Event-Driven Finance

IEOR – Fall 2017

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Recall from the first lecture that individual events may be accompanied by extended temporal changes in the volatility landscape.

We saw that a large single trade may cause the volatility surface to drop or rise subsequent to the trade. Which way for a sale? Which way for a purchase?

In the cases where pinning might occur, the volatility surface changes and the temporal effects last from the “onset” of significant open interest in a nearby strike until the stock has moved far away OR expiration.

This leads us to think more deeply about temporal regions of disturbance.

Let’s look at a schematic picture:
Here we have abstracted the entire volatility surface into a single vertical direction.

We consider a generic cartoon situation where volatility is unaffected before time \( t = t_0 \), rises until time, \( t = t_1 \), and then falls until time, \( t = t_2 \).

I have not specified the current time, nor have I indicated which if any time I wish to associate with an “event”.

Instead, let us associate the entire temporal expanse from \( t_0 \) to \( t_2 \) with the “event”.

We think of an onset \( (t_0) \), an extremal point \( (t_1) \) and a dissipation region ending with \( (t_2) \) and a return to unremarkable structure.

The region from \( t_0 \rightarrow t_2 \) is often a region of significance from a trading standpoint.
• Although I have drawn a region with increased volatility, that was simply a random choice. The volatility might decline or fluctuate in the temporal region of interest.

• Also note that the final volatility was pictured as lower after t2; although this was a random choice, it is not necessary for the final volatility surface to be identical with the original one.

• What is important is this:
  – We can envision three models of the stock process, $S_{<}(t<t_0; \alpha_1, \ldots, \alpha_j)$, $S_{>}(t>t_2; \alpha_1, \ldots, \alpha_j)$, and $S_{\text{event}}(t, \tau; \alpha_1, \ldots, \alpha_{j'})$.
  – The early and late stochastic models depend on a single time variable and some number, j, of ancillary variables, $\alpha$ (such as $r$, $\sigma$, etc) with weak time dependency. For the most naïve models, say BS, there may be a simple functional time-dependence, and $\sigma_{<}$ and $\sigma_{>}$ may be constants with no time-dependency at all.
  – In the regime of the event, there will in general be a completely different functional form for S. The $S_{\text{event}}$ will have an additional time dependence on the signed distance from the extremal point, $\tau$, or clock time from t0 if there is no extremum, or multiple extrema.
• Recall that in the case of pinning we saw 2 times of significance; the onset of the large open interest, and expiration.
• The time to expiration, $\tau$, appeared in the FPE.
• One could derive an implied volatility, $\sigma$, in the region, and this was for any given time in the region lower than the corresponding value of $\sigma$ before the big trade.
• (The volatility was gotten by inverting the straddle price in BS.)
• The following cartoon is a more complex situation (possibly appropriate to take-overs).
• Although this does not follow from the general formulation, we can hope that the volatility in the event-driven regime satisfies an approximate form:

\[ \sigma = \sigma_0 + \bar{\sigma}(\tau) \]

• (This will turn out to be the case with earnings and hard-to-borrows)
• Then even if we cannot derive a good expression for \( S \), we can approximate \( C(\sigma, t, \alpha_i) \) by \( \text{BS}(\sigma_0 + \bar{\sigma}(\tau), t, \alpha_i) \), where BS is the BS value of the call option.
Deutsche Bank's Wild September
Shares fell to record lows before bouncing back

Deutsche Bank AG

Bloomberg
• Summary:
  – Find a regime of strong time-dependency
  – Try to model
  – If not possible, assume $\sigma = \sigma_0 + \tilde{\sigma}(\tau)$, and the call values are BS in $\sigma$.
  – Trading may be more lucrative/risky in the variable zone
Consider the following scenarios:
Stock XYZ; price, $S_0 = 50.00; 3$ weeks to go to expiration.

Earnings date: 4 weeks away.
For concreteness, we take the front month options to be the Junes.

Which option generally has the higher implied vol, the Jun 50 C or Jul 50 C?

Suppose that XYZ announces a change in the earnings announcement, moving the date ahead 1 week. What will happen to the implied vols?

Suppose XYZ preannounces earnings today;
– what will happen to the vols?
– Will it matter whether the announcement is better than expected, or worse?

Usually, only bad earnings gets preannounced.


Lecture 5f  

Dynamics

• Some basics:
  – How many times a year are earnings announced?
  – What would happen if a stock fails to announce earnings?

• Imagine that earnings are coming out in 2 days (Jun expiry), and XYZ drops $3 to $47.00.
  – What will happen to the Jun 50 vol?

• Suppose earnings are announced and XYZ drops $3 to $47.00.
  – What will happen to the Jun 50 vol?

• What is the difference between these two scenarios?
There are two kinds of new information that get disseminated in the marketplace. They are *scheduled* events and *unscheduled* ones.

It is often pretty easy to distinguish between the two. Let’s try some examples:

- **Earnings**
- **Drug trial results**
- **Upgrades/downgrades by analysts**
- **Terrorist bombing in USA or Western Europe**
- **Articles in the news media**
- **Fed open market meeting/short rate change**
- **Mergers/take-overs/acquisitions**
- **State/federal actions for improprieties**
- **Corporate personnel changes (CEO, CFO, etc.)**
• One of the things which we should like to understand is how the volatility surfaces adjust themselves before and after both kinds of events. In a thorough research project, one would examine stocks in different industry groups, of different market caps, etc., and look for regularity.

• Is there an existing theory which addresses these concerns?

• No.

• Note: Theory is different than empirical results. Good (predictive) results will never get published!

  – Why???
• Earnings announcements come (usually) at very specific, well-defined times. What frequency?

• For some stocks, earnings are a small effect;
  – which ones might these be?

• For others, earnings announcements move the stock more than any typical daily move. As a result, the implied volatilities increase strongly heading into earnings. In this way, IVs are anticipative.

• The following is a graph of the IVs for CAT over a six-month interval. (Brown curve; ignore the blue.)
  – Can you identify the earnings dates?
  – About how long before earnings does volatility appear to begin climbing?

• Problem Set V explores this issue.
Day before **LNKD earnings**
Day after LNKD earnings
• Drug announcements come in two varieties.
  – There are scheduled dates for stage trial announcements,
  – but also sudden news releases.

• I’m not sure which one applies to the following, but you can see the potential for trading opportunities and blunders!
Monday, Mar 14, 2005

Interim Analysis of Phase III Trial Shows Avastin Plus Chemotherapy Extends Survival of Patients with First-Line Non-Squamous, Non-Small Cell Lung Cancer

-- First Positive Phase III Results with an Anti-Angiogenesis Therapy in Lung Cancer --
• When a corporate event happens *suddenly* and *unexpectedly*, a typical response in the market is to have a large size trading day. We have just seen this with DNA. However, size trading can accompany big *increases* or *decreases* in volatility and sometimes no change at all.

• The DNA event, a large *upward* price jump, was accompanied by a big spike in volume. Below are two spikes in volume coinciding with *down* moves.

• What do you imagine may have happened with the following news event?

• Why?
McDonald’s chairman, CEO dies unexpectedly

Cantalupo suffers heart attack; fast-food giant taps replacement
• When a news event is *anticipated*, such as earnings, there is a lag time for dealing with the event. The volatility must go up for earnings, drug announcements, etc.

  – Why?

  – Can you think of a future, scheduled event which will reduce volatility? (We will discuss such an event in a later week.)

• What would cause the volatility to go up *slowly*? In other words, why wouldn’t the vol stay high from earnings to earnings?

• Let’s take a look again at a blow up of the CAT pre-earnings chart:
• This is why vol doesn’t stay high from start to finish. Rising vol just means prices decline at a slower pace.
• It is important to understand the change in volatility heading into earnings announcements. For typical curves of this sort there are two elements of interest:
  – The size of the change, and
  – The characteristic time scale over which this change occurs.
• Why would it be insufficient to only know one of these properties?
• Characteristic time scales can be eye-balled off the graph, however if the growth curve is exponential, it is conventional to identify the half-life of the curve, the time required to double in value (from a baseline).
• Is there a well-formulated theory of this effect in the literature?
  – The only one I know is:
• The previous slide shows a drug event in CLSN Jan 2013. Although the date of the event was not known with certainty, the volatility also increased into the event.

• Why?

• It’s clear that one needs to know one’s products well!
In Problem Set V you explore earnings announcements and volatility growth.

Enough about volatility before these events.
  - What can we say about volatility after these events?

The behavior of vol about scheduled and unscheduled events will generally be very different.
  - Why?

How do you expect CAT vol after earnings to compare with CAT vol well before earnings? (What does well before mean?)

What are some of the consequences of this understanding?

What about vol after the CEO of McDonald’s dies suddenly?
  - (There may be a characteristic time post this event).

The following two slides show Hewlett-Packard (HPQ) through its earnings event: AMC 2/18/09, near months then mid-months.
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Lecture 5f
Dynamics

Experimental Finance
Mike Lipkin, Alexander Stanton
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• Now let’s consider the vol surfaces.
• For simplicity let us restrict the discussion to one stock, one series. (For concreteness, we could imagine the XYZ Jun options with May being the front month.)

  – What is the usual shape of the volatility surface for this series?

  – What will happen if the stock experiences a *gradual* price change which shifts the at-the-$\$?*
  – What will happen if the stock experiences a *sudden* price change which shifts the at-the-$\$?*

• Is there a theory which covers this behavior?
• No.
Let’s be blunt about standard option pricing theory!
It applies when every option is well-priced. ONLY!
In other words, if conditions materially change, standard option theory will not be able to distinguish between the need to alter the parameters of the model used and the presence of arbitrage!

I am plenty redundant about this point!!!!!!!!!

When a stock drops dramatically, the vol often changes. But it can go down and up!
A theory would be a dynamic theory, but there is no such theory currently.

An attempt to patch statics to dynamics is sticky strike/sticky delta.
Problem Set V explores this.

The following two slides show recent flashcrashes: AAPL(2/10/11);
MNKD (1/19/11)
This is significant selling pressure. The volume spike is enormous and the move down wasn’t orderly.

Not orderly Selling... That’s $3 of disordered selling pressure.
Lecture 5f

Dynamics
• What is sticky strike?
• What is sticky delta?

• Sticky strike postulates that as the stock moves the vol skew stays put. This gibles with our intuition that as the stock moves lower the volatility might go up. But is this true?

• What if XYZ drops suddenly on uncertain news?

• What if XYZ drops suddenly because of definitive news (such as earnings or a drug trial results)?

• Will up moves be different than down moves?
• Sticky delta postulates that as the stock moves the vol skew stays with the corresponding option, delta by delta. This gibes with our intuition that the at-the-$S$ options should have a depressed vol.

• Why?

• Should a time scale matter here? In other words, if the stock drifts gently up or down is this different than if the stock shoots quickly to another value?

• How would you define such a time scale?

• The same kinds of spikes can happen in the entire market’s volatility. Here is a 3-year graph of the VIX. The data set I used ended with the onset of a vol spike in May 2006.
• So, here is a mini-quiz!

• The following slide is a picture of a stock I traded for a number of months in 2006.

• Can you look at it and deduce what happened to the volatility surface from before to after the event in question?

• One thing that did not change much was the realized vol on either side of the event!

• Why would the implied volatility not be a reflection of the realized volatility?

• The key story is that implied volatilities assimilate the expected movement over an extended time horizon. They are a poor man’s representation of a jump process.
• Here is a similar stock, in this case prior to an announcement:

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Subsequent to an event, the vol may be ca. 60.
• Here is VMW before the Jan 2008 earnings announcement:
• What do you think happened to the vols after this event?
• Can you tell from the candlesticks what happened to the realized vol?
• We will come back to this product next time when we look at hard-to-borrows because another exciting non-standard thing happened.

• If we want to look at events and volatility surfaces we need to be careful about the effects of day boundaries.
• Stocks trade pre- and post-market, but volumes are different, spreads are less predictable and conclusions need to be tempered by good intuition.
One can see from the previous slides that VVUS started trading premarket (7 am) near $22 and then fell continually to below $20.

The opening (9:30 am) price was $20.60.

However if you looked at the “market price” graph you would see only the low opening and straight upward move to over $21.30.

IVY will have the market open/close prices and high/low prices, but these are intraday info.

They do not encapsulate the entire trading “event”.

You must always be aware of “boundary” effects near market openings and closings.

These are analogous to “Gibbs Phenomena”.