

MEMORANDUM FOR THE RECORD

Event: Emanuel Derman, Columbia

Type of Event: Group phone interview

Date of Event: May 12, 2010, 2:00 pm

Team Leader: Greg Feldberg

Location: 1717 Pennsylvania Ave, Suite 800

Participants - Non-Commission:

- Emanuel Derman

Participants - Commission:

- Mike Easterly
- Greg Feldberg
- Scott Ganz

MFR Prepared by: Greg Feldberg

Date of MFR: May 18, 2010

Summary of the Interview or Submission:

This MFR is a paraphrasing of the dialogue and should not be quoted as a transcript.

- Models. My business has been on derivatives... I'm really surprised that people expect so much from models. If you build a derivatives model, in order to value anything, you're making an assumption about volatility; when you're building a CDO model you're making assumptions on default rates and housing prices. It won't be accurate... it will be an approximation, and the data is going to be wrong. Make the model match liquid instruments and apply them to illiquid instruments. I can't understand why people expect great accuracy from their models. They're incomplete. You start with the present and you try to say where it is going in the future. In most derivatives models you're making assumptions about the future... if your assumptions are wrong, your answers are going to be no better.
- Figuring out what an illiquid thing is worth given a number of liquid things. It depends on how unsettled the world is.
- Background. [Author of *My Life as a Quant*] I worked at Goldman for 17 years; the last couple of years I was in firm-wide risk. I was in charge of a group call derivatives analysis. We tried to gauge the risks that traders took... we tried to argue the best way to do it was to take a variety of models. I was working on equity derivatives. There are models that work off of the model of illiquid instruments... I wrote a paper on this once, while at Goldman, about how to mark illiquid products. One of the things we used to do is, you have an illiquid product, you would try to

model what people would do... Black Scholes might not be right but that's what the market would do. We would argue that you should mark it at the mean and take a reserve for the error that you would have. These were long-term options that Goldman had sold to people. They were simple options... from what I know, Goldman was pretty good. There wasn't a systematic under-pricing... on these deals, the traders would make up intuitively their own number for uncertainty.

- If the option moved deeply out of the money, there was less uncertainty. It's a tough problem. I never worked on very complicated things like CDOs... where there are many more assumptions in a CDO model than in a Black Scholes model, which at least based on hedging and assumptions that you can at least test...
- CDO models are really just actuarial models and less trustworthy.
- [Would CDO models capture herding behavior?] I think not. That's very hard to do to be fair. It's easier to think about in your head than to put it in your model. You can say, volatility will triple... [Corporate vs. ABS CDOs?] Haven't looked at specifically. Black Scholes assumes there is a random walk, that you can hedge, then you say this is what it would be worth. With CDO models, you're saying if the correlation is 15% or something and everything's normal, this is just what you should expect. CDO models are more actuarial models... if people die at this rate, the value will be different, but it doesn't tell you how to rate the security. Black Scholes is a manufacturing process. In both options and CDO models, you have to make assumptions about correlation... it tells you how to hedge. The CDO model isn't a derivative market... it's one step more removed from how to make things. Options there is a liquid market in the underlyings, you can measure the volatility of the options, whereas in CDOs, while they like to make an analogy to Black-Scholes, you can't really measure the volatility.
- [...]
- [CDOs is more top down, typical CDS is bottom up.] Black-Scholes is making fruit salad out of fruit. [To what extent can traders, the people selling these things... while it seems Black-Scholes underlying are more simple to conceptualize, is it possible the trader and the buyer can understand what they are buying... the risk profile of the derivative they are creating? The way the risk modeling interacted with the people selling the thing?] I think most of the sales people at Goldman were pretty smart and pretty numerate... I don't know the people in mortgages or CDOs but normally they were pretty good at it... [Is it appropriate to sell this?] You make more assumptions in modeling a CDO. When you consider baskets of options, it gets more complicated. A stock is pretty complicated thing too. If you own stock in Apple, you have a company that is manufacturing in China and selling all sorts of different products. The mistake people make with CDOs is to think you can have a triple-A rating for it... When you try to model the credit of a company... [Rating agencies?] I don't think there is a right model for valuing an option or a CDO. You can make some assumptions. Maybe it is caveat emptor. I'm not sure what the regulatory solution is... It was driven by people selling these. To be fair, people sold convertible bonds for years before people developed a model for them... since long before Black Scholes. I suppose on the buy side people buy these things on the basis of some expected rate of return. People in the mortgage markets used something called Option-Adjusted Spreads when I

was in the business 20 years ago. Clients crave a number. There are many different Treasury bonds with many different coupons and maturities. People value them on Yield to Maturity because they wanted one measure on which to judge these things. People when they sold these things looked for some kind of metric to show, this has a higher score than that.

- [Gaussian copula?] Copula models in general, when you're dealing with a lot of different underliers, and you know how each one behaves, you have the margin distribution, the rate at which an individual bond defaults, what you really want is the relationship among a lot of different things. What the Gaussian copula does, it's a mathematic technique that existed long before David Li. You make assumptions about how to put together two or more individual distributions into a joint distribution. Assuming you take default probabilities for a bunch of individual bonds... it's a fancy way of doing correlations, but it's just a statistical technique... it's not saying, if you know these simple things, you can create a complicated thing... It's up to you... there are other copulas, the T copula, where people make different assumptions to sandwich it together into a joint distribution. What they try to do is go from distributions from individual distributions of default to joint distributions of default; it's difficult because you don't see bonds default very often. [Does it make sense to use individual CDS?] It's taking CDS of individual bonds to back out the joint distribution of the whole parcel... it is kind of circular but I'm trying to be fair, if you look at the market for S&P options... it's also a little bit circular. You're trying to make assumptions about the correlations in the future to arrive at a value today.
- If everybody marketing this stuff had put skin in the game, they would have been a lot more careful. But you look at Merrill... they ate their own cooking and they still got in trouble. Jim Grant... he is like a stopped clock that is right every few years. He said, everyone who runs a financial business should be individually on the line, so they are more cautious. In the old days when Goldman was a partnership, they weren't paid in cash, they were illiquid—there was much less of an incentive to do things with your own money.
- Certainly with S&P and Moody's, it seems to me they were rating things more inaccurately and maybe with a conflict of interest. I don't know if it was the sellers driving this than the buyers. You read about people putting money in Icelandic banks on the Internet to get more yield.
- [To what extent should we blame the rating agencies?] Yes. I suppose that applies to quants too. I think the rating agencies should be blamed for pretending they can say something... I've worked on Wall Street. If you're a quant person, if you don't believe your model is accurate you should tell people. Paul Wilmott and I wrote the quants manifesto a year ago.
- I imagine there are quants at the rating agencies and their bosses don't want to listen them. I expect there's a mismatch between the people who do the math and the models...
- [Your background?] I came to graduate school and got a degree in physics in 1973; worked through 1980 doing research in particle physics. From 1980 to 1985 I worked in Bell Labs. In 1985 I went to Goldman to work on fixed income derivatives, with Fischer Black pricing options on bonds. I spent three years from 1985 to 1988, one year at Salomon in 1989 working on adjustable rate mortgage models, and then I came back to Goldman in equity derivatives from 1990 to 2000, and build trading systems. Then I spent two and a half years in firm-wide risk, looking over traders. I've been at Columbia since 2002, I run a master program at Columbia.

Also have a fund of funds, looking on the risk management side and help pension funds to invest in hedge funds.

- [Quant crisis in August 2007?] It looks like what happened is that there was a liquidity crisis. A lot of them have similar models. A lot of them are based on mean reversion in stock trading, and a lot of them probably go into similar stocks. If they were multi-strategy funds they start unwinding their positions at the same time. I think that's very different from what happened in the subprime mortgage business. The crash of 1987 was a big technical financial event but didn't affect the economy. The 2007 quant crisis that lasted for a couple of days was sort of a liquidity event that didn't have any economic impact. The things they traded came back in a few days but they lost money long term because when the market went down they got scared and unwound their positions. Whereas what happened the other day on the market's 1000 point drop, that was also a technical thing but it played on the fears and had economic consequences. It was sort of a model failure in the sense that their models don't take into account what could happen if everything goes down at the same time.
- [Interconnectedness?] I think that's true. Globally things are a lot more interconnected. There were multistrategy funds, and they ended up inflicting their troubles on the equity quant side.
- I think people are too excited about efficiency. A lot of people are saying, we do this or that, it will be more efficient.
- [VaR models?] They're just like OAS or YTM, people want to give you one number... but it's not really capturable with one number. I don't think VaR is useless... I don't think the solution is finding a better model. I think the solution is regulatory rather than mathematical. Not letting people take on as much leverage, and I come back to, if they take the upside they should have taken the downside. [TBTF?] People getting paid 100 cents on the dollar on risky securities that got bailed out. I don't want the hold world to collapse but there's something wrong about firms being on the verge of extinction and then making giant profits.
- I don't know what the right thing to have done was in this crisis...
- I'm going to send one paper I've got, about marking illiquid products; another is about models in general.
- [Who else?] Rick Bookstaber. I think people do take too much comfort from models. You've got to try to use them; there's an alternative to using models but you have to be asking, what could go wrong, what's wrong with what I've done. Black-Derman-Toy Model. It's a reasonable model but if you look at the assumptions and then ask, does the world really work this way, you have to say, it's not really likely.