

## Look Back In Anger

*Editor's note: Cash market derivatives, including so-called exotic options, already dominate risk management in a number of markets. These traders use exchange-traded instruments to manage residual risks in their portfolio. Given the size of their trades and the correlation of many large fund positions, these activities can produce outsized effects in exchange-traded markets. This article is the first in a series explaining various types of cash-market derivatives.*

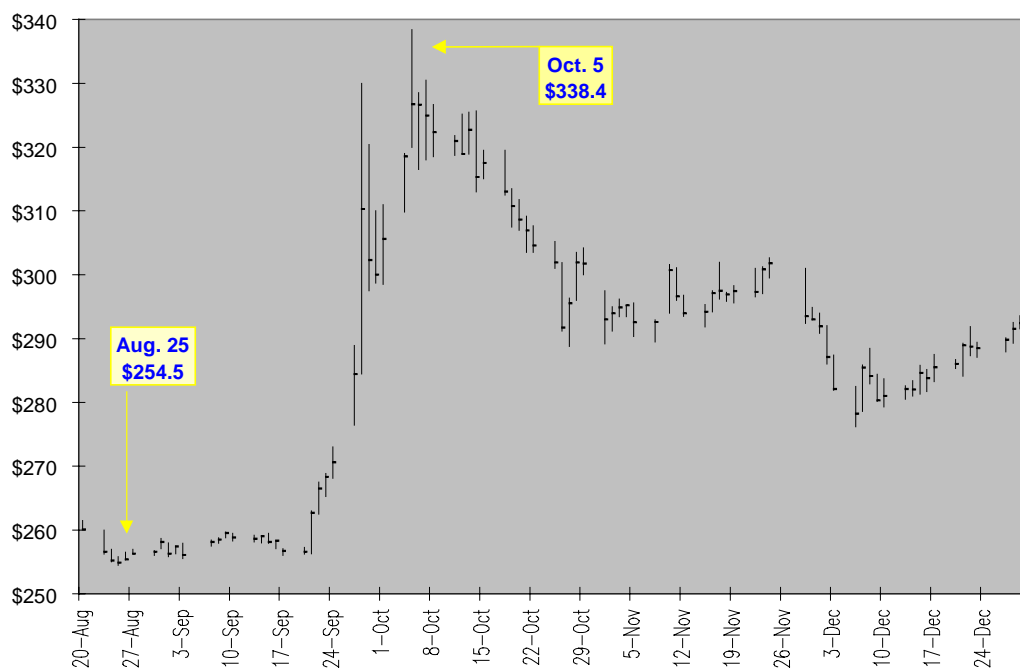
With the possible exception of that dancing paper clip on Microsoft help screens, is there anything more infuriating than those mutual fund advertisements beginning "If you had invested \$10,000 in...?" Despite the facts you didn't have a spare \$10,000 at the exact market low always chosen, and wouldn't have stuck it in that then-obscure fund anyway, these ad headlines succeed in grabbing your attention. Bernard Baruch, financier and adviser to presidents during the first half of the recently-departed 20<sup>th</sup> century, stated he was always content to let the other fellow have the first 1/8<sup>th</sup> and the last 1/8<sup>th</sup>, but in general, it is quite simply human nature to want to buy the low and sell the high.

Entire industries and professions prosper by appealing to our bad habits, and financial engineers, hard though it may be to believe, are guilty of this tendency on occasion. Thus we have the lookback option. A lookback call option is the right, but not the obligation, to purchase the lowest price over a fixed window of time, while a lookback put option is the right, but not the obligation, to sell the highest price over a fixed window of time. These maximum and minimum prices are actually the option's strikes. The payoff on a lookback is the difference between the underlying asset's price at maturity and the strike;  $\max(F-S,0)$  for the call, and  $\max(S-F,0)$  for the put. Unlike other options, which are both executed and priced before the period of uncertainty, lookback options are executed before the risk period, but priced only after all of the information is known and after the risk has passed.

The term "exotic" is something of a misnomer, especially when used in comparison to exchange-traded, or "vanilla" options. Few commercial applications are hedged exactly by vanilla options, while few speculators are served best by exotics. Exotics tend to match commercial practices and needs well, and when we study them we should be wearing our commercial/hedger hat.

What are some of the commercial applications for lookbacks? A producer in a competitive market with abundant supplies and numerous sellers – grains, for example – may write a lookback call option to a buyer to take advantage of another facet of human nature, the unwillingness to recognize sunk costs. Once a buyer has contracted for the lookback call option, its business should be assured to the seller – unless the buyer managed to time a purchase at a price less than  $[P_{\min} + \text{call premium}]$ . The producer increases his probability of selling his output and receives the option premium – but incurs the risk of selling at what may turn out to be a short-lived market low, such as a spike bottom.

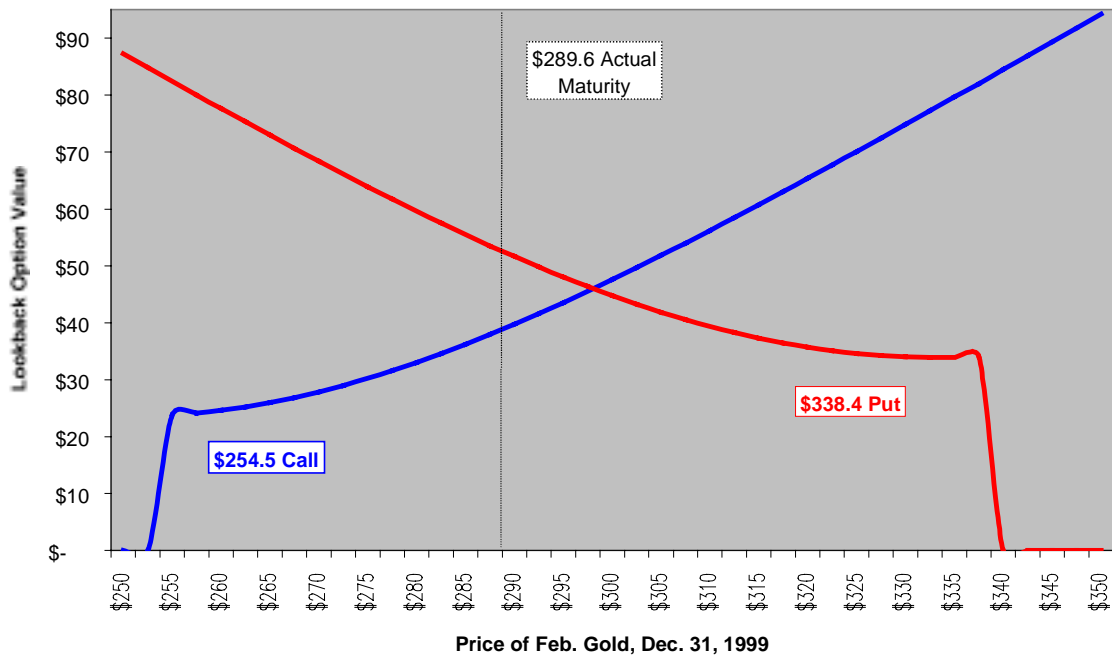
### February 2000 Gold



#### A Golden Glance

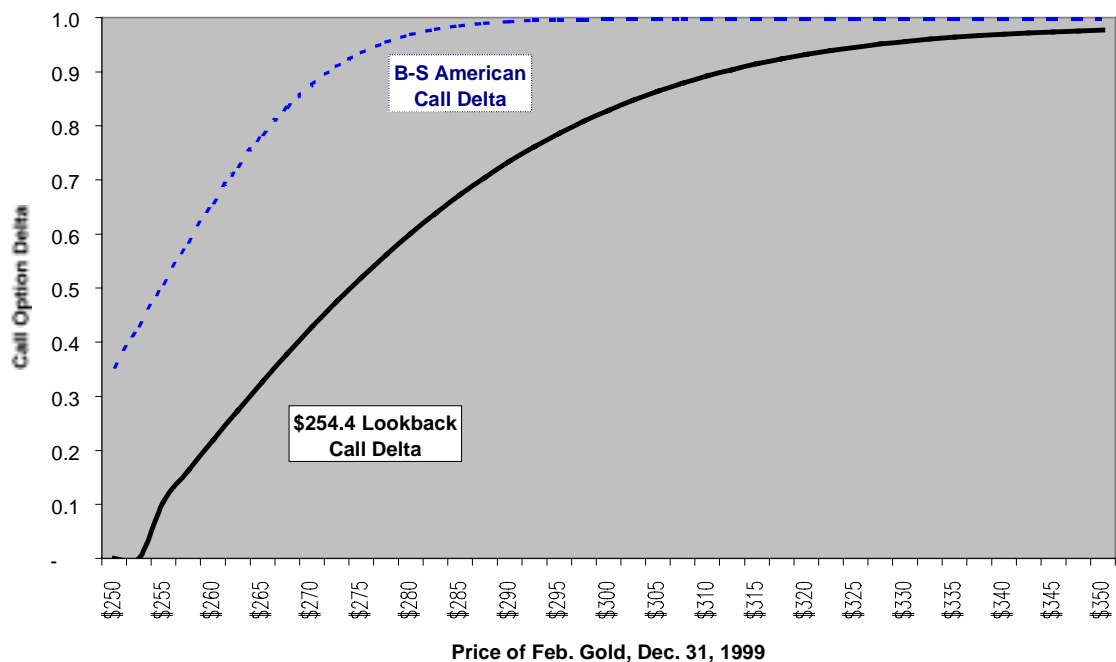
Let's look back at the last 90 days of trading in 1999 for February 2000 gold, a period which unlike most of the 1990s for gold, actually had a measurable trading range. The low was \$254.5, the high was \$338.4, and historic 90-day volatility was on the order of 24.75%. Once the maturity date of the lookback option approaches, both the price and the payoff of the lookback option will depend on the price at maturity, as depicted below.

### Sensitivity Of Lookback Option To Final Price



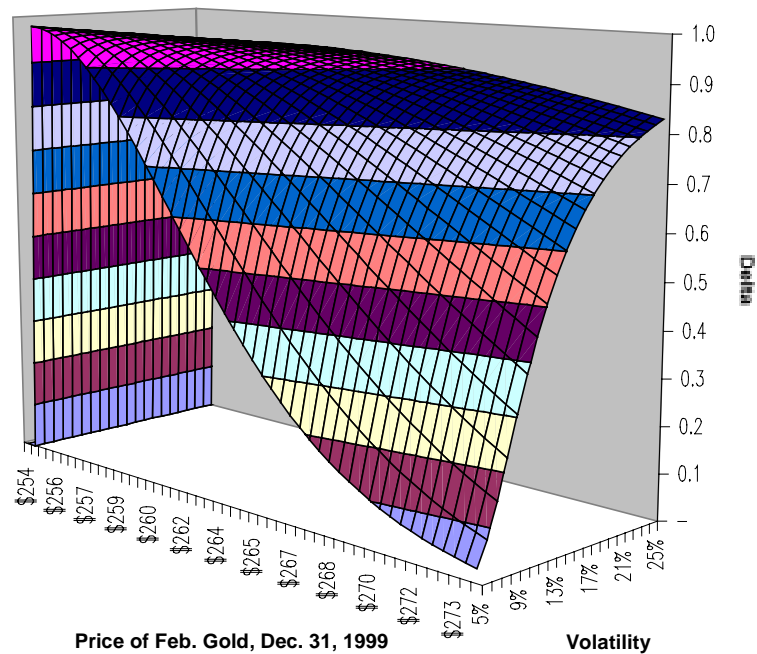
Should the market be near the high or low of the range as maturity approaches, some interesting things happen. If the maturity price is the high price of the range, the put option will have no value, and the call option will have no value at the low end of the range. This creates an unusual situation for the option's delta, or its expected price change with respect to the underlying asset, as we can illustrate with the lookback call option. The delta of a February \$255 American call option, the one that would hedge the lookback \$254.5 call best, is included for purposes of comparison.

### Comparative Call Option Deltas: Lookback and Black-Scholes



Once we start talking about the probability of the maturity price settling at the high or low end of the range, we are of necessity entering the realm of volatility and its effects on the behavior of option derivative statistics, delta in particular. As we approach maturity, higher volatility increases the probability of the maturity price settling at the low of the range, which keeps the option's price moving at a rate approaching the underlying asset's – a delta near one. The opposite is true for low volatility; if the current price is well over the range's low, it is likely to stay well over the range's low. At all levels of volatility, however, lookback call delta is very unstable near the range's low.

Delta of A Lookback Call Option As Function Of Price & Volatility



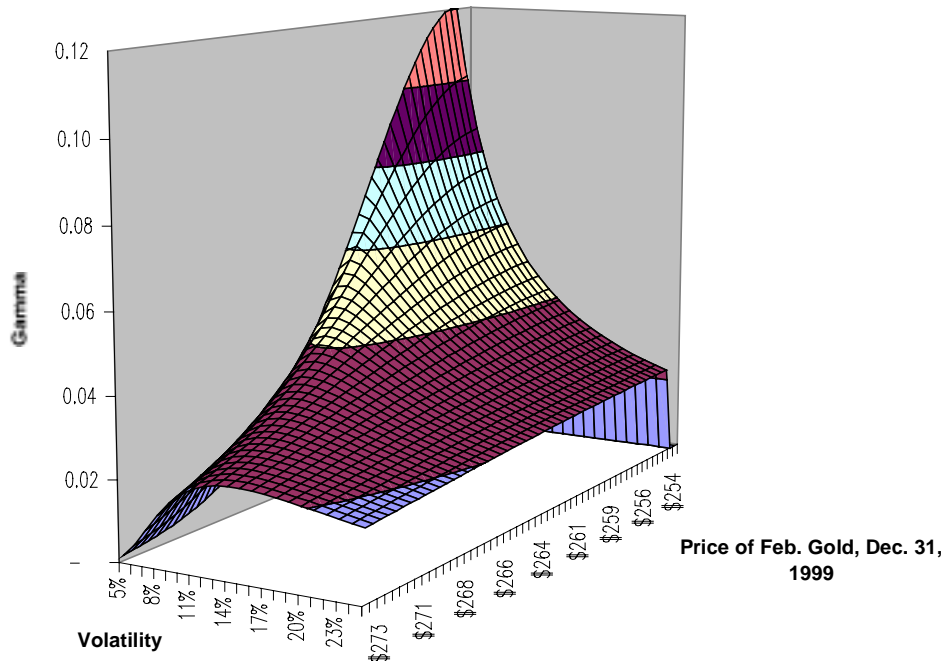
### Hedging And Trading Implications

Most traders get acquainted early with a concept dubbed "pin risk," the tendency of markets to move toward strikes on option expiration days. This is somewhat unfortunate, as it encourages the notion of futures markets being dangerous games with no real risk management purpose. The mechanics behind pinning are simple, however; owners of call options are unlikely to sell futures as their long strike is approached, and owners of put options at that strike will sell them for residual value, which is another form of buying. So, unless a market appears ready to remain motionless on an expiration day, always an unlikely scenario, any directional movement will set the pinning process in motion.

This process is visible; the presence of large lookback option positions in the cash market, however, is invisible to most. No matter, we can infer their presence. If the buyer of the lookback call option on gold in our example above senses a move toward a new range low as maturity approaches, he is in position to get a double win: The option will be priced at zero, and he will be buying at the low price. Not bad for a day's work. His buying power will be absent from the market, and this will increase the likelihood of a self-fulfilling prophecy if his position is large enough. The opposite is true if the price is well over the \$254.5 range low: The buyer can be a little more aggressive since he will be receiving the economic equivalent of the range low over the contract volume. If the price approaches the range high, the lookback put buyer will delay his selling and hope for both a zero-price lookback put and the opportunity to sell at the range high.

The unstable delta pattern for lookback options near the strike produces an interesting gamma pattern. Since high volatility makes the price of the option more active, its delta remains high across a wide price range. The opposite is true for low volatility, and delta – and hence gamma, the rate of change of delta – both move rapidly.

**Gamma Of Lookback Call Option As A Function Of Price And Volatility**



Since most option makers want to make their spread and go home neutral at the end of the day, how can lookback options be hedged? The answer is surprisingly simple and straightforward: We can create a synthetic lookback call by buying a future and a lookback put at the same strike. Buying this and writing a natural lookback can give us a hedged position.

It might be easy to dismiss this discussion and those to come as of interest only to large, sophisticated traders. One thing we have seen from the world of electronic day trading in stocks, however, is technology is the great equalizer. Now that we are in the 21<sup>st</sup> century and can do futuristic things, don't be surprised if one day your quote screen or trading Web site is quoting lookback options – and you're trading them.