

# D THE JOURNAL OF DERIVATIVES

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## Vol Is Back! (But Where Did the January Effect Go?)

Over the last several years, I have commented repeatedly on these pages about the puzzling phenomenon that despite extreme uncertainty about the future state of the world economy, not to mention the U.S. political scene, volatility in the stock market remained at rock bottom over long periods. That now seems to have changed. In the six months from August 2014 through January 2015, the VIX volatility index averaged about 15.7%, up from 13.4% in the previous six months. Currently, in early February 2015, the VIX stands at 17.0% and has spiked over 22% a couple of times in the last three months. At least three major factors are roiling markets and economies all over the world and generating high volatility, and there's one more factor that seems like it should produce volatility but doesn't appear to be doing so.

The first three sources of current economic uncertainty are the collapse in oil prices, the slowing of major economies almost everywhere except in the United States, and the political events in Europe precipitated by the crisis in the Ukraine and elections in Greece.

The unprecedented drop in the price of oil, from more than \$107 a barrel for WTI crude in June 2014 to under \$45 a barrel in early January 2015, is rippling through the world economy: oil company stocks are under severe pressure, firms are cutting back sharply on spending plans and laying off workers, and serious economic strain is being felt in the economically weaker oil-exporting countries, such as Russia and Venezuela. There is enormous uncertainty about where and when prices and production levels will settle down and what the ultimate impact will be. Waves of new information enter the market daily, translating into extreme price volatility.

Major economies around the world are slowing, most notably China's. (It is extraordinary that a drop in the real growth rate to "only" 7.3% is treated with the same degree of alarm as negative growth rates and actual price deflation cropping up in parts of the Eurozone.) The exceptionally painful austerity policies that have been pursued across Europe for years, voluntarily or involuntarily, have not worked so far. Real GDP in Greece is more than 20%

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lower, and indebtedness is substantially higher, now than when austerity began, despite years of severe belt-tightening and unemployment rates as bad or worse than in the 1930s.

The real puzzle, to my mind, is that it has taken so long for the people to take to the streets in protest and to the polls to replace their governments with ones that promise to fight austerity. That may be beginning, starting with the Greek elections in January that brought Syriza (Coalition of the Radical Left) to power. Again, enormous uncertainty is leading to high volatility.

The seemingly important factor that is producing great uncertainty but not much volatility is the rout of the Democrats in the November 2014 U.S. elections and the takeover of both houses of Congress by the Republicans. The last few years have featured repeated episodes of gridlock and self-imposed crisis in Washington over what used to be uncontroversial technical matters, such as raising the debt ceiling or passing a budget. The result has been long periods in which uncertainty about the future was high, but little new information was flowing into the market and the volatility of day-to-day price changes remained very low. The Democrats and Republicans have switched places in the Senate, but so far this just means the Democrats are now blocking the Republicans' proposals rather than the reverse. The resulting paralysis is just the same.

So, while we wait for the oil market to settle down, the Chinese and the Europeans to figure out how to get their economies back on track, and Godot to arrive to fix everything in Washington, let's take a look at this issue of *The Journal of Derivatives*.

The first article, by Bernhart and Mai, proposes a sensible and tractable way to deal with a very common practical problem in option pricing: dividends. Most stocks pay dividends, and not in the form of an easily-handled continuous rate proportional to the stock price but in discrete lumps that can vary in size. Assuming a simple structure for the future dividend stream may make it hard to incorporate known but uneven nearby dividends and can lead to inconsistencies if extended into the infinite future. The trick is to separate nearby dividends that can be handled directly from the totality of dividend flow over the indefinite future after that. The latter is modeled with flexible dynamics, like an asset price.

The next article, by Tian, Zhu, Lee, Klebaner, and Hamza, also deals with a common and hard to handle problem in option pricing. Long ago, it became clear that the constant volatility assumption in the Black-Scholes model was not consistent with how options were priced in the market. An attempt at a solution is to allow volatility to change over time, either nonrandomly or stochastically, but neither approach works completely. The authors construct a hybrid "local-stochastic volatility" model that has attractive features of both.

The next two articles are concerned with the risk-neutral probability distributions embedded in current option prices. Tian is interested in the implied

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binomial tree model, which sets up a binomial lattice constrained to reproduce the same expiration date risk-neutral probability density as is observed in the market. This is a substantial calibration problem that grows rapidly as the number of time steps in the tree increases. Tian shows how it can be accelerated with very little loss in accuracy by grouping the terminal nodes and calibrating only a subset of them to market prices.

The following article, by Ludwig, focuses only on the extraction of a proper probability density from the options market. A variety of methods are in use, but there are certain problems that affect them all. Ludwig introduces a neural network technique that produces a risk-neutral density that fits the data at multiple maturities over the full range of strikes while imposing appropriate constraints for a probability density.

The last two articles present valuation models for two interesting kinds of derivatives. Guillaume tackles the problem of valuing autocallable structured products. As he describes, these are popular products but may include a large number of contingencies of different types, including path dependence, contingent coupons, partial protection of principal, and more. Amazingly, he develops a general valuation model that covers them all.

Finally, Afik describes and prices optional contracts that Israeli car dealers offer to a new car buyer that effectively guarantee a minimum future trade-in value. A swap-type contract, for example, allows the customer to trade in the current car for a new one by paying a fixed exercise price. Exercise timing is up to the customer.

Returning to the problem of pervasive uncertainty in the world, February 2 was Groundhog Day. For those unfamiliar with weird American customs, by legend on this day the groundhog is supposed to emerge from hibernation, coming out of his hole underground, and check the weather. If he sees his shadow, it means winter will go on for another 6 weeks. If he doesn't see his shadow, spring starts immediately. (Check this out on the web, for an amusing few minutes of zaniness.) Unfortunately, in my neighborhood, and the rest of the northeastern United States, we have had so much snow and freezing weather this year that there is a layer of ice on the ground so thick a groundhog couldn't get through it with a jackhammer! I suspect this is a prediction that winter will continue until next February, when the groundhog will have another chance. But it's not certain.

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