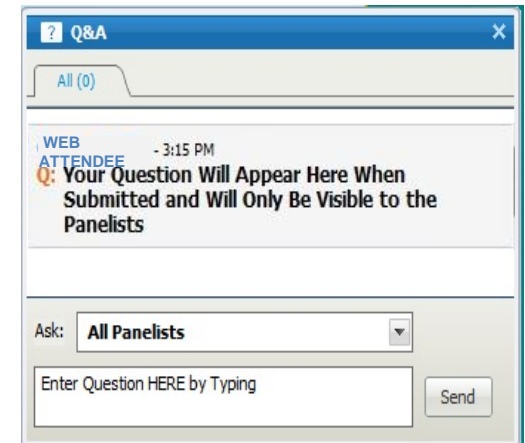
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