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A Commentary by Harley Bassman:

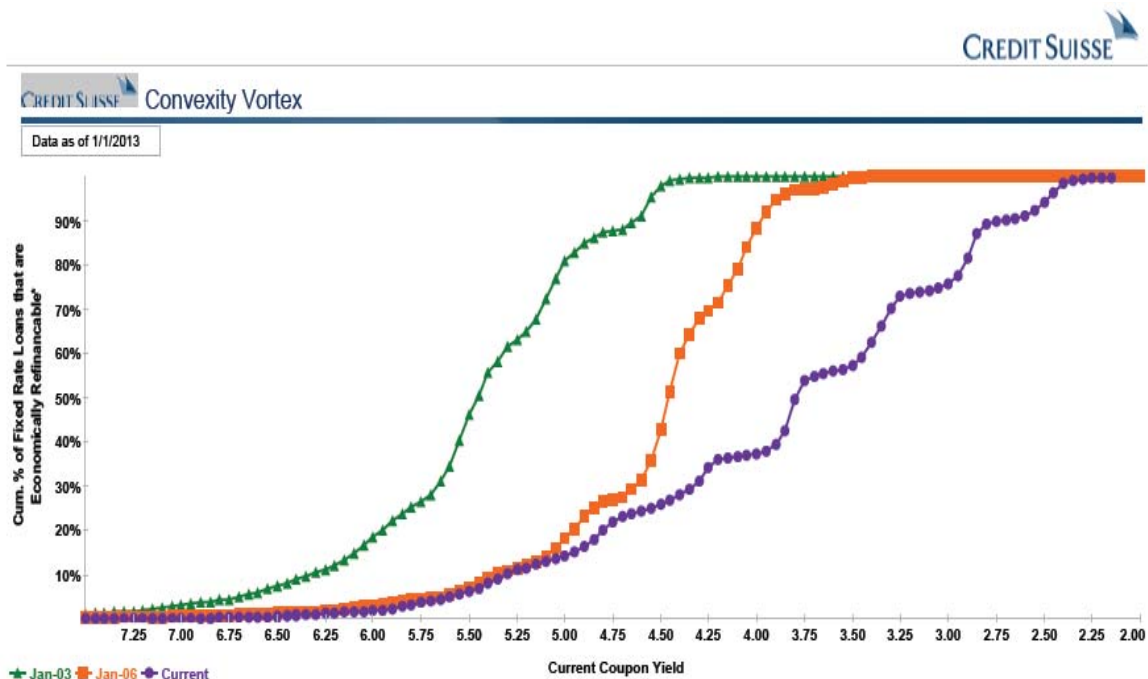
The Convexity Maven

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Value Concepts from the Credit Suisse Trading Desk
March 6, 2013

"The Convexity Vortex"

As Interest Rates have finally broken above the FED's QE ~ (infinity) induced range of 1.40% to 1.80%, a dull murmur can be heard above the din about the possibility of an MBS induced Convexity selling panic. As such, this seems like a fine time to re-introduce the concept of the *Convexity Vortex*.



The Theoretical Background of the Convexity Vortex

The supportive backbone of option pricing models and contingent claims portfolio management rests upon the assumption that the Central Limit Theorem holds for Financial Product valuations. The CLT states that the mean of a sufficiently large number of independent random variables, each with a finite mean and variance, will be approximately normally distributed.

Since the above definition is clearly gibberish, let's propose a more practical explanation. Imagine a hat full of marbles of various colors. At its core, the CLT declares that all the marbles have been stirred up nicely and are distributed evenly throughout the hat. As such, when you reach into the hat, the chances of pulling out a marble of a certain color are consistently random and proportional to how many marbles are in the hat. Particular to options trading, certain properties of Brownian Motion (a subset of the CLT) support the assumption that there is pure and constant liquidity at every price along the distribution; as such, the ability to delta hedge at any price level is always available.

The cold reality is that both assumptions are somewhat faulty, thus the expression that "one can be too smart to trade" explains why so many rocket scientists (turned traders) have trouble producing revenues. For while the econometric scholars peacefully manage their models in air conditioned offices, those of us sweating it out in the trenches know that markets frequently behave in a non-normal and discontinuous manner.

To stay on topic, let's ignore the "gap risk" of a bad Payroll number and focus instead upon the fact that certain risks are not distributed uniformly as assumed by the CLT. Specific to the MBS market, the coupon rate of the underlying loans packaged to create mortgage bonds often tends to clump around a certain rate level. Since a thirty year fixed-rate mortgage loan is effectively an amortizing bond plus a powerful call option, the location of the strike of this option matters greatly. MBS managers care because the propensity for these loans to prepay early makes the ultimate return on the MBS bonds quite variable. Other market participants care because changes in prepayments alter the duration profile of the massive MBS market.

As any options dealer will tell you, the key to managing risk is to have a diversified portfolio of positions. In this way, the Gamma, Theta, and Vega (the greeks) of the book will stay relatively constant over time and over rate profiles. However, if the book develops a concentration near a single strike or expiry date, the book can quickly become unbalanced and significant (and often costly) hedging is required to maintain stability.

So what might happen if most of the embedded options in the MBS universe were concentrated near a single “strike”? The answer is simple: Instability and discontinuity as the market nears this location – We have dubbed this the *Convexity Vortex*.

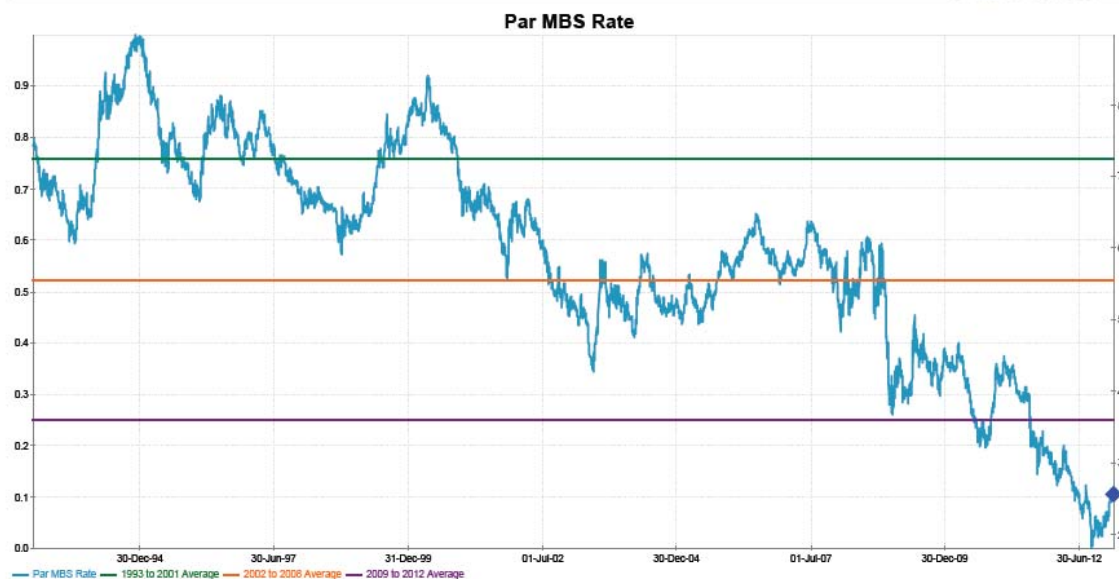
Just as an option book runner finds it difficult to manage a portfolio with concentrated strike risk, so the overall USD Rates market would become slightly unhinged if all the optionality of the MBS market were to become focused upon a few specific locations. Switching metaphors: Where a CLT proponent might expect a smoothly mixed milkshake of option strikes, a market with concentrated strikes would resemble a tub of Chunky Monkey (with a few unshelled walnuts tossed in to crack a tooth). The critical purpose of the *Convexity Vortex* is to identify, ex ante, these locations of discontinuity where the embedded MBS options are concentrated. We propose that at these locations, where all market participants are short optionality, the Rates market will see increased Realized Volatility, which will inexorably lead to higher Implied Volatility. Furthermore, we suggest that since option models assume a CLT world, traders may not properly value various derivatives by ignoring their proximity to the *Convexity Vortex*.

The Creation of the Convexity Vortex

While theoretically possible to create premium and discount mortgage bonds via the issuance of off-market loans, nearly all new MBS bonds are issued near par by the pooling of loans with coupons about 50bps above the MBS rate. And since the borrower is long the prepayment option, the average coupon on MBS bonds tends to stair step down quickly via refinancing as rates decline but rises rather slowly as homeowners with below market rates tend to treasure them.

In the next chart, the [-turquoise line-](#) is the Par MBS Rate for the past two decades. Notice how the MBS Rate has experienced three broad ranges. From [1993 to 2001](#) the average MBS rate was about [7.25%](#). After the “Dot Com” bubble popped and the FED lowered rates to support the economy, the MBS Rate meandered in a rather tight band from [2002 to 2008](#) with an average Rate of [5.55%](#). Finally, after the housing bubble burst, the FED lowered Rates even further to help de-lever the nation’s financial balance sheet. As a consequence, since [2009](#) the MBS Rate has averaged [3.60%](#).

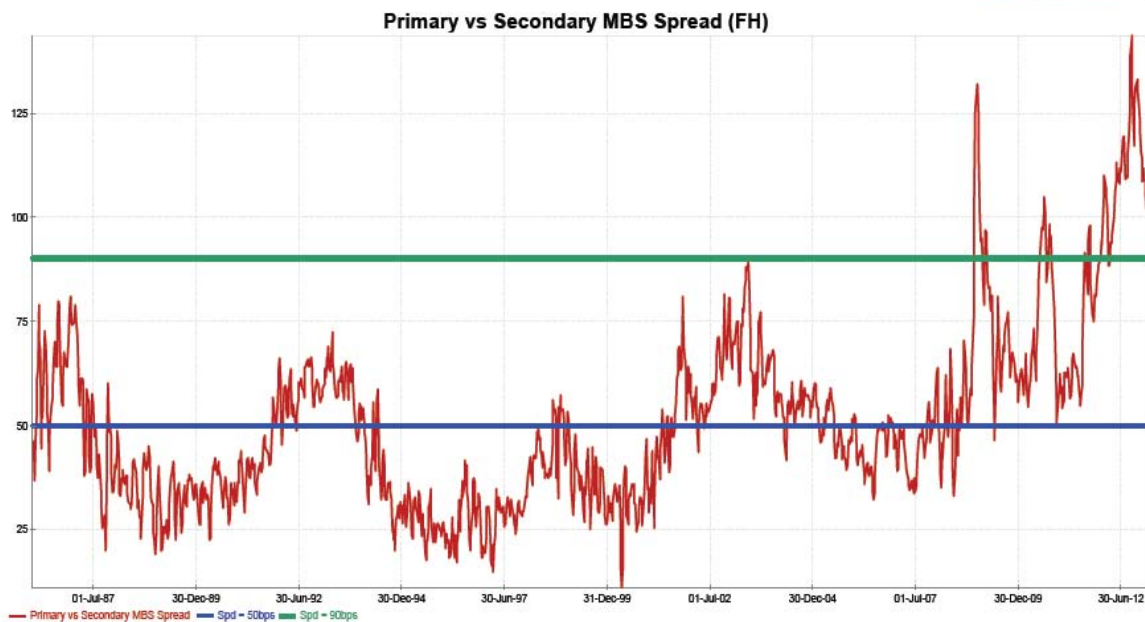
Each new range lasted long enough to allow most homeowners to re-finance to a lower rate loan. As the older higher coupon MBS prepaid early and were subsequently re-issued as Par bonds, the distribution profile of the embedded options changed, we call this “Re-Couponsing the Stack”.



As a preamble to the construction of the *Convexity Vortex*, let us make clear that the Vortex does not measure Prepayment risk; nor does it anticipate how the net Duration of the MBS market will change. Its sole purpose is to locate points of Convexity concentration where trading may become discontinuous. Since an option is most Convex when it is "at-the-money", concentrated strike location plays an important part in the risk management process for all managers who have exposure to interest rate risk.

On the cover is our most recent chart of Economic Refinancability. Each line is a snapshot in time of the cumulative total percentage of Conventional 30year Fixed-Rate Pass-through securities that have a Gross Weighted Average Coupon (GWAC) of 140bps higher than the Constant Current Coupon secondary market yield. [MTGEFNCL Index GPO <go>] on Bloomberg]. While the 140bp is somewhat arbitrary, it is probably close to reality. We assume a 90bp origination/servicing cost between the primary and secondary MBS rates. We also expect a 50bp Refinance incentive is required to cover the homeowner's costs of time and money. The sum of these is the 140bps spread. When a loan exceeds this spread, we say it is "Economically Refinancable". That means it could refinance, but it may not; we leave that analysis to our prepayment experts.

This hurdle is 40bps wider than the spread we might have used in the past when a 50bp Primary vs. Secondary ~~–persimmon line–~~ spread existed. This wider spread is almost certainly permanent as it reflects: 1) Larger GSE guarantee fees, 2) More costly credit scrutiny by lenders, 3) A much less competitive origination market because of a greatly reduced "correspondent" network, and 4) A generally more adversarial relationship between lenders and borrowers.



Interpreting the Convexity Vortex

Referring to our cover chart, the **purple line** shows the most recent snapshot of the MBS profile. Also on this chart are other past profiles to show how the Vortex has migrated and rotated over time. The easiest way to understand how a Vortex is created is to compare the **green line** which profiles the market in January 2003 versus the **orange line** which shows January 2006. Notice how the profile not only shifted to the right to reflect the lower rate environment, but also a “kink” developed near the 4.75% Current Coupon rate level. This “kink” is where there is a concentration of MBS bonds. It is here where only a few basis points change in rate significantly alters the cumulative total of Economically Refinancable bonds.

Since actual prepayments take three months to process through the system, the market must focus upon its expectation of the future. As such, it is critical to know the conditions that will alter anticipated prepayments. Since MBS rate level is the key driver of refinances, locating the fulcrum of that risk vector is critical. To make this analysis more useful to the non-mortgage community, we sometimes add an interpolated Treasury 10yr Rate level to the upper axis of the chart. Presently we have removed this vector since the stability of the MBS basis has been severely compromised by QE~ (infinity). We expect to return to our old format sometime later this year.

Why it Works

Many times, there are both longs and shorts who somewhat cushion the volatility of various markets. However, the MBS market is strictly a one-way street. The homeowner is long the (pre-payment) option and everyone else is short. The MBS holder is effectively long a callable bond that shortens in a rally and lengthens in a back up. The Servicer is long an asset whose cash-flow can quickly vanish when rates decline. Because of the time it takes to document a new loan application, the MBS originator frequently offers a "rate lock" (option) to the borrower to facilitate the funding process. The financial community is short all off these contingent claims and must manage this risk if they are to maximize their returns. Since an option is most Convex at strike, a concentration of strikes will create instability as the entire market rushes to hedge at the same time.

This is the classic shout of "Fire" at Wimpy's hamburger convention; someone is going to be squished when all of these well fed beef connoisseurs try to squeeze through that one slim door at the same time.

Critical Observations

We take great pride in having coined the notion of the *Convexity Vortex* nearly a decade ago. Moreover, this concept has been uncanny in anticipating market volatility. Unfortunately, we must confess that its influence has been muted by a number of significant changes in the financial markets.

- 1) For many years, the GSEs managed the presciently named Retained Investment Portfolios (RIPs) where the embedded Convexity risk was only partially hedged. As such, they became large buyers or sellers of duration as pre-payment risk vibrated. Their hedging activities often exaggerated and extended rate movements. However, since the GSEs were placed into conservatorship, not only has the size of their portfolios diminished, but also their coupon profile is less rate sensitive.
- 2) The FEDs various LSAP programs have absorbed a large portion of the outstanding MBS. Since the FED does not hedge its holdings, the effect has been to significantly reduce market volatility. (Yes, this was intended.)
- 3) For both economic and regulatory reasons, it is now much harder for even a "quality" borrower to refinance. As such, interest rate sensitivity for MBS has been reduced while credit sensitivity has increased. This makes the embedded option much less convex to interest rates.

Interpreting the Convexity Vortex

Notwithstanding the above provisos, analyzing an updated *Convexity Vortex* is still valuable to the risk management process.

What is most apparent is that the **-purple line-** on our cover page, representing the February 2013 profile, is not nearly as steep as the **-orange line-** of January 2006 or the **-green line-** of January 2003. This means that the underlying Gross WACs of today's MBS bonds are more evenly distributed than in 2003 or 2006. This reduction in "concentration" will result in multiple locations of convexity, each with less power than if there were only a single convexity point.

How much less? The 25bp spread between 4.60% and 4.35% on the **-orange line-** expands the refinance potential from 31% to 64% of the MBS universe. In contrast, a similar spread on the **-purple line-** between 2.80% and 3.05% has almost 60% less power as refinance potential shrinks from 89% to 75%.

Examining the chart, the first point of convexity occurs around 2.80% for the Mortgage Rate. This is presently about 30bps above current market levels or close to 2.25% on the Treasury ten-year rate. As such, it is no wonder that many market seers have warned of an MBS related shock if rates rise a bit more. However, this is mostly an exhibition in showmanship since many of the factors that drove previous MBS shocks have been reduced. That said, there will be a "bump" at that rate level, if only because the madness of crowds makes it so.

Trade Recommendations

In past times, the trade was quite simple – own options struck near the *Vortex* and sell options that are further away, either higher or lower in rate. Period.

This time is different. Since the GWAC of the MBS stack is so diverse, there is no single strike to purchase. Instead, we would note that Volatility in general is too low and we would suggest you find ways to buy "Volatility as an Asset Class", the most superior being the CS Constant Maturity Volatility Swap.

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