BEAR STEARNS

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Interest Rate Strategy

Weekly Eurodollar Mid-Curve Options

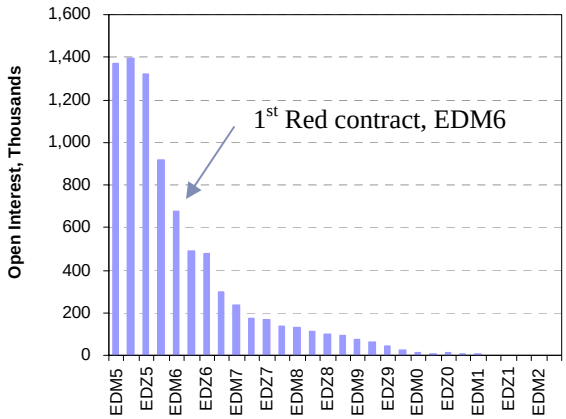
The Chicago Mercantile Exchange will deepen its market for the already successful mid-curve options by listing weekly expirations on the fifth quarterly Eurodollar future, the first red contract. At any one time there will be at least five expirations on this contract, including the existing serial and quarterly mid-curve options. Sometimes a few notes are all that separate a discordant rumpus from an immaculate symphony, and these new expirations will represent individual economic news in a way that hasn't been possible before. In fact, these weekly options are the perfect complement to our existing work on volatility mapping and allow us to take the next step in the work: discern how traders are positioned for each week's economic releases.

Mid-curve options are short expiration options on longer-dated contracts. For example, one-year mid-curve options on June '06 will expire in June '05, one-year before the underlying futures contract. The advantage of mid-curve options is they have less time value than if they expired at the same time as the underlying futures, which allows them to represent more distant points on the yield curve. Prior to weekly expirations, the gold mid-curves were the more recent addition to the lineup, and these options allow for a reasonably complete means of conditionally trading the Eurodollar curve. Though their introduction may seem like an incremental step, weekly expirations fill out CME options offerings in a way that allows for something unique: measuring the volatility traders are expecting any given week.

Why are volatility expectations important? The listed options that trade right now are too long to parse out expectations of market moves for any individual week. A mid-curve option, for example, might have three months to expiration, during which time there may be three non-farm payroll releases, Humphrey-Hawkins testimony from the Federal Reserve and two CPI releases. What is the market expecting from each release? It's impossible to tell from an option that spans the whole group. The only way to tease out the answer would be to watch how the implied volatility changes after each release, to see what the market is expecting from the remaining news. This is a poor solution since it only allows for measurement after the fact.

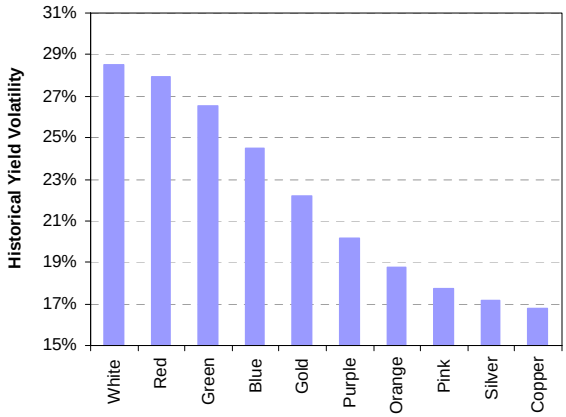
Suppose, however, that weekly option expirations were available. Instead of watching the price of a three-month option change as time goes by, we can work this process in reverse, beginning with a short period and then adding additional weeks. The first weekly option is priced from expected volatility during that first week alone. The next weekly option will cover an additional week, and should contain the same volatility expectations for week number one *plus* the volatility expectations for week number two. The third weekly option will cover three weeks worth of economic releases, and implied volatility for the first two weeks can already be inferred from existing options, so the uniqueness in pricing will come from volatility expectations during the third week alone. The trick here is to recognize that the calendar for economic releases is fixed, so each option will represent a referendum on a small list of economic news.

Figure 1. Open interest by contract



Source: Bear, Stearns & Co.

Figure 2. Realized 90-day volatility by pack



Source: Bear, Stearns & Co.

Figure 3. Contract specifics

Option expiration matches underlying futures:

Two serial
Eight quarterly

Mid-Curve options expiring before underlying futures:

1y	*Four Weekly*
	Two Serial
	Four Quarterly
2y	*Four quarterly*
5y	*Four quarterly*

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We've only just begun to scratch the surface, since markets don't move solely based on the fact that a piece of economic news is released, but rather on how different that news is from trader's expectations. There have been a number of times in 2005 when non-farm payrolls came out very close to estimates, and the market barely budged. There have been other times when the payroll number was far away from estimates, and the market jumped. Realized volatility doesn't just depend on reaching an economic release date, but on missed expectations. If delivered volatility has to do with surprises, then it should be possible to measure the historical impact on yields of these surprises. The last piece of the puzzle will be to marry these measurements with implied volatility of the weekly options to discern what kind of surprises the market is expecting from each week's economic releases.

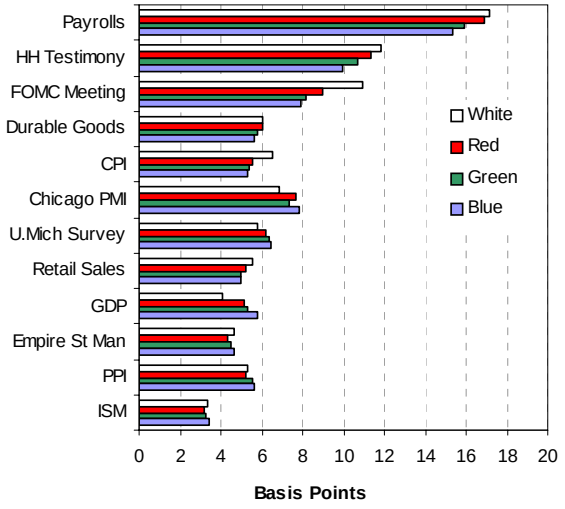
Figure 4 illustrates the close-to-close historical changes to each of the first four Eurodollar packs the day of each economic release. It's interesting to point out that the news affects each part of the curve in a slightly different way. While volatility generally increases as maturity decreases, this relationship is sometimes inverted between the red and white packs. The white pack is sometimes less volatile, because the front month is converging to spot 3-month LIBOR, which is far more predictable a few weeks in the future than it is months or years down the road. Figure 2 graphs the empirical volatility over the past 90-days for each contract, and shows that the red pack is among the most responsive to economic news.

Figure 4 is the first step towards our ultimate goal, but it hides, to some degree, the underlying dynamics of the situation. This chart implies yield moves are tied to an economic release, rather than surprises in the economic data. In reality, the market moves more when the news is far from the market consensus, and the volatilities measured in Figure 4 are caused by these surprises. Figure 5 shows the average difference between forecast and actual values for our dozen market-moving economic releases that constitute the surprises driving yield volatility. Now that we've measured historical curve movements and the associated surprise, we might conclude the analysis two different ways.

First, we might presume that our best guess of surprises in the future is an average of surprises in the past. Knowing each future release date for each of our dozen economic releases, we may be able to anticipate the schedule and magnitude of future volatility. This volatility map is shown in Figure 6, and simply takes the average volatility for each release since the beginning of 2004 and arranges them on a weekly calendar going forward in time. A second direction for our analysis begins with market-implied volatilities, and then backs into the magnitude of surprise that would be necessary to match market prices. For example, if the implied volatility for week one were 19 bp, during which time *only* non-farm payrolls would be released, we might conclude from Figure 5 that it would take a surprise (either positive or negative) of about 100,000 jobs for the market to move by this amount.

Let's work an example starting with a projected volatility map to imply an annualized yield volatility and option price. Suppose the yield on the first red contract were 4.25% and we were going to analyze delivered volatility for existing mid-curve options, expiring on May 13 and June 10. In this case, we would measure the standard deviation of log changes in yield of a series that has 4.25% as its beginning value, but changes on days when there are economic releases. Analysis is simple in this case

Figure 4. Volatility map of historical yield changes



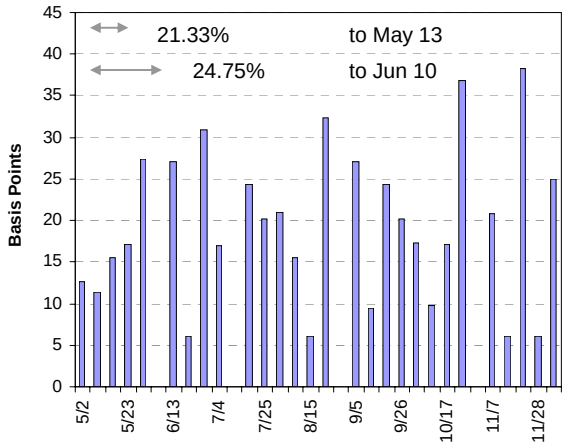
Source: Bear, Stearns & Co.

Figure 5: Average historical surprises by release

	Last	Average Error	Unit
Payrolls	110	84	value / thousand
HH Testimony			event
FOMC Meeting	2.75%	0.25%	annual percent
Durable Goods	-2.80	0.85	rate / million
CPI	3.10%	0.12%	YoY percent
Chicago PMI	69	4	index points
U.Mich Survey	89	1	index points
Retail Sales	0.30%	0.72%	MOM percent
GDP	3.10%	0.10%	QoQ percent
Empire St Man	3	7	index points
PPI	4.90%	1.27%	YoY percent
ISM	55	1	index points

Source: Bear, Stearns & Co.

Figure 6. Expected 5th contract volatility by week



Source: Bear, Stearns & Co.

since we are simply taking measurements of the same rate history over different lengths of time. Suppose the standard deviation of this series is 21.31% and 24.72% respectively for the May and June options. These values translate directly to implied volatilities for at-the-money options, and using Black-Scholes we can calculate options prices and compare them to the market price to gauge relative value.

Figure 7 illustrates straddle prices for the May and June expiration mid-curve options using the yield volatilities implied from the volatility map in Figure 6. Does a relatively large difference between the price derived from our volatility map and the market price in May options imply a mispricing? Perhaps, but remember that our analysis focuses on what we believe to be the twelve most important market-moving economic releases. Economic releases are not the only factors that drive bond pricing, but we focus on them because they are the only factors we can anticipate on a regular schedule. If our dozen factors were the only news to impact the market, and everyone used Black-Sholes to price options we could directly compare calculations from our volatility map to implied volatilities from market prices. It is also possible to work this process in reverse. If we begin with market prices, we can back out an implied yield volatility and the expected surprises associated with each economic releases.

Finally, it's important to distinguish these products from "event options" that trade in over-the-counter markets. An event option is a bet on an individual economic release, such as non-farm payrolls. A futures option gains or loses value depending on the price of the underlying futures contract, and economic events have to be translated into futures prices for them to mean anything to this market. Second, futures markets respond to surprises in the economic number, not necessarily the actual number. Expectations indirectly play into the price of an event option, but are influenced more directly by the number of traders willing to trade these products. Eurodollar futures and options, on the other hand, are the most liquid futures contracts in the world.

Figure 7. 0EM5 mid-curve straddle prices

	May '13		Jun '10	
	Straddle		Straddle	
	Implied Vol.	Price	Implied Vol.	Price
Market	28.71	$525	26.13	$775
Model	21.33	$390	24.75	$734
Difference		$135		$ 41

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