

The Financial Modelers' Manifesto

by Emanuel Derman and Paul Wilmott

Preface

A spectre is haunting Markets – the spectre of illiquidity, frozen credit, and the failure of financial models.

Beginning with the 2007 collapse in subprime mortgages, financial markets have shifted to new regimes characterized by violent movements, epidemics of contagion from market to market, and almost unimaginable anomalies (who would have ever thought that swap spreads to Treasuries could go negative?). Familiar valuation models have become increasingly unreliable. Where is the risk manager that has not ascribed his losses to a once-in-a-century tsunami?

To this end, we have assembled in New York City and written the following manifesto.

Manifesto

In finance we study how to manage funds – from simple securities like dollars and yen, stocks and bonds to complex ones like futures and options, subprime CDOs and credit default swaps. We build financial models to estimate the fair value of securities, to estimate their risks and to show how those risks can be controlled. How can a model tell you the value of a security? And how did these models fail so badly in the case of the subprime CDO market?

Physics, because of its astonishing success at predicting the future behavior of material objects from their present state, has inspired most financial modeling. Physicists study the world by repeating the same experiments over and over again to discover forces and their almost magical mathematical laws. Galileo dropped balls off the leaning tower, giant teams in Geneva collide protons on protons, over and over again. If a law is proposed and its predictions contradict experiments, it's back to the drawing board. The method works. The laws of atomic physics are accurate to more than ten decimal places.

It's a different story with finance and economics, which are concerned with the mental world of monetary value. Financial theory has tried hard to emulate the style and elegance of physics in order to discover its own laws. But markets are made of people, who are influenced by events, by their ephemeral feelings about events and by their expectations of other people's feelings. The truth is that there are no fundamental laws in finance. And even if there were, there is no way to run repeatable experiments to verify them.

You can hardly find a better example of confusedly elegant modeling than models of CDOs. The CDO research papers apply abstract probability theory to the price co-movements of thousands of mortgages. The relationships between so many mortgages can be vastly complex. The modelers, having built up their fantastical theory, need to make it useable; they resort to sweeping under the model's rug all unknown dynamics; with the dirt ignored, all that's left is a single number, called the default correlation. From the sublime to the elegantly ridiculous: all uncertainty is reduced to a single parameter that, when entered into the model by a trader, produces a CDO value. This over-reliance on probability and statistics is a severe limitation. Statistics is shallow description, quite unlike the deeper cause and effect of physics, and can't easily capture the complex dynamics of default.

Models are at bottom tools for approximate thinking; they serve to transform your intuition about the future into a price for a security today. It's easier to think intuitively about future housing prices, default rates and default correlations than it is about CDO prices. CDO models turn your guess about future housing prices, mortgage default rates and a simplistic default correlation into the model's output: a current CDO price.

Our experience in the financial arena has taught us to be very humble in applying mathematics to markets, and to be extremely wary of ambitious theories, which are in the end trying to model human behavior. We like simplicity, but we like to remember that it is our models that are simple, not the world.

Unfortunately, the teachers of finance haven't learned these lessons. You have only to glance at business school textbooks on finance to discover stilts of mathematical axioms supporting a house of numbered theorems, lemmas and results. Who would think that the textbook is at bottom dealing with people and money? It should be obvious to anyone with common sense that every financial axiom is wrong, and that finance can never in its wildest dreams be Euclid. Different endeavors, as Aristotle wrote, require different degrees of precision. Finance is not one of the natural sciences, and its invisible worm is its dark secret love of mathematical elegance and too much exactitude.

We do need models and mathematics – you cannot think about finance and economics without them – but one must never forget that models are not the world. Whenever we make a model of something involving human beings, we are trying to force the ugly stepsister's foot into Cinderella's pretty glass slipper. It doesn't fit without cutting off some essential parts. And in cutting off parts for the sake of beauty and precision, models inevitably mask the true risk rather than exposing it. The most important question about any financial model is how wrong it is likely to be, and how useful it is despite its assumptions. You must start with models and then overlay them with common sense and experience.

Many academics imagine that one beautiful day we will find the 'right' model. But there is no right model, because the world changes in response to the ones we use. Progress in financial modeling is fleeting and temporary. Markets change and newer models become necessary. Simple clear models with explicit assumptions about small numbers of variables are therefore the best way to leverage your intuition without deluding yourself.

All models sweep dirt under the rug. A good model makes the absence of the dirt visible. In this regard, we believe that the Black-Scholes model of options valuation, now often unjustly maligned, is a model for models; it is clear and robust. Clear, because it is based on true engineering; it tells you how to manufacture an option out of stocks and bonds and what that will cost you, under ideal dirt-free circumstances that it defines. Its method of valuation is analogous to figuring out the price of a can of fruit salad from the cost of fruit, sugar, labor and transportation. The world of markets doesn't exactly match the ideal circumstances Black-Scholes requires, but the model is robust because it allows an intelligent trader to qualitatively adjust for those mismatches. You know what you are assuming when you use the model, and you know exactly what has been swept out of view.

Building financial models is challenging and worthwhile: you need to combine the qualitative and the quantitative, imagination and observation, art and science, all in the service of finding approximate patterns in the behavior of markets and securities. The greatest danger is the age-old sin of idolatry. Financial markets are alive but a model, however beautiful, is an artifice. No matter how hard you try, you will not be able to breathe life into it. To confuse the model with the world is to embrace a future disaster driven by the belief that humans obey mathematical rules.

MODELERS OF ALL MARKETS, UNITE! You have nothing to lose but your illusions.

The Modelers' Hippocratic Oath

~ I will remember that I didn't make the world, and it doesn't satisfy my equations.

~ Though I will use models boldly to estimate value, I will not be overly impressed by mathematics.

~ I will never sacrifice reality for elegance without explaining why I have done so.

~ Nor will I give the people who use my model false comfort about its accuracy.
Instead, I will make explicit its assumptions and oversights.

~ I understand that my work may have enormous effects on society and the economy,
many of them beyond my comprehension

Emanuel Derman
January 7 2009

Paul Wilmott
January 7 2009