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# The Convexity Maven

Value Concepts from the BAS/ML Trading Desk  
March 23, 2010

## "The Largest Volatility Sale Ever"



Starting in May 2007, we wrote a series of commentaries that identified the MBS market as the "Wizard behind the curtain" manipulating the direction of both the Shape of the Yield Curve and the Level of Implied Volatility. [See RateLab – "The World's Largest Buyer of Volatility Returns", May 15, 2007 and "Case Closed: The Yield Curve Conundrum Explained", June 26, 2007]

Since we are about to build on top of the concepts previously detailed, below is a partial reprint of those earlier publications:

*"The reason that Implied and Realized USD rate Volatility is greater than the rate Volatility for all other G-7 countries is quite simple: We have a huge "at will pre-payable" Fixed-Rate Mortgage market.*

*The patriarch of this family of bonds is the 30-year MBS; it is effectively an Agency thirty-year non-call one twelfth, the most negatively convex bond created on a regular basis. Analytically, each time \$100mm of new MBS bonds are issued, the homeowners behind these bonds are effectively buying the Vega Equivalent of \$50mm 3yr-10yr straddles. Taken as a whole, the USD rate market, comprised of nearly 40% MBS bonds, has a core short convexity structure that creates substantial duration drift as rates vibrate. As such, Asset/Liability managers at Banks, Insurance companies, and Pensions must actively monitor their risk dynamics. To maintain a stable portfolio at the margin, managers must be net buyers of the market as prices rise and yields fall, and vice versa, as prices fall and rates increase. This is the primary source of the additional USD rate volatility over other currencies.*

*Today's RateLab proposes that there is a grand correlation between the net buying (or selling) of Volatility by US homeowners via the Fixed-rate MBS market and the level of Implied Volatility.*

*Moreover, this relationship will be maintained regardless of the buying or selling of Volatility by MBS Servicers, Agencies, Hedge Funds or other market participants. This is because the MBS issuance activity is the ultimate buyer or seller of options into the USD market and all other intra-market transactions just shift the risk between investors." [May 15, 2007]*

What caught our attention back then was the anomalous situation that Net Fixed-rate issuance from late 2002 to mid-2005 was actually negative. The ultra-steep Yield Curve combined with the introduction of a plethora of Adjustable Rate Mortgage (ARM) products created a wave of homeowner refinancings out of Fixed and into ARMs. Mathematically, homeowners were selling Volatility and selling the Yield Curve. How ?

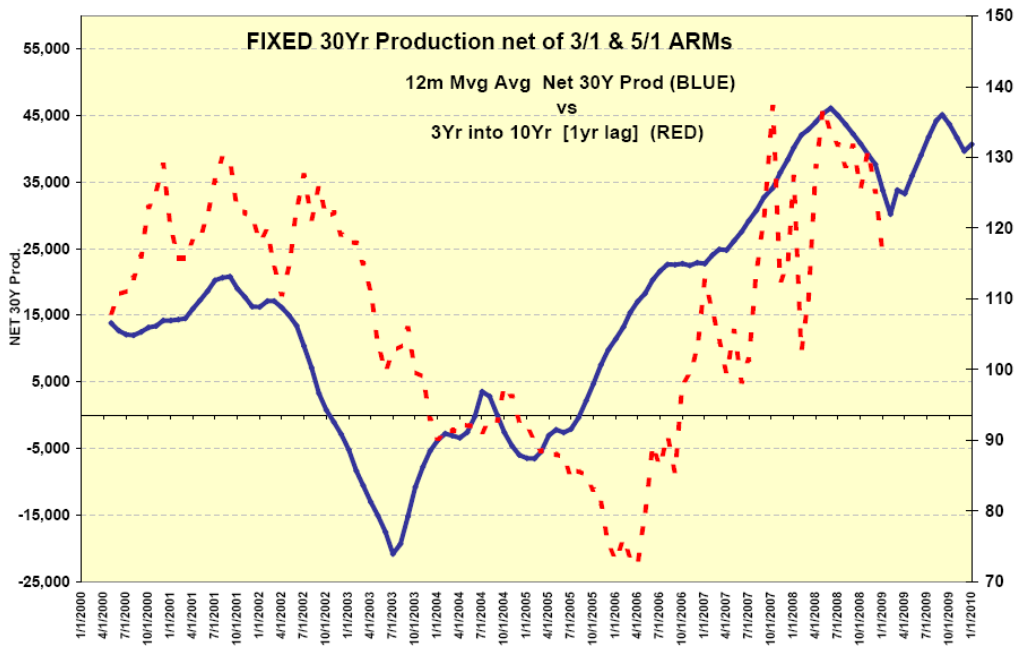
When homeowners prepaid their fixed-rate mortgages they were extinguishing the powerful embedded 30 year option they were long and converting it to a much less convex "periodic cap" embedded in an ARM. This had the grand impact of massively reducing the overall convexity of the MBS market.

The substitution of Fixed-rate MBS for ARMs had a similar impact on the Yield Curve. When homeowners prepaid their mortgages, they were "calling" long-dated cash flows from the market. So the market, writ large, had to buy long duration assets to replace what was lost. And when the homeowner converted their borrowings to ARMs, the risk sold into the market via securitization was all short-dated cashflows that had to be hedged by selling the front-end of the Yield Curve.

As this shifting of risk proceeded over the course of many months, the Yield Curve flattened and Implied Volatility declined.

What sparked our interest in early 2007 was the realization that the net issuance of Fixed-rate MBS had executed a giant U-turn. In fact, net Fixed-rate production was consistently above \$25 billion a month, a new record.

To follow our logic in the converse, this had to eventually lead to an increase in the level of Implied Volatility. Below, we reprint our original chart extended to the present. The **blue line** is the twelve month moving average of the net issuance of 30yr MBS minus the net production of 3/1 and 5/1 ARMs. The **red line** is the Implied Normal Volatility of a 3yr into 10yr swaption, lagged by one year.



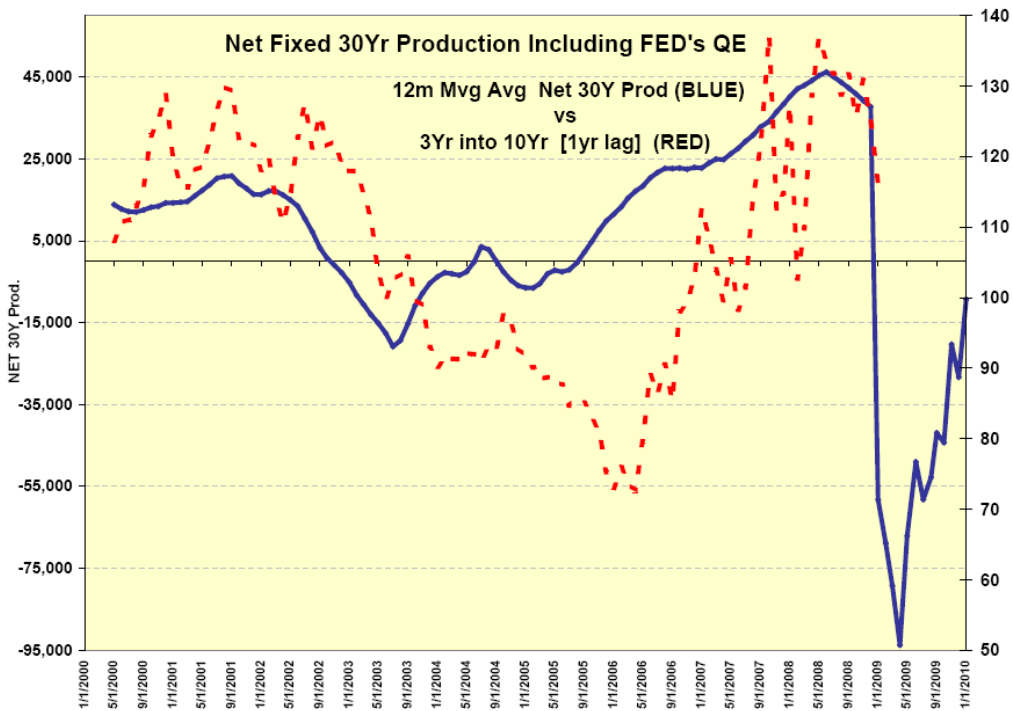
All charts, unless otherwise noted, are sourced from BAC/MER data

We will admit, as we did three years ago, that to some degree this graph is a clever contrivance. In structuring the Fixed production figure, we ignore 15 year MBS as well as longer-dated ARMs. Moreover, lagging the Implied Volatility by one year was driven more by “optics” than by analytics. Nonetheless, it cannot be disputed that there is a sound fundamental basis for this entire notion.

But this commentary was NOT intended to be a “pat on the back” victory lap for us (although that would not at all be surprising). Rather, these past few pages have been a prelude to another inspiration, specifically, that the FED’s \$1.25

Trillion MBS purchase program has precisely reversed this process once again. Since the FED is not going to "delta hedge" the MBS they own, they have effectively removed the "option risk" from the market as surely as Fixed to ARM issuance did seven years ago.

In the chart below, we have modified the ~~blue line~~ by assuming that the monthly FED purchases of the past fifteen months count as prepayments not recycled back into the market. It does not take much extrapolation to notice that the potential for mid-expiry Implied Volatility to decline more than it already has is entirely reasonable.



So if we are going to stick our necks out and state that "Belly Vol" could have more downside, can we make an educated guess to a target level? Well, yes we can.

Early on we noted that the core difference between the Euro Interest Rate market and the USD market is the existence of a callable MBS market. So for argument's sake, let's stipulate that this is the only difference and work from there.

When examining Volatility, the best single predictor of Implied Volatility is Realized Volatility. After all, Implied Volatility is the "rent" you pay to own the Realized Volatility. Below, the ~~turquoise line~~ is the 1y-10y Implied Nvol while

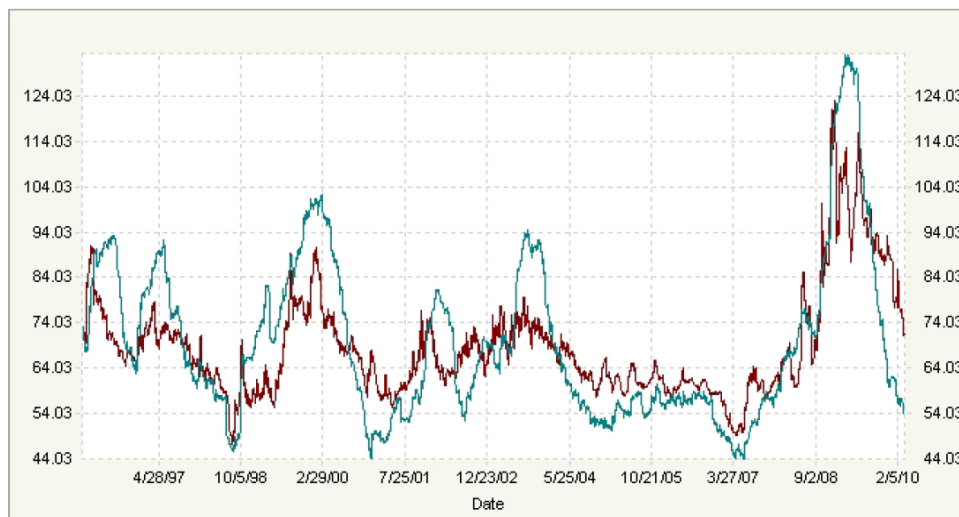
the **-pink line-** is the six month Realized Volatility. Although this graph is a tad lumpy, the 15 year average for the Implied Volatility is 108 Nvol while the Realized Volatility over the same time period has averaged 106 Nvol.

Turquoise - Implied USD 1y-10y Nvol  
Pink - Realized 6 month Volatility



A similar pattern has occurred in EUR Volatility. Here, the **-maroon line-** is the Implied while the **-teal line-** is the Actual. They have averaged 69 Nvol and 70 Nvol respectively.

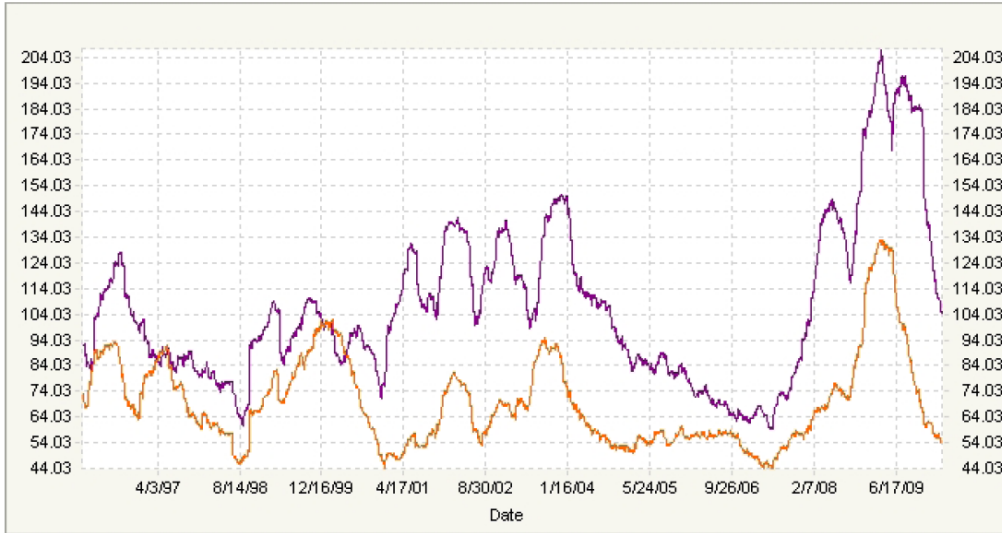
Maroon - EUR 1y-10yr Implied Nvol  
Teal - EUR 6 month Realized Vol



We propose that it is the Actual Volatility that drives the Implied Volatility. Moreover, we believe the core difference between the USD market and the EUR market is the MBS component. As such, it is the repetitive hedging activity in the

USD market, that does not occur in EUR, which causes Volatility in the USD to be consistently higher. Our next chart shows the **purple line** representing the Implied Volatility of the USD 1y-10y while the **orange line** is the same for EUR 1y-10y.

Purple - USD 1y-10y Implied Nvol  
 Orange - EUR 1y-10y Implied Nvol



Below, the **green line** takes the hard to read previous chart and presents it as

Green - Ratio of USD divided by EUR 1y-10y IMPLIED Nvol  
 Gold - Ratio of USD divided by EUR 1y-10y ACTUAL Nvol



a ratio. This somewhat active ratio of Implied USD to EUR has a long-term value of 1.58. To prove our previous point, we have overlaid the **gold line** which is

the same ratio for the Actual Volatility for USD over EUR. Its value is 1.55, almost the same as the Implied ratio.

Where are we going with this line of thinking ?

We can observe that both the Implied and Realized USD Volatility have averaged about 56% higher than EUR Volatility. If it is the case that this difference can be mostly attributed to the vagaries of MBS hedging, then any material change in the MBS market will be impactful upon this difference.

So let's place pencil to paper. During the 33 month period of late 2002 to mid-2005, the Fixed-rate universe, as we have defined it, declined by about \$200 billion or about \$6 billion a month. Concurrently, both the Implied and Realized ratio of USD to EUR volatility also began to slowly decline. While hard to specify the exact relationship, it does fit our hypothesis.

Presently, over the past 14 months, our defined Fixed-rate universe has declined by \$675 billion or nearly \$48 billion per month. This is a substantially larger reduction of MBS optionality than occurred previously. Moreover, this does NOT include the additional \$200 billion purchased by the US Treasury. Taken in total, the US Government has decreased our MBS universe by over \$800 billion or four times the reduction that occurred during the 2002 to 2005 period. Simple extrapolation indicates that we should expect a significant contraction of the USD to EUR Volatility ratio.

Let's do one more back of the envelope calculation to demonstrate how impactful the FED's QE program could be. As noted at the outset, each 100mm of MBS purchased by the FED (and not hedged) implicitly represents a Vega risk reduction to the market of \$50mm 3yr into 10yr straddles. So their purchase of \$1.25 Trillion MBS effectively sold into the market \$625 billion straddles. Although there is no "right" answer, we model the theta/(gamma) exposure that the FED has sold as roughly \$40 million a day. To "Replicate" that into three month CBOT exchange options would require a total notional sale of about \$350 billion options or 3,500,000 contracts. To provide some scale, our most recent quarterly expiry cycle had a near strike open interest of 900,000 contracts of which about 400,000 were attributable to accounts that we would classify as "MBS Replicators".

We can have "fun with numbers" for quite awhile, so let's cut the chaff: *The FED's actions have had the direct effect of tightening Credit spreads; but the longer-term impact will be a significant reduction in the Realized Volatility of the USD interest rate market relative to what it would have been otherwise.*



For many years, traders have tried to manage the spread between USD Volatility and EUR Volatility; and the sellers of USD have more often than not been on the losing end of the trade since the needs of the MBS hedgers overwhelmed all other risk transactions. However, the various arms of the US Government now own about 40% of the Fixed-rate MBS market and they will most likely NOT be hedging the embedded Convexity. All else equal, hedging activity will be 40% lower going forward, which should lead to dampened realized volatility. Furthermore, the only way to reverse this process will either be for the FED to sell their holding back into the market or for a ReFinance wave to recycle MBS out of the Government's portfolio and back into the public domain.

#### Key implications:

- 1) The relative spread between USD and EUR Implied Volatility could shrink from 155% to 133% (A 40% decline in the net spread).
- 2) The long-term average for 1yr-10yr could decline from 108Nvol to 93Nvol.
- 3) The long-term Nominal spread of MBS to Sw10s [CMM vs. CMS] could contract from 72bps to 61bps. (This represents a 14% decline in Vega.)
- 4) The Yield Curve should flatten, although it is unclear if it will be a Bull or Bear event.

While we cannot flatly state that Implied Volatilities will continue their recent one-way descent, it does seem clear that the average level and range should be lower over the next five years than over the past fifteen.

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