

## FAQ | Fed Funds Rate Used in the Calculation of Price Alignment Interest for Eris Credit Futures Contracts

This document is intended to answer the technical questions around the source, determination and timing of the US Federal Funds Effective Rate that is used in the calculation of the daily price alignment interest (PAI) included in the 'C' value of Eris credit futures contracts.

### Source

The Fed Funds Rate used in the 'C' calculation is sourced from:  
<http://www.newyorkfed.org/markets/omo/dmm/fedfundsdata.cfm>

### Timing

The Fed Funds Rate is typically published one day in arrears; for example, the rate calculated for February 4, 2015 will be published the following business day - February 5, 2015.

This means that at the daily market open for Eris credit futures, the Fed Funds Rate that is being used will be the value from two (2) business days prior, as this is the most recently available rate.

At approximately 8:00 AM ET, the most recent Fed Funds Rate is published. This publication time is not fixed. As a result ICE Futures U.S. will wait until 8:13 AM ET. If an updated rate has not been provided by this time, then ICE will continue to use the existing Fed Funds Rate for the rest of the trading session.

If an updated rate has been published by 8:13 AM EST, then ICE will update the Fed Funds Rate used to calculate the most recent day's PAI, and this value is then used to update the 'C' value that is used for trades during the rest of the trading session. This update will take place as soon as possible after the updated rate is received.

### Corrections

Any published corrections to the Fed Funds Rate will not be used.

## FAQs

### **What happens to transactions executed before the Fed Funds Rate is updated? Is their 'C' value modified after the Fed Funds Rate update?**

No. All transactions executed during the trading session prior to an update of the Fed Funds Rate will keep their original 'C' value and their clearing price will remain unchanged.

### **What happens to the 'C' value for unexecuted orders in the order book, when the Fed Funds Rate is updated?**

When the Fed Funds Rate is updated, all unfilled orders in the order book will automatically be updated to reflect the new 'C' value associated with the updated Fed Funds Rate.

### **What 'C' value will be used for Block/EFS/EFRP transactions?**

The 'C' value applied to the transaction will be the value maintained by the trading system at the time that the Block/EFS/EFRP message reaches the trading system.

**Does this mean that I could buy/sell at the same clean price before and after a Fed Funds Rate update, close the position after the update and not have zero P&L?**

Yes - however:

1. The probability of the Fed Funds Rate changing sufficiently to change the all-in clearing price of the futures contract is very low.
2. Many of the significant changes in the Fed Funds Rate were due to reasonably predictable events, which would allow market participants some level of ability to adjust their prices accordingly.
3. If there were an impact, the maximum impact on the price is minimal in all but the most extreme scenarios of the last 60 years (see Appendix C).

**Example**

**Analysis of the impact of a 25 basis point change in the federal funds effective rate on the Eris Credit Index Swap Futures settlement price**

**Assumptions:**

Index Series: HY22  
 Trade Date: 04/16/2014  
 Traded Clean Price: 107.02  
 Prior Day Settlement Price 'A' value: 107.1095  
 $A_{\text{accrued interest}} = 0.3888889$   
 $B = 0$   
 Cumulative PAI to 04/15/2014 = 0.0003230024  
 Fed Fund Effective Rate available at 2:00am ET: 0.09%  
 Fed Fund Effective Rate available at 8:13am ET: 0.34%

**Methodology:**

The Daily Price Alignment Interest calculation is performed by taking the prior day's dirty price used for the calculation of the daily settlement price, and applying the appropriate number of days interest at the most recently available Fed Funds Effective Rate.

We have 1 day of accrual to calculate (value would be 3 days on a Monday to include weekend accrual), so the formula is:

$$1 / 360 * 0.09\% * (107.1095 - 100) = 0.0000177738$$

If we make the same calculation again after the 8:13am ET update to the Fed Fund Effective Rate (now 0.34%), then the calculation becomes:

$$1 / 360 * 0.34\% * (107.1095 - 100) = 0.0000671453$$

The difference between the two values for a 25 basis point increase in the Fed Funds Effective Rate is 0.0000493715

The difference is less than half of the minimum settlement price fluctuation of 0.0001, and equates to a mark-to-market value of 4.9 cents per \$100,000 contract.

Applying these two different daily PAI values to the cumulative PAI from the prior day, and then adding in the other 'A' and 'B' values, would give us settlement prices of:

Fed Funds Effective Rate of 0.09%  
 $A = 107.02 + 0.3888889 = 107.4088889$   
 $B = 0$   
 $C = 0.0003230024 + 0.0000177738 = 0.000340776$   
Futures Price =  $107.4088889 + 0 - 0.000340776 = 107.4085$

Fed Funds Effective Rate of 0.34%  
 $A = 107.02 + 0.3888889 = 107.4088889$   
 $B = 0$   
 $C = 0.0003230024 + 0.0000671453 = 0.000390148$   
Futures Price =  $107.4088889 + 0 - 0.000390148 = 107.4085$

In this example a 25 basis point change in the federal funds effective rate is insufficient to cause a change to the daily settlement price.

In general then, a 25 basis point change in the Federal Funds Effective Rate will be insufficient to cause a change in the daily settlement price, unless the prior day's cumulative PAI is sufficiently close to changing at the 4<sup>th</sup> decimal place. This could trigger a change in the value of the 4<sup>th</sup> decimal place of the cumulative PAI, which in turn could (but may not, due to rounding to 4 decimal places of the daily settlement price) cause the daily settlement price to vary by 0.0001 (or 10 cents per contract).

By looking at the historical data (see Appendix A for more details), we see that since data was first published in 1954, 83.0% of daily changes in the Fed Funds Effective Rate have been 25 basis points or less. This figure rises to 92.2% if we consider only the last 25 years of data (1989 onwards) and to 97.4% if we consider only the last 15 years of data (1999 onwards).

## Conclusion

As the appendices show, the potential impact of a change in the Fed Funds Effective Rate is limited in frequency and whilst predicting the size of any changes was not covered by this document, it was shown that it is frequently possible to predict when movements in the Fed Funds Effective Rate that could potentially affect futures prices may occur.

Recent interest rate policy has provided such low volatility in the Fed Funds Effective Rate since 2009 as to effectively invalidate analysis using this period. Whilst there is significant additional data available, which demonstrates greater volatility, care must also be taken not to place too much emphasis on these periods of historical data as directly comparable, as the nature of both the global economy and Fed Funds policy implementation have materially changed since the 1980s and 1990s, and whilst a return to the more extreme levels of volatility observed in the 1970s or 1980s cannot be ruled out, neither can such an event be proven highly probable through this analysis.

Furthermore, to be at risk of a negative profit and loss event, due to this effect, a market participant would need to hold a futures position prior to that day's Fed Funds Effective Rate Announcement, which was then closed out after the announcement.

The direction of the open position (long or short) that would result in any loss would be determined by the current market price for the contract. In each case, we need to determine whether the buyer or seller of futures would be negatively impacted by the change in the Fed Funds Effective Rate.

On days where the contract is trading above par, that day's Price Alignment Interest would be paid by the participant that is long futures (sold protection), so a large increase in the Fed Funds Rate would negatively impact the long futures position, but a large decrease would positively impact the long position.

On days where the contract is trading below par, the short futures position would pay the Price Alignment Interest, and therefore the outcome is reversed: a large increase in the Fed Funds Rate would negatively impact the short futures position, but a large decrease would positively impact the short position.

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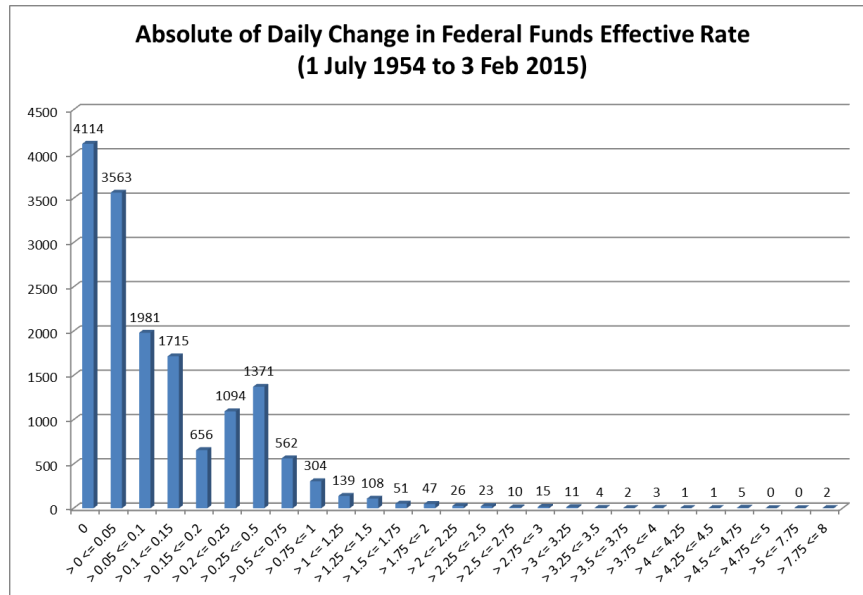
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## Appendix A - Analysis of Daily Changes in Federal Funds Effective Rate

We examined the daily changes in the federal funds effective rate from 1 July 1954 to 3 Feb 2015. The source of the data was <http://www.federalreserve.gov/releases/h15/data.htm>.

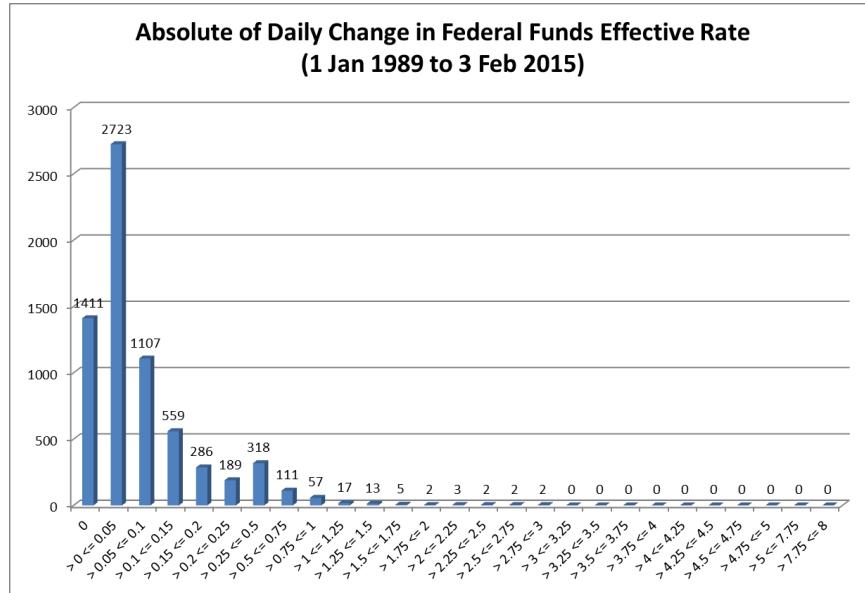
We removed data from Saturdays and Sundays, leaving 15,809 data points. We then calculated the absolute of the daily change of the effective rate, and then grouped the data into various buckets of daily change.

**Graph 1**



We can see in Graph 1 that 13,123 of the 15,808 daily changes, or 83.0% of the observations, were of less than or equal to 25 basis points ( $\leq 0.25$ ). The largest single day change was 7.89% on 2<sup>nd</sup> January 1987.

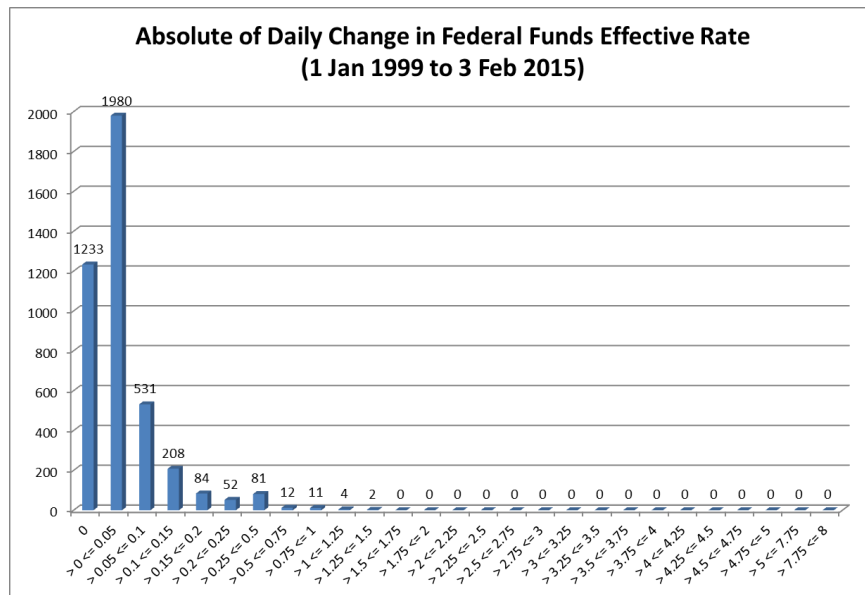
**Graph 2**



Using data starting in 1989, to focus only on data for the last 25 years, then the percentage rises to 77.0%.

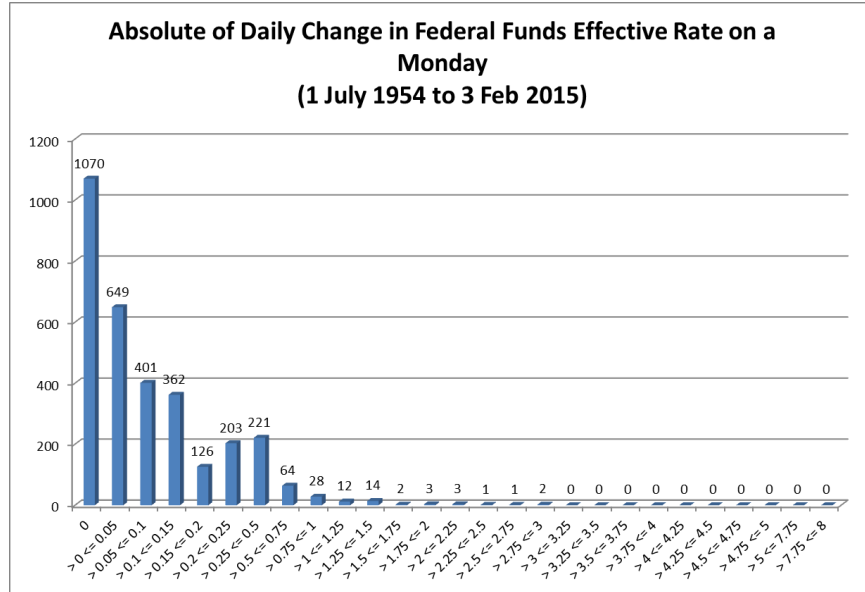
The largest single day change drops from 789 basis points to 283 (on 23<sup>rd</sup> January 1991).

**Graph 3**



Using data starting in 1999, the percentage of daily changes <= 25 basis points jumps to 97.4%. The largest single day change drops to 1.44% on 3<sup>rd</sup> January 2000.

Graph 4



Next we examine data for Mondays only, to account for the fact that typically the Monday PAI calculation will include the 2 weekend days (for a total of 3 days), instead of just 1 weekday.

On a Monday, 88.9% of all daily changes were <= 25 basis points, with the largest daily change of 300 basis points on 06/30/1969. However as we are accruing 3 days of interest on a Monday, we should use 25 basis points / 3 days as the filter if we wish to be able to establish how many days would likely have resulted in a similar price impact as our 25 basis point example when it accrues for 1 day.

Using 0.083% (8.3 basis points) as a filter 2,018 of 3,162 daily changes or 63.8% of daily changes would likely have resulted in no price impact.

## Appendix 2 - Analyzing the causes and frequency of > 25 basis point changes in Fed Funds Effective Rate

Year	Chg > 25 bps	Year	Chg > 25 bps	Year	Chg > 25 bps	Year	Chg > 25 bps	Year	Chg > 25 bps	Year	Chg > 25 bps	Year	Chg > 25 bps
		2009	0	1999	33	1989	29	1979	77	1969	122	1959	23
		2008	29	1998	37	1988	46	1978	29	1968	52	1958	81
		2007	14	1997	35	1987	44	1977	33	1967	43	1957	18
		2006	0	1996	50	1986	35	1976	27	1966	63	1956	21
2015	0	2005	5	1995	35	1985	74	1975	50	1965	22	1955	22
2014	0	2004	1	1994	44	1984	93	1974	81	1964	24	1954	31
2013	0	2003	3	1993	40	1983	38	1973	102	1963	22		
2012	0	2002	1	1992	66	1982	135	1972	41	1962	35		
2011	0	2001	16	1991	52	1981	174	1971	53	1961	123		
2010	0	2000	8	1990	34	1980	163	1970	89	1960	67		

The above table shows the number of days in each calendar year where the daily change in Fed Funds Effective Rate was greater than 25 basis points.

Not surprisingly, given recent interest rate policy, we have to go back to 2008 to find the first year with any daily changes exceeding 25 basis points.

For example, of the 29 occurrences in 2008:

- 17 occurred in the month immediately following the sale of Merrill Lynch to Bank of America on 09/14/2008 and the Chapter 11 filing of Lehman Brothers on 09/15/2008.
- 6 occurred on or that day after a rate policy change (1/22, 2/4, 3/17, 3/18, 5/2 and 10/29)
- 2 were predictable seasonal events based on the New Year and 4<sup>th</sup> July holidays.
- Leaving 4 unexplained days, of which 3/25 and 3/31 occurred in the 2 weeks following the sale of Bear Stearns to JPM on 03/16.
- The remaining 2 days were 04/22 and 06/30.

If we consider the period 1/1/1999 to 1/1/2015, there were 110 days on which a > 25 basis point move was observed, of which 58 can be classified as dates upon which high volatility could be expected, either due to:

- Federal Reserve rate policy changes, or
- Seasonal effects, such as 4<sup>th</sup> July or changing of calendar year, or
- Due to volatile markets based on news, such as Y2K, 9/11, Bear Stearns and Lehman bankruptcies.

Of the remaining 52 days, for which there is no immediately obvious explanation, 21 occur in the first 5 months of 1999.



### **Appendix 3 - Worst-Case Analysis of Potential Impact Due to Fed Funds Effective Rate Changes**

The following examples build on the data presented earlier in the document to provide a set of scenarios based upon potential changes in Federal Funds Effective Rate.

To ensure that the calculations are as conservative (i.e. worst possible case), an assumption is made that 4 days of interest are required to be calculated on a given day, requiring that the change occurred that was published on the day after a weekend on which either the day immediately before or after the weekend was a day on which the clearing house was closed. At the time of writing this paper, there are typically only 2 days on which ICE Futures U.S. closes (25<sup>th</sup> December and 1<sup>st</sup> January holidays, or appropriately adjusted dates if either is not a business day).

We make the same price and previous PAI assumptions as previously made in this document:

Traded Price	107.02
Prior Settle	107.1095
$A_{\text{accrued interest}}$	0.3888889
B	0
Cumul. PAI to prior Day ( $C_{t-1}$ )	0.000323002
Days	4

We assume a base case Fed Funds Rate of 0.01%, and calculate the Futures Price that would be used for daily settlement based on the above information, using the same methodology as previously outlined, but assuming 4 days of accrual.

We then repeat the process with different Fed Funds Effective Rates at 25 basis point increases to 1.01%, and then 50 basis point increases to 8.01%. In each case we then compare the daily settlement values to the 0.01% scenario to determine what the difference in the daily settlement price would have been, if we had observed the various changes in Fed Funds Effective Rate.

Fed Fund Rate	Daily C	New Cumulative C	New Futures Price		Difference		
			(A + B - C)	(A + B - C) - 4 dp	to 0.01%	in \$ value / contract	in ticks *
0.01%	0.00000790	0.00033090	107.40855800	107.4086	0.0000	\$0.00	0
0.26%	0.00020539	0.00052839	107.40836051	107.4084	-0.0002	-\$0.20	-0.02
0.51%	0.00040287	0.00072587	107.40816303	107.4082	-0.0004	-\$0.40	-0.04
0.76%	0.00060036	0.00092336	107.40796554	107.4080	-0.0006	-\$0.60	-0.06
1.01%	0.00079784	0.00112085	107.40776805	107.4078	-0.0008	-\$0.80	-0.08
1.51%	0.00119282	0.00151582	107.40737308	107.4074	-0.0012	-\$1.20	-0.12
2.01%	0.00158779	0.00191079	107.40697811	107.4070	-0.0016	-\$1.60	-0.16
2.51%	0.00198276	0.00230576	107.40658314	107.4066	-0.0020	-\$2.00	-0.2
3.01%	0.00237773	0.00270074	107.40618816	107.4062	-0.0024	-\$2.40	-0.24
3.51%	0.00277271	0.00309571	107.40579319	107.4058	-0.0028	-\$2.80	-0.28
4.01%	0.00316768	0.00349068	107.40539822	107.4054	-0.0032	-\$3.20	-0.32
4.51%	0.00356265	0.00388565	107.40500325	107.4050	-0.0036	-\$3.60	-0.36
5.01%	0.00395762	0.00428062	107.40460828	107.4046	-0.0040	-\$4.00	-0.4
5.51%	0.00435259	0.00467560	107.40421330	107.4042	-0.0044	-\$4.40	-0.44
6.01%	0.00474757	0.00507057	107.40381833	107.4038	-0.0048	-\$4.80	-0.48
6.51%	0.00514254	0.00546554	107.40342336	107.4034	-0.0052	-\$5.20	-0.52
7.01%	0.00553751	0.00586051	107.40302839	107.4030	-0.0056	-\$5.60	-0.56
7.51%	0.00593248	0.00625549	107.40263341	107.4026	-0.0060	-\$6.00	-0.6
8.01%	0.00632746	0.00665046	107.40223844	107.4022	-0.0064	-\$6.40	-0.64

\* in ticks represents quotation ticks to index clean price granularity of 0.01 (i.e. the minimum tick that can be used when quoting clean price), not settlement price tick, which is 0.0001

In the above table, the first column shows the assumed Federal Funds Effective Rate used in each calculation and each row of the table represents a different scenario.

The 'Daily C' column shows the value calculated for 4 days of Price Alignment Interest Accrual for each Fed Funds Rate, and the "New Cumulative C" column shows the outcome of adding 'Daily C' to our assumption of cumulative PAI to prior day (Ct-1). From here we perform the A + B - C calculation using our base assumptions, as described above, and round the result to 4 decimal places to arrive at the daily settlement prices.

The 'Difference to 0.01%' column shows the difference in daily settlement price of the Futures price calculated with the different Fed Funds Effective Rate to the base calculation using a 0.01% rate. This is then represented in terms of a dollar value per contract, and finally in terms of quoted ticks.

The analysis shows that the most extreme daily change (7.89% on 2<sup>nd</sup> Jan 1987) would have resulted in just over half a tick change in the quoted price, equivalent to \$6.40 of P&L per \$100,000 contract.

If we look at the 2.01% result, we can see that the impact would have been 0.16 of a tick, or \$1.60 per \$100,000 contract. This figure is relevant because 99.3% of all observed daily changes in Fed Funds Effective Rate since July 1954 were less than 200 basis points (2.00%).