

*CHAPTER 5B

THE RISKS OF IGNORING MODEL RISK¹ (NEW)

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5B.1 INTRODUCTION. Models and their analysis pervade business. Examples include a litigation expert who employs a model to estimate commercial damages, a marketing analyst who forecasts future expected sales of a new product line, and a portfolio manager who allocates capital according to an optimization program. The following are some of the primary applications of business models:

- Forecasting
- Investment Management
- Litigation
- Risk Management
- Valuation

Analysts often discuss models as they exist in textbooks. In practice, such analyses seldom prove straightforward. Overlap often occurs, wherein an analyst uses a model from one of the preceding categories for a second purpose. For example, an investor seeking recompense for losses might use a valuation model in court to demonstrate that a fund manager originally bought assets at inflated prices. Alternatively, a pension fund that relies heavily on an interest rate forecasting model may see an increase in unfunded liabilities if the model does a poor job of prediction. The analyst needs to be sure that a model developed for one purpose suits another purpose not anticipated when the model first took form.

A model-based decision made at one level often affects subsequent actions, such as regulatory breach and legal action. Model risk can end up costing individ-

uals, financial institutions, and corporations in the form of lost income, lost time, and tarnished reputations.

5B.2 MODEL FUNDAMENTALS. To understand model risk, one must first understand what a model represents and what constitutes an effective model. Despite their differences, all models embody the same notion, an expression about a relation or set of relations.

Some models have common applications, such as estimating total revenue by multiplying price by quantity for any business. Others appeal to a specific group. Sales forecasting models have limited use to scientists but are popular with manufacturers preparing for full-scale production. The sophistication of models varies. The linear model for revenue involves only two variables (price \times quantity). The complex sales model includes multiple factors, some of which may interact with sales in a nonlinear fashion. Some analyses embed separate models within larger models.²

No model is perfect but rather seeks to reflect the state of the world as it would be under simplifying, but realistic, assumptions. Precision trades off with cost. Assuming, however, that a model cost-effectively mirrors economic reality, its use offers several advantages over more subjective assessment methods.

Generally speaking, an effective model should exhibit the attributes shown in Exhibit 5B-1.

- Uses plausible assumptions
- Generates results that comport with expected outcomes
- Generates consistent results
- Appears logical
- Is cost-effective
- Provides robust results even when inputs are outliers
- Is comprehensible to others

Exhibit 5B-1. Characteristics of a Good Model

The importance of these characteristics varies with context. For example, one financial model (say, the binomial model with 300 lattice points for valuing an option) may prove too expensive because it requires hours of computational processing time and one can employ an adequate substitute (say, Black-Scholes) for the purpose at hand. A court or other user may find a model acceptable if relaxing some of the assumptions does not dramatically affect the outcome—evidence of a model that generates consistent results.

5B.3 MODEL RISK BASICS. Model risk encompasses several problems, including those listed in Exhibit 5B-2. Improper data may invalidate the results of a suitable model, and model validation testing may indicate wide swings in outcomes for some market scenarios but not others.

- Use of bad data or assumptions
- Failure to incorporate structural changes
- Incorrect application
- Instability over time

Exhibit 5B-2. Model-Related Problems

Do the assumptions make sense? Can one change them a bit without materially affecting results? For example, consider the assumptions of the Black-Scholes option pricing model, which include zero transaction costs, zero dividends, constant volatility, and a constant risk-free rate. While these may be sensible for the original purpose—valuing options with lives of six months or less—they seldom represent the reality of employee stock options, which can be long term and carry restricted exercise terms, along with lengthy vesting periods.

5B.4 MODEL RISK AND LEGAL IMPERATIVES. For legal practitioners, context has a special meaning since 1993 and the teachings of *Daubert v. Merrell Dow Pharmaceutical, Inc.* Evidence presented in the federal courtroom—and in many state courts—must meet various tests before the court can accept it as valid. Attorneys, consultants, experts, judges, and regulators must evaluate a theory or technique on the basis of its testability, acceptance by peers and diagnostic measurement to ensure its reliability.³

5B.5 MODEL VARIETY IN FINANCE. There are different ways to model things in finance. For example, the simplest approach to bond valuations discounts future expected coupon payments and principal back to present using one discount rate. Here, the bond's yield to maturity equals the coupon reinvestment rate for the remaining life of the security. An alternative method looks at a coupon-paying bond as a portfolio of individual zero-coupon bonds, each with a different maturity and discounted back at the appropriate spot rate.⁴ Yet another variation models interest rates, using the results to project future cash flows before discounting. Take into account currency payouts, conversion options, amortization, and call features, and bond valuation becomes more complex. Each approach represents a valid way to value bonds, and each poses different model risk issues.

Common stock valuation models have a similar situation. Consider dividend discount models and market multipliers that assume a long holding period. Analysts use both types of models. A dividend discount model makes no sense when a stock pays few or no cash dividends, when the dividends vary in size, or when the growth in dividends fails to track growth in earnings. A market multiples approach will not apply when there are few peers for comparison.

Many models require an explicit discount rate, which the analyst derives from still another model. Ignoring model risk at the outset is bad enough. Ignoring its compound effect can cause headaches later on, giving the opposing side a huge advantage.

NOTES

1. The information provided by this article should not be construed as financial or legal advice. The reader should consult with his or her own advisors.
2. Complex financial securities frequently require a separate model to ascertain the behavior of inputs before the inputs can be used in the primary valuation model.
3. A later case, *Kumho Tire Co. v. Carmichael*, 119 S.Ct. 1167, 1999, extended the *Daubert* decision to persons other than scientists.
4. A spot rate can be thought of as the yield to maturity for a zero-coupon bond with a specified time to maturity.

LIST OF CASES

Daubert v. Merrell Dow Pharmaceuticals, 509 U.S. 579, 595 (1993).
Kumho Tire Co. v. Carmichael, U.S. 119 S.Ct. 1167 (1999).