CHAPTER 22

Key Lessons

The sheer length of this book may give the impression that derivatives are a long and complicated subject. If it were a murder mystery, we might expect hundreds of characters and a complex story line. The irony is that the characters are few—two main characters, a forward and an option, and two supporting characters, a risk-free bond and the underlying asset. And the story line is simple: Two perfect substitutes must have the same price and, therefore, price dynamics. Consequently, the price risk of one instrument can be managed using the other.

This book is about risk management using derivative contracts, that is, how derivatives can be used to effectively manage the different types of risks faced by individuals, corporations, governments, and governmental agencies in their day-to-day operations. For corporate producers such as oil refiners, managing price risk of input costs (i.e., crude oil) as well as output prices (i.e., heating oil and unleaded gasoline) are relevant. For end-users such as airlines, managing its exposure to jet fuel prices is important. Depending upon user, some risks may be acceptable, while others may not. A gold company, for example, may have a thorough understanding of the world's supply and demand for gold production and, consequently, may be better able to predict gold price movements in the short- and long-run. On the other hand, it may have little or no awareness of probable movements in exchange rates. For this company to accept the gold price risk exposure and, at the same time, to hedge foreign currency risk exposure of sales commitments in a different currency is perfectly sensible.

The key lessons of this book are few:

1. **Derivatives markets exist because of high trading costs and/or trading restrictions/regulations in the underlying asset market.** A firm with floating rate debt can convert it into fixed rate debt using an interest rate swap at only a small fraction of the cost of floating a fixed rate bond issue. A wheat farmer can sell his unharvested crop in the spring even though the underlying grain does not yet exist by selling wheat futures. A hedge fund can shed the interest rate risk of a junk bond portfolio by selling interest rate futures. The ability to transfer risk in a cost-effective manner is derivatives markets' *raison d'etre*.

2. **The expected return/risk relation for derivative contracts, like risky assets, is governed by the capital asset pricing model.** In financial economics, the capital asset pricing model (CAPM) provides the structural relation between expected return and risk. This relation is central to the understanding risk management using derivative contracts. The motives for trading derivatives contracts are twofold. Hedging refers to reducing risk, and speculation refers to placing a directional bet. What is critical, however, is that risk management is synonymous with expected return/risk management. As the CAPM shows, in equilibrium, we cannot move one without moving the other.
3. **The absence of costless arbitrage opportunities (i.e., the law of one price) ensures that derivative contract price is inextricably linked to the prices of the underlying asset and risk-free bonds.** A cereal producer, for example, may require wheat for production in two months and wants to lock in its cost today. He has two possible strategies. First, he can buy the wheat in the spot market and carry it for two months. Second, he can buy a two-month forward contract. Since both of these strategies provide an inventory of wheat in two months at a price known today, the cost of the two alternatives must be the same. Otherwise, costless arbitrage profits are possible.
4. **The no-arbitrage price relation between a derivative contract and its underlying asset ensures that derivative contracts are effective risk-management tools.** If we know the structure of the price relation between the derivative and its underlying asset, we can precisely measure the change in the price of the derivative with respect to a change in the price of the asset (i.e., the derivative contract's price risk with respect to unexpected movements in the asset price). If we can measure risk accurately, we can use derivative contracts to manage asset price risk effectively.
5. **The key insight into derivative contract valuation is that a risk-free hedge can be formed between a derivatives contract and its underlying asset.** If a risk-free hedge between a derivative contract and its underlying asset can be formed, derivative contract valuation does not depend on individual risk preferences and, hence, need not depend on estimating expected risk-adjusted returns.[1] Consequently, we can approach derivative contract valuation as if all individuals are risk-neutral. In a risk-neutral world, all assets are expected to have a rate of return equal to their risk-free rate of interest, and the need to estimate risk-adjusted rates of return is eliminated.
6. **Only two basic types of derivatives exist—a forward and an option.** Even though a seemingly endless number of derivative product structures trade in the marketplace, all of them are nothing more than portfolios of basic forward and option contracts. In some instances, the construction of the portfolio is obvious. A protected equity note, for example, is a portfolio of risk-free bonds and an index call. In other instances, the construction is less obvious. An index put option can be replicated dynamically using a stock index futures contract and risk-free bonds.
7. **Valuing and measuring the risk of complex derivatives is made possible by valuation by replication.** Since the cash flow contingencies of complex derivatives

[1] If a risk-free hedge can be formed between two risky securities, the securities are *redundant*, and each can be priced in relation to the other as if investors are risk-neutral.

can be replicated using a portfolio of basic forward and option positions, the law of one price dictates that the value (risk) of such a contract equals the sum of the values (risks) of the constituent forward and option positions. An important corollary to this rule is that, if all of the contingencies of a particular contract cannot be modeled, its value and risk cannot be computed accurately and the contract should not be avoided.

8. **Derivatives valuation and risk measurement principles are not asset-specific.** The valuation equations/methods and risk management strategies for foreign currency derivatives are no different than those used for stock derivatives, stock index derivatives, interest rate derivatives, and commodity derivatives. The only distinction between the different underlying assets is the net cost of carry parameter. The net cost of carry is the cost of holding an asset through time. One carry cost common to all assets is the opportunity cost of funds. To come up with the purchase price, we must either borrow money or liquidate existing interest-bearing assets. The remaining costs/benefits are asset specific. For a commodity such as wheat, storage costs (e.g., rent and insurance) are incurred. At the same time, certain benefits may accrue. By storing wheat, we may avoid some costs of possible running out of our regular inventory before two months are up and having to pay extra for emergency deliveries, that is, we may accrue convenience yield. For a financial asset or security such as a stock or a bond, income (yield) may accrue in the form of quarterly cash dividends or semiannual coupon payments. Thus, the net cost of carry of an asset equals interest cost plus (less) any other costs (benefits) that accrue while holding the asset.
9. **Accurate parameter estimation is critical in applying derivative contract valuation models.** Statistics and regression analysis play important roles in the application of derivative contract valuation models. In valuing long-term employee stock options, for example, it is necessary to estimate the expected future volatility rate over the remaining life of the option. One approach is doing so is to estimate the parameter using a long time-series of historical return data. Choosing the length of the series, the frequency of the data, and the formula for computing the historical volatility rate are among the statistical decisions that must be made in arriving at the parameter estimate. The degree of comfort that we should feel with this estimate can be measured by computing its confidence interval. Testing the robustness of the estimate across estimation methods can also provide valuable insights regarding the stationarity of the parameter through time.
10. **So-called "derivative disasters" reported in the financial press did not arise from a failing in the performance of a derivative contract or the market in which it traded.** In recounting "derivatives disasters" in various chapters of the book, the main conclusion is that they were largely "management disasters," brought about by a lack of meaningful internal controls and/or supervision. From the money market management activities of Orange County and the State of Wisconsin Investment Board to the stock index arbitrage activities conducted by Barings Bank in Singapore, and from the currency hedging activities by AWA Ltd in Australia to the foreign currency option market making operations of ABN Amro in New York, one common theme emerges—huge bets can produce huge losses. With proper internal control and supervision, the bets would never have been taken.