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A Practitioner's Guide to Structuring Listed Equity Derivative Securities

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INTRODUCTION

Since the mid-1980s, "financial engineers" have created a wide array of instruments for use by professional investors in their search for higher returns and lower risks. Institutional investors are typically the most voracious consumers of structured derivative financial products, however, retail investors are increasingly availing themselves of such products through public, exchange-listed offerings. Design and engineering lie at the heart of the market for equity derivative securities. Through the use of computerized pricing and valuation technology and instantaneous worldwide communications, today's financial engineers are able to create new and varied instruments that address day-to-day client needs. This in turn has encouraged the development of new financial products that have broad investor appeal, many of which qualify for listing and trading on the principal securities markets. Commonly referred to as *listed* equity derivatives because they are listed on stock exchanges and trade under equity rules, these new financial products fuse disparate investment features into single instruments that enable retail investors to replicate both speculative and risk management strategies employed by investment professionals.

Options on individual common stocks are the forerunners of many of today's publicly traded equity derivative products. They have been part of the

securities landscape since the early 1970s.[1] The notion of equity derivatives as a distinct class of securities, however, did not begin to solidify until the late 1980s. By then, options and futures on foreign currencies, U.S. government securities, and stock indexes started to attract increasing attention among a wide range of investors.[2] Before then, many of these same financially engineered products were only available to the largest and most sophisticated financial institutions and investors.

The term *financial engineering* encompasses a variety of applied financial technologies that combine the research, development, and commercial use of new financial instruments. Although grounded in economic and option theory, the actual pricing of these products remains as much an art as a science.

Financial engineers come from a variety of backgrounds and include not only investment and commercial bankers, but also stock and commodity traders, research and credit analysts, mathematicians, and lawyers. The diversity of people entering this field testifies to the opportunities available for those with an analytical approach to problem solving and the ability to perceive creative solutions to complex problems.

Derivative products serve principally to shift risk from one investor or group of investors to another, without necessitating the sale of underlying assets. As a result, investors who might otherwise avoid certain investments, or liquidate an investment because of heightened risk concerns or increased trading volatility, may choose to use derivative instruments as a mechanism for effectuating an overall investment strategy. They are also used as capital-raising tools[3] to lower the cost of corporate funding and, in certain instances, are employed in conjunction with merger and acquisition activity.[4]

There are three different, but related, ways to manage financial risk. The first is to purchase various types of *insurance* for the management of certain types of risks, such as those arising from fire or other catastrophes. The second is *asset/liability management.* This approach involves both the careful balancing of assets and liabilities so as to eliminate net value changes, and

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[1] Standardized options on underlying stocks were first introduced in April 1973 by the Chicago Board Options Exchange, an entity created by the Chicago Board of Trade. The American Stock Exchange entered the market in 1975, with each of the other stock exchanges quickly following suit.

[2] On February 16, 1982, the Commodity Futures Trading Commission approved futures on the Value Line Average Stock Index. Since then, more than 30 other stock index futures have been approved. By 1987, the average daily trading value of futures contracts on stock indexes exceeded average daily trading on the New York Stock Exchange (Testimony of Richard C. Breeden, Chairman, Securities and Exchange Commission, before the Securities Subcommittee of the Securities Committee on Banking, Housing, and Urban Affairs, March 29, 1990).

[3] See Currency Warrants, PERCS, and Index-Linked Notes in the Listed Equity Derivatives section in this chapter.

[4] See Contingency Value Rights in the Listed Equity Derivatives section in this chapter.

portfolio insurance strategies to achieve a combination of cash flow, upside appreciation, and downside price protection. The final approach, which can be used alone or in conjunction with one or both of the prior two, is risk management or *hedging,* which is the taking of offsetting risk positions. The instruments most often used for hedging are futures, options and swaps. *Risk management,* one of the most important areas requiring the skills of financial engineers, is a four-step process: (1) identify risk exposure, (2) quantify the exposure, (3) determine the outcomes sought, and (4) design or engineer a strategy to transform the risk exposure to the desired form.[5] The challenge for the engineer is to create an instrument that balances the profit motive of the issuer with the price sensitivities of the investor.

This chapter provides an overview of equity derivative securities and the structuring process.[6] Topics discussed include:

- The initial public offering of structured products.
- Regulatory review and registration.
- Quantitative analysis, pricing, and valuation.
- Listed equity derivative securities.

THE INITIAL PUBLIC OFFERING OF STRUCTURED PRODUCTS: "KISS"

The structuring, underwriting, and issuing process of publicly traded derivative securities requires an integrated approach, encompassing research, internal consensus-building, analytics, legal coordination, and marketing. In most instances, it is the financial engineer who must act as the liaison among these different constituencies. Structured derivative products like any security to be sold must compete for finite resources within a firm (capital, research coverage, access to retail and institutional sales networks, and the attention of the syndicate desk). An overriding concept to be considered when trying to build momentum for a new derivative product is expressed in the old Wall Street adage "KISS"—*Keep It Simple, Stupid!*

The language of derivatives (such as hedge, delta, vega, gamma, roll-risk, notionals, and vol-points) may be confusing not only to many investors, but to many seasoned securities professionals as well. As a result, the language of derivatives must be made understandable to fellow employees who must help launch new products, and to retail brokers and investors who will not consider an investment in a new product unless they can understand it quickly

[5] J. F. Marshall and V. K. Bansal, *Financial Engineering, A Complete Guide to Financial Innovation* (New York: New York Institute of Finance, 1992), pp. 147–177, 239.

[6] *Structuring* refers to a process of creating and fabricating new financial instruments. *Structured products* refers to a category of financial instruments that are actually "constructed" with few or no established precedents or guidelines.

and easily. If properly explained and marketed, using familiar concepts and language where possible, structured products will enter the mainstream more readily and provide investors with easy access to markets and product combinations that are otherwise out of reach.

Research

Research provides the fundamental rationale for newly structured instruments. It is important for those responsible for structuring new derivatives to monitor and evaluate research analysis and opinions that support their new product proposals. Indeed, research support is usually the first order of business when presentations are made to new product committees. Although specific market opportunities may seem obvious to proponents of new derivative structures, management uses research as an independent, objective validation for proceeding. Research is used to point out market conditions, such as anticipated changes in the interest rate, exchange-rate volatility, and earnings expansion or contraction in certain markets and industries. In addition, published reports, presentations by analysts, strategists, and economists help orient sales and trading personnel to investment themes and market conditions. Finally, good research is an invaluable aid to retail and institutional sales efforts throughout the initial public offering process and during secondary trading.

Term Sheet

Once an idea begins to take shape, the basic outline of a product structure is usually set forth in a term sheet. This is intended principally to advise management of the basic elements of a proposed transaction, as well as to inform sales personnel and possible co-underwriters of the salient points of the potential offerings. It is also used by stock exchanges in determining listing eligibility and whether new listing rules must first be obtained from the SEC. Although there is no standard form or length, Table 21.1 reflects a number of basic elements that are typically included. Brief explanations are provided for those unfamiliar with the information or the reasons for such detail.

The *Issue* section is simply intended to highlight the fundamental nature of the offering being proposed. The name of the *Issuer* establishes the credibility and financial strength of the credit backing the offering. The Issuer has the obligation to comply with the terms of the offering, such as providing funds to pay any cash settlements. *Registration* describes the type of regulatory filing that is being used—in this case, a "takedown" (partial use) of an effective SEC "shelf" registration (a type of filing used by issuers wishing to launch multiple offerings). The advantage of an existing shelf registration is that it normally precludes an extensive SEC review, thereby saving considerable time and effort in launching a new offering. The *Issue date* is projected so that all parties can coordinate their activities (legal and regulatory, marketing, syndicate, and risk management). *Term of warrants* describes the length of

Table 21.1 Sample Term Sheet: ABC Equity Derivative Securities

Issue	Equity Derivative Securities on the Emerging Market Index
Issuer	Mega Corp. and the Sovereign Nation of Euroasia
Registration	Takedown of $100,000,000 Equity Derivative Securities shelf registration
Issue date	June_____ 1999
Term warrants	3 years
Underwriter(s)	Hot Issues Inc. and Investors First Corp.
Number of warrants	5,000,000+
Total $ premium	$30,000,000+–
Total % premium	12% +– of strike index level
Issue price	$5.50–6.50 per warrant
Strike index level	Index level will be set at 100 on the pricing date
Gross spread	5.00% ($0.29–0.33 per warrant)
Selling concession	3.00% ($0.17–0.20 per warrant)
Symbol listing	EDS.WS/American Stock Exchange
Index symbol	EMI
Index quotation	Continuously calculated and updated during AMEX trading hours
Dissemination	AMEX Tape
Exercise	American-style/continuous exercise
Settlement	U.S. dollars

time until expiration of the instrument, which usually ranges from 18 months to 5 years. *Underwriters* are investment banks that organize selling syndications and oversee the offering process. They build and manage offerings prior to the pricing and sale of new issues to investors. *Number of warrants* indicates the projected size of the transaction, even though the offering may later be "up-sized" if demand proves to be stronger than initially indicated. This figure usually represents an approximation of the threshold of economic viability, or the minimum number of securities necessary to meet exchange-listing criteria. *Total $ premium* is determined by multiplying the issue price by the number of securities to be issued ($6.00 × 5,000,000 = $30,000,000). *Total % premium* is a measure of the cost of the option as a percentage of one unit of the underlying asset; such a percentage is a function of the option strike price, the underlying price of the asset or security, time to expiration, the risk-free interest rate, the dividend or coupon rate, and the volatility of the underlying asset (see a later section of this chapter, Quantitative Analysis, Pricing, and Valuation). *Issue price* is usually expressed as a range, because of the tendency for markets to fluctuate prior to the actual pricing date. *Strike index level* describes the starting point for measuring whether the instrument moves in-the-money (increasing in value) or out-of-the-money (declining in value). The strike usually remains fixed throughout the life of the instrument, except in the case of certain "reset" structures whereby the strike is changed after a cer-

tain period or when the underlying asset reaches a prescribed level or value. *Gross spread* and *selling concession* describe the percentage offering price to pay the underwriting and offering expenses, management fees, and brokerage commissions. *Symbol/listing index symbol* specify what letters may be used to retrieve quotations on the instrument and underlying index or benchmark on which the derivative security is based. It also indicates the marketplace where secondary (post-offering) trading takes place. It should be noted that stock exchanges play an important role in securing regulatory approval for certain types of new derivative structures through filings with the SEC or other regulatory bodies for new or amended listing rules. *Index quotation* is a description of the source of the data and method of calculating the index. *Dissemination* provides investors with the means to track the underlying assets that form the basis of the value of derivative instruments. By transmitting data via the "Tape,"[7] worldwide dissemination of market information takes place for the hundreds of thousands of subscribers to electronic stock market data. The availability of underlying market information not only provides critical information for investment decisions, but helps to attract additional investors, thereby creating trading liquidity (an abundance of active buyers and sellers). *Exercise* and *settlement* pertain to the method of exercise, in this case "American-style"; this means that, in addition to being tradable on an exchange, the instrument can be exercised into cash by investors at any time prior to expiration. "European-style" instruments can be exercised only at expiration.

Retail Marketing and Distribution

The driving force behind any public offering is investor demand. Soundings of the marketplace are made by retail marketing professionals at various steps along the product development process. During this period, questions from brokers and investors frequently arise concerning the proposed pricing, the availability of published research supporting the product's investment objectives, anticipated secondary trading characteristics, customer suitability, tax issues, and future theoretical price expectations. Frequently, questions lead to changes in product structures and provide insights into the appropriate mar-

[7] The Consolidated Tape Authority (CTA, the "Tape") is owned by the New York and American stock exchanges. Network A reports equity transactions on the New York Stock Exchange trading activity. Network B reports American Stock Exchange trading activity. All options transactions are reported through OPRA (Options Price Reporting Authority) to the media and electronic information vendors. OPRA is an information processing organization which is jointly owned by all of the options marketplaces (e.g., CBOE, AMEX). This same procedure is essentially followed by all Nasdaq transactions with the principal difference being that Nasdaq transactions are reported through a central NASD facility. All other securities transactions, including transactions in stocks and structured equity derivative products, such as index-linked notes and warrants, are carried on the Tape pursuant to rules adopted by the CTA.

keting strategies, such as division sales meetings, reports to brokers, audio or videotapes, and branch office "road shows."

In the private OTC markets, a limited number of institutional buyers can provide the economic incentive necessary to pursue a transaction. Profit margins can be very good, offering costs are low, and transactions can be completed quickly and frequently. On the other hand, public transactions, where access to distribution channels is the key to economic success, can take literally months of effort and are expensive to structure and launch. However, successful public deals can often generate very significant returns.

The type of derivative product being offered must typically be matched to the appropriate broker and investor. Specialized products, such as currency and index-linked notes, are marketed to brokers and investors experienced in owning and trading derivative products and familiar with the market niches involved. Alternatively, products based on well-known, broad-based indexes or those with enhanced yields and guaranteed principal protection can frequently be marketed to a much wider investor audience.

The financial engineer's primary responsibility is to manage the entire process. This also includes negotiating for a license, warrant agent, and calculation of agreements and service contracts. Directing the work of attorneys and controlling product development costs are critical responsibilities as well. Once the marketing period starts, the financial engineer often engages in retail and institutional conference call presentations, road shows, and discussions with clients.

REGULATORY REVIEW AND REGISTRATION

To be successful in the listed equity derivatives business, one needs not only some understanding of various asset classes and markets around the world, but also an appreciation of the offering process and the regulatory framework that govern the public sale and trading of derivative instruments. In conjunction with research presentations, senior management consultations, and marketing reviews, the financial engineer initiates a complete study of legal and regulatory issues with legal counsel (in-house and outside counsel). As noted in the introduction to this chapter, derivative product originators should possess a working knowledge of regulatory and stock exchange requirements in order to generate viable new product ideas and minimize legal costs associated with the registration process. Unlike the largely unregulated market for privately negotiated derivative instruments, where the parties can consummate a transaction in a matter of days or sometimes even hours, the process is much more complicated and time-consuming if the security is to be offered to retail investors and traded publicly.

From a regulatory perspective, the first step in considering any new derivative security offering for the general investing public is to determine whether the instrument, as structured, will fall under the jurisdiction of the

Commodity Futures Trading Commission (CFTC) or the Securities and Exchange Commission (SEC). The importance of focusing immediately on this question lies in the fact that only a relatively small percentage of securities brokers and investors are qualified to engage in "commodities" transactions.[8] Under the Commodities Exchange Act (CEA), the CFTC possesses exclusive regulatory jurisdiction over all futures and commodity option transactions. In 1982, Congress amended the CEA and the Federal Securities Laws, dividing jurisdiction over options and futures contracts on financial instruments between the CFTC and the SEC. Pursuant to these amendments, the CFTC was granted exclusive jurisdiction over all futures on stock indexes and options on futures contracts, and, at the same time, gave the SEC jurisdiction over options directly on securities, including options on exempt securities, certificates of deposit, and stock indexes.

Jurisdiction and other legal questions are, of course, best left to those schooled in these very technical areas of the law.[9] Nevertheless, since most derivative instruments will be structured to come within the jurisdiction of the SEC, a basic appreciation of the Federal Securities Laws is essential for working in this area. To the extent that a derivative instrument constitutes a "security" under the Federal Securities Laws,[10] its offer and sale must comply with the federal securities laws, which are enforced by the SEC. Thus, in terms of the Federal Securities Laws, issuers and underwriters of derivative instruments are in no different position than they would be if engaged in any new securities offering.

Stock Exchange Listing Requirements for Equity Derivative Securities

Each stock exchange also has specific standards that must be met as a condition to listing and registration. For example, stock exchanges have minimum size and distribution requirements as well as minimum financial standards for the issuer. These standards are designed to ensure that issuers are able to meet their financial obligations to investors and that there will be sufficient public

[8] The term *commodity* is given very broad meaning under the CEA, embracing a wide variety of physical commodities, currencies, debt instruments, and even economic or market indicators. See CEA Section 2(a)(1)(A) and 4(c)(b).

[9] Although jurisdictional conflicts usually do not arise after an agency assumes jurisdiction, such a case did arise in 1989, to the consternation of the SEC and exchanges. In *Chicago Mercantile Exchange v. Securities and Exchange Commission,* 883 F.2d 537 (7th Cir. 1989), the Court held that in approving certain index participation products, the SEC had exceeded authority. Although index participation products are no longer being traded, efforts are under way to reconfigure these products so as to fall within the SEC's jurisdiction as delineated by the Court.

[10] The term *security* is defined in Section 2(1) of the Securities Exchange Act of 1933 and Section 3(a)(10) of the Securities Exchange Act of 1934 to include any note, stock, treasury stock, bond, debenture, certificate of interest, or participation in any profit-sharing agreement—or any put, call, straddle, option, or privilege entered into on a national securities exchange relating to foreign currency, or in general, any instrument commonly known as a "security."

distribution to ensure a fair and orderly market.[11] Exchange regulations can take a variety of other forms as well. Derivative products are viewed by regulators as being inherently speculative and complex, and are frequently restricted to investors with option-approved accounts. In other instances, regulatory concerns over the possible impact of a derivative security on the underlying cash market may result in some limit being placed on the number of securities that can be created.[12]

SEC—New Product Guidelines

Since new instruments are constantly being designed, a literal reading of existing exchange rules may not always provide a definitive answer to the question of listing eligibility. This has led to the practice of informally discussing "new and/or unusual products" with the exchange on which the instrument is to be listed, before a registration statement is filed with the SEC. Since most of the exchanges maintain informal channels of communication with the SEC staff, they are usually in a position to ascertain whether a particular instrument will be permitted without the necessity of a formal rule amendment, which can frequently take months to obtain.[13]

The ability to create products based on foreign stocks is an example of one area that has proven to be troublesome for those wishing to have the product traded on an exchange. For example, before warrants or other derivatives can be created on foreign indexes, the SEC has indicated that each must meet the following conditions:

1. The index must be sufficiently broad-based and composed principally of only the most actively traded and well-capitalized stocks.
2. The procedures for calculating the index must be clearly delineated and understood.

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[11] See Securities Act Release 33–152, October 3, 1988.

[12] See, for example, SEC Release 34–32343, May 20, 1993, approving the listing and trading of Equity-Linked Term Notes (ELNs). Current listing criteria can be found in SEC Release 34–36995, March 20, 1996. ELNs are defined as debt securities linked to the performance of a common stock.

[13] Section 19(b) of the Securities Exchange Act of 1934 (Exchange Act) provides broad authority to the SEC to approve or deny proposed rule changes. This section contains certain procedural requirements mandating public comment and findings by the SEC. Under Section 6(b)(5) of the Exchange Act, stock exchange rules must meet the following requirements: "The rules of the exchange are designed to prevent fraudulent and manipulative acts and practices, to promote just and equitable principles of trade, to foster cooperation and coordination with persons engaged in regulating, clearing, settling, processing information with respect to, and facilitating transactions in securities, to remove impediments to and perfect the mechanism of a free and open market and national market system, and, in general, to protect investors and the public interest; and are not designed to permit unfair discrimination between customers, issuers, brokers, or dealers, or to regulate by virtue of any authority conferred by this title matters not related to the purposes of this title or the administration of the exchange."

3. The warrants (or derivative instruments) are not likely to adversely affect the securities marketplace in the United States or the country where the underlying securities are traded.
4. The value of an underlying index or other benchmark must be available to the retail investing public at large.
5. There must be special customer suitability, disclosure, and compliance requirements.
6. There must be an adequate surveillance sharing agreement in effect between the exchange on which the security is traded and the principal market on which the stocks constituting the index are traded.

Over the past several years the SEC and the exchanges have sought to streamline the product review process. For example, in July 1996, the SEC, at the urging of various exchanges, approved generic listing guidelines for narrow-based index warrants. Although this as well as other changes have helped to lessen the delays in obtaining new product approval, in many instances it is simply impossible to obtain approval for a new product structure or classification within the time constraints required by a proposed issuer. Due in large part to increasing competition from the overseas and the over-the-counter derivatives market, the SEC recently announced a series of changes to provide that the listing and trading of new derivative security products by an exchange would not constitute a rule change for purposes of Section 19b of the Exchange Act, as long as the exchange's existing trading rules, procedures, surveillance programs, and listing standards apply to the product class covering the proposed new derivative security. The rule defines new derivative securities products broadly to include options, warrants, hybrid securities products, or any other securities whose value is based on the performance of an underlying instrument.[14]

Registration

Once the legal and regulatory review is completed and the product structure is finalized, a registration statement can be drafted by the issuer's and underwriter's counsel in consultation with the financial engineer. In public transactions, stock exchange officials should be consulted about applicable regulations and appropriate listing rules or amendments that may need to be filed with the SEC or the CFTC. In the case of cross-jurisdictional matters (i.e., conflicting SEC and CFTC regulations), close consultations with legal experts and exchange officials are particularly important. Once an equity derivative registration statement is filed, the SEC registration, review, and comment process generally takes between 30 and 90 days or more. In order to accelerate the SEC process, many issuers put shelf registrations (defined below) in place so

[14] See SEC Release No. 34–39885 (April 29, 1998).

that pricing, distribution, and trading can begin as soon as possible[15]—in certain cases, in a matter of days.

A number of practical terms are used in the SEC registration process. A *shelf registration* (or "blanket" registration statement) refers to a generic disclosure document filed with the SEC under the Securities Exchange Act of 1933[16] that describes the basic elements of a category of security. It provides a mechanism for the issuer to launch multiple offerings as "take-downs" from a base prospectus without re-registering each offering, as long as each issue conforms to the general provisions of the original shelf registration. A *take-down* is a partial, expedited use of a shelf registration using a *prospectus supplement,* which, when printed, incorporates both the base prospectus and supplement. A take-down can be effectuated in a matter of days or weeks depending on the novelty or uniqueness of the offering.

QUANTITATIVE ANALYSIS, PRICING, AND VALUATION

Options and option theory form the basis for creating and valuing most derivative securities. The ability to use options and option concepts in a variety of ways to create unique financial structures makes them appealing to financial engineers, as will become more apparent later in this chapter. Option theory provides the most convenient framework for analyzing financial risk. Although options are traditionally written on underlying common stocks, option-like structures have become the most adaptable platform from which to address and create risk solutions across many asset classes.

Overview of Options

Option contracts confer the right, but not the obligation, to the buyer (also known as the *holder*) to buy from *(calls)* or sell *(puts)* to the seller (also known as the *writer*), the underlying asset (stocks, bonds, currencies, etc.) at a specified price (the *strike* or *strike price*) for a specified period of time (the *term*), the end of which is called the *expiration date.* The price paid or received is called the *premium,* the calculation of which involves a number of valuation parameters.

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[15] Certain sales to professional and institutional investors may be exempt from SEC registration, such as certain over-the-counter and 144A (private placement) transactions. Although 144A transactions are exempt from registration, they are still subject to certain disclosure requirements, thus requiring the use of a prospectus, much like publicly offered transactions.

[16] The Securities Exchange Act of 1933, as originally enacted and revised, addresses and specifies the types and degrees of disclosure that must be made in registrations with the SEC for the benefit of investors. Issuers of securities and their advisors will be held liable for material misstatements or omissions of material facts in such disclosure documents. The Securities Exchange Act of 1934 regulates the formation, operation, and listing requirements of stock exchanges and other "self-regulatory organization" (SROs) where securities are listed and traded.

The *strike* or *strike price* is the level of the underlying asset from which an option or any other derivative attains or loses value; it is the starting point for determining the value of an option. *Put warrants* decrease in value above the strike (out-of-the-money), increase in value below the strike (in-the-money), decrease in value below the strike (out-of-the-money), and have no intrinsic value at the strike (at-the-money). If not exercised by the end of its life, an option expires worthless. Nevertheless, options are attractive both as speculative instruments, providing considerable investment leverage,[17] and as risk management tools that can protect against downside risk while preserving the opportunity to benefit from favorable price movements.

The market value of an option consists of two main parts, intrinsic value and time value. *Intrinsic value* is an amount by which an option is in-the-money (above the strike if a call and below the strike if a put), excluding any time value remaining until expiration.[18] *Time value* is the amount by which an option price exceeds its intrinsic value. It represents that part of the value of an option relating to the amount of time left until the instrument expires.[19] Time value declines over the life of the instrument and represents the option's potential to acquire more intrinsic value before it expires.[20]

Options contracts can be standardized, such as those listed on options exchanges (CBOE, AMEX, PHILX, et al.), or custom-made and privately negotiated (called private or over-the-counter [OTC] contracts). Although *warrants*[21] are frequently thought of as long-term options, there are three principal differences between options and warrants. First, warrant purchasers must look to the creditworthiness of the issuer for payment as opposed to option

[17] A standardized option contract listed on an exchange provides a good example of *leverage.* A single listed option contract traditionally controls 100 shares of stock. For a relatively small premium, say $300 ($3 × 100 shares = $300), an investor can control 100 shares of stock which might be worth $1,000 ($10 per share × 100 shares = $1,000). Therefore, for a small investment an investor can control a much larger financial position. That's *leverage.*

[18] For example, when the underlying asset on which the option is based is at a higher price than the call's strike, the call option will be in-the-money, even at expiration.

[19] Another way of looking at time value is to consider an option you may have to purchase a house. You want as much time as possible to evaluate your potential investment with the hope that mortgage interest rates decline. The purchase option preserves your right to buy the house. The amount of time you can wait to make a purchase decision has value. The closer you get to the expiration of the option, the less time you have to make a decision to buy the house. You might even be willing to pay the seller an additional premium for additional time to make a decision. Thus, time has value.

[20] Marshall and Bansal, *Financial Engineering,* pp. 337–362.

[21] Warrants are traditionally listed with common stock and give the holder the right to purchase a specific amount of stock at a specified price over a specified period of time, much like options. Warrants are typically used by corporations as a capital-raising mechanism. When a company's stock reaches a certain level, warrant holders will exercise and purchase more stock, which provides fresh funds for the company. Warrants relating to a specific common stock are usually listed along with the common stock on an exchange, under equity-listing rules. Frequently, cash-settled warrants based on various equity or currency indexes are used in derivative offering.

purchasers, who look to the Options Clearing Corporation (OCC), an entity owned by its participants. The participants and owners of the OCC include many large U.S. securities firms that deal in options. Second, warrants are distributed to investors through underwritten transactions by investment banks. Warrants, because they are underwritten and therefore placed in the hands of a large number of investors, are said to have the option equivalent of an immediate *open interest.*[22] In contrast, the number of options expands and contracts to whatever size or open interest the market demands. Finally, options, in addition to being subject to different margin treatment, are traditionally less than one year in duration.[23] The terms of warrants usually range from 18 months to five years. Chapters 1, 7, and 17 of this book provide more information about options and warrants.

Warrants are popular with financial engineers because of their long-term nature, their flexibility resembling that of options (variable terms, strikes, and prices), and their ability to be listed and sold like stocks. In contrast to private OTC transactions, where there are a limited number of buyers and sellers, exchange-listed warrants provide investors with trading liquidity (many buyers and sellers) and price transparency (each transaction is publicly disclosed).

Pricing, Valuation, and Hedging

In evaluating the pricing of derivative securities, it is necessary to deconstruct such instruments into their component parts. Debt and/or equity components can be evaluated using established analytical techniques (yield to maturity, net present value, book value, earnings ratios, etc.). The embedded option component must also be studied to determine if it is over, under, or "fairly" valued. Option prices are evaluated using six option model pricing parameters: (1) the strike of the underlying asset, (2) the underlying security price (of stocks, bonds, or other assets), (3) time to expiration of the option, (4) interest rate assumptions, (5) dividend rate (stocks) or yield (bonds), and (6) the volatility of the underlying asset.

In addition to the future direction of interest rate movements, the direction and magnitude of price volatility are the most difficult option pricing parameters to quantify. Volatility is a measure of the frequency and intensity of price changes of the asset on which an option is based. Of the risks inherent in managing market positions, volatility is perhaps the most critical because of

[22] "Open interest" refers to the total number of contracts (one seller/writer and one buyer/holder equals one contract) in an options or commodity market that are open at any point in time; that is, they have not been exercised, closed out, or allowed to expire.

[23] Although traditional listed options are less than one year in duration, there are a number of long-term equity options that are now listed on exchanges. Called LEAPS (Long-Term Equity Anticipation Securities), these option contracts last as long as three years. In 1992, the AMEX and CBOE introduced three-year LEAPS on 32 individual common stocks. To date, trading volume, open interest, and liquidity have been limited.

its effect on profitability. The more volatile the price of an asset, the more price risk exposure to investors and the greater the expense in hedging such exposure. (See the discussion of dynamic hedging and roll-risk in this section.) Volatility and its effects on option pricing are evaluated using various proprietary mathematical "black-box" models run on computers. Most firms involved in derivatives have their own option valuation models, which are usually refined variations of the original Black–Scholes Option Pricing Model.[24] Volatility measures the percentage deviation of the price of an asset from its expected value and is a function of market conditions.

Future volatility, by its nature, is unknowable. *Historical* volatility is easily determined by measuring the historical price changes of the underlying asset. *Implied* volatility, which is used in valuing or "pricing" derivative instruments, may be extrapolated from historical volatility or determined from a "black box" using an overlay of assumptions that form the option model pricing parameters previously discussed. Implied volatility can be solved mathematically when all the other option pricing variables are given. For example, when the price of an option is quoted by a competing dealer or marketmaker, its implied volatility can be calculated and thus reflects the market estimate of future volatility.

Option price changes can be quantified using a number of mathematical contructs called delta, gamma, vega, theta, and rho. *Delta* is the amount an option's price should change in response to a change in the price of the underlying security. It is also generally an approximate measure of the probability that an option will finish its life in-the-money. *Gamma* is the amount by which an option's delta will change in price in relation to the price of the underlying security. Gamma is a function of the time remaining until expiration of the option. *Vega* (or *kappa*) is the amount of change of an option price with a one-point change in the volatility of the underlying security. *Theta* is the amount by which an option price changes due to changes in time to expiration, often thought of as the amount of "time value decay" that occurs in the price of an option as it approaches expiration. *Time value decay* refers to the decline of an option price as it approaches expiration (also called *erosion* or *evaporation* of time premium). *Rho* is the amount of change in an option price owing to changes in interest rates.

As mentioned in the introduction to this chapter, protecting or "hedging" investments requires the ability to quantify and manage risk over time. *Delta hedging* refers to a risk management strategy whereby an offsetting option position is established in an underlying security equal to the option position multiplied by the value of its delta.[25] *Dynamic hedging* includes

[24] The Black–Scholes Options-Pricing Model was first introduced by Fischer Black and Myron Scholes at the University of Chicago in 1973, about the same time that exchange-listed options started trading. The impetus for the development of the model was the need to determine the fair valuation of options.

[25] See the appendix to this chapter for a further description of option pricing and valuation.

changing the structure of a risk management strategy employed in response to or in anticipation of market events. One example is selling stock index futures in order to protect stock portfolios from adverse price movements. Thus market risk is eliminated without incurring stock transaction fees, which are higher than for futures instruments, and without losing dividend cash flows from the stocks themselves. At times, positions may be "naked" or at risk from some portion or possibly all of their "notional"[26] market exposure. In the case of unmatched positions where the term of a hedge is different from that of the related instrument, a loss is possible if the actual volatility at each roll-point[27] over the term of the instrument is greater than the implied volatility assumed in the past when the hedge position was set (i.e., roll-risk). Firms may hedge a portion of the risk associated with a market position by using listed options, futures, or options on futures, or by replicating the index with securities in the underlying cash market. On occasion, a portion of the hedge may consist entirely of OTC options purchased from creditworthy counterparties.

LISTED EQUITY DERIVATIVES SECURITIES

As mentioned in the introduction to this chapter, listed equity derivative securities trade on stock exchanges under equity rules.[28] The assets underlying such instruments, however, can include any asset such as stocks, bonds, currencies, and commodities. Since new products are constantly being developed, those interested in the most recent public announcements are encouraged to consult financial periodicals and information services as well as new product and regulatory announcements by the stock exchanges. Following are brief descriptions of the various equity derivative products that the SEC has approved for listing and trading on one or more of the various exchanges.

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[26] The term *notional* refers to the aggregate dollar amount of underlying assets that are controlled by a derivative instrument; that is, the amount that serves as the basis for calculating the potential payoff to investors and the amount that is at risk and must be hedged by the issuing party. In the case where a derivative instrument controls a multiple of the underlying asset, the issue price of each unit times the number of units sold times the multiplier equals the notional amount. For example, if a derivative is priced at $50 but is intended for retail investors and sold in $5 units, the multiplier is $10 ($50/$5 = $10). If 5,000,000 units are sold, the notional amount of the offering is $250,000,000 ($5 × 5,000,000 × $10 = $250,000,000).

[27] A roll-point in time occurs when some or all of a hedge position is reestablished because of the expiration of one of its component securities (i.e., a listed option or future). The price risk associated with reestablishing such a hedge is called *roll-risk.*

[28] In view of the ever-changing regulatory environment, it is possible that future equity derivative securities may trade under rules other than those applicable to equities.

Asia Tiger 100 Index Warrants

The Asia Tiger 100 is a modified-capitalization weighted stock index calculated, published, and disseminated by the CBOE. The stocks selected are among the 100 highest capitalized stocks from Hong Kong, Indonesia, the Philippines, Singapore, South Korea, Taiwan, and Thailand. Stocks in the Asia Tiger 100 Index are valued in U.S. dollars using each country's cross-rate to the U.S. dollar. The index is adjusted annually for country weights as of the last trading day of the prior calendar year and semiannually (i.e., March and September) for individual stocks. In addition, at the September stock rebalancing, country weights will be re-set to their previous annual weighting. Call warrants on the Asia Tiger 100 began trading in April 1998.

Hong Kong Index Warrants

In June 1993, the AMEX created and began calculating a capitalization-weighted index (share price multiplied by shares outstanding), composed of 30 common stocks traded on the Hong Kong Stock Exchange. Warrants on the index, which began trading in October 1993, have since expired.

Nikkei Index Warrants and Notes

Warrants on the Nikkei 225 stock average were introduced in early 1990. The Nikkei 225 is a price-weighted index consisting of 225 of the leading Japanese common stocks traded on the Tokyo Stock Exchange. All of the Nikkei put and call warrants that were issued in the early 1990s have since expired. Five-year notes linked to the Nikkei are currently trading on the CBOE and NYSE.

Japan Export Index Warrants

This index is composed of 40 stocks of companies that are estimated to be among the largest Japanese export companies as measured by total annual yen-denominated export revenue and are listed on the First Section of the Tokyo Stock Exchange. As of the last rebalancing, the stocks that make up the index are from 10 different industry groups. The Japan Export Index is an equal-dollar weighted index, calculated, published, and disseminated by the CBOE. Call warrants on the index were issued in April 1997 and expired in March 1999.

British FT-SE 100 Index Warrants

Like warrants on the above indexes, warrants on the Financial Times-Stock Exchange 100 share index have given investors an opportunity to hedge their existing UK stock holdings or to speculate in the United Kingdom market as a whole. First published in 1984 by the London Stock Exchange and *The Financial*

Times, the broad-based FT-SE 100 Index (often referred to as the "Footsie") represents 100 industrial companies throughout the United Kingdom. As a capital-weighted index (as opposed to a price-weighted Nikkei 225 Index), the FT-SE 100 is affected by price changes for shares of companies with a large number of shares outstanding, as opposed to changes for smaller capitalized companies. All previously issued warrants on this index have since expired.

French CAC-40 Index Warrants

The French-based CAC-40 Index (Cotation Assistee en Continu, or Continuous Calculation and Quotation) was first published by the Societé des Bourse Françaises in 1988 and is designed to reflect the movements of the top 40 common stocks trading on the Paris Bourse. Like other U.S.-listed index warrants, CAC-40 warrant issues have generally provided a limit option feature that helps to minimize the risk of exercising in advance of major price changes. The *limit option* allows an exercised warrant to be nullified in the event the closing level of the index used for valuation purposes has moved a specific number of points away from the level of the index when the warrant was exercised. This user-friendly feature, elected at the time of exercise, allows investors to preserve much of the intrinsic value of a warrant position between the day of exercise and the next day when the value of the warrant is determined.

Eurotrack 200 Index Warrants

Index warrants are no longer available on the Eurotrack 200 Index, an index that was previously compiled and calculated by the London Stock Exchange and designed to measure the market performance of the common stocks of 200 major European corporations. The Eurotrack 200 represents a combination of the Financial Times-Stock Exchange (FT-SE) 100 Share Index and the FT-SE Eurotrack 100 Index. There are no products currently trading on this index.

Currency Warrants

Most currency warrants, like currency options, are designed to mirror changes in the value of the U.S. dollar relative to a single specified non-U.S. currency, such as the Japanese yen, Deutsche Mark, and British pound. Available for public trading since 1987, all the currency warrants that have been issued in the United States thus far represent the economic equivalent of puts on a specified non-U.S. currency and calls on the U.S. dollar. In addition to being exchange-traded like common stocks, currency warrants may be exercised and cash settled in U.S. dollars on any business day prior to expiration. Most of the original currency warrant offerings were issued in conjunction with debt offerings. The additional premium raised through sale of the warrants effectively low-

ered the cost of financing. The warrants were sold to retail investors under the same prospectus as standalone, publicly listed securities.

Cross-Currency Warrants

Cross-currency warrants are similar to "single" foreign currency warrants except that their value is related not to the U.S. dollar but to exchange rate differentials between two specified non-U.S. currencies (e.g., yen/Deutsche Mark, Deutsche Mark/French franc). Like other U.S.-listed currency warrants, cross-currency warrants are traded and settled in U.S. dollars and may be issued for periods ranging from 18 months to five years.

Currency Index Warrants

Although the SEC has signaled its intention to permit warrants (and similar securities) based on indexes composed of multiple currencies, only warrants on the major Market Currency Index have ever been publicly traded in the United States. Though no longer published, the index was created as an equal-weighted, currency exchange-rate index that measures day-to-day percentage price movements in the value of the U.S. dollar relative to the British pound, Deutsche Mark, and Japanese yen. The warrants, like other publicly traded currency instruments, were issued by a corporate entity rather than the Options Clearing Corporation, which is the issuer of currency options. The use of currency warrants either to protect profits in non-dollar-denominated assets (such as equity or bond funds) from adverse exchange-rate changes, or simply as a means to speculate on currency movements, has grown among U.S. investors in relation to their purchases of debt and equity outside the United States.

Commodity Trust Units

Commodity Trust Units, which are structured into "grantor trusts" (in this case, a legal entity with a fiduciary relationship between trustee and beneficiary investors) for legal purposes, provide investors with a relatively simple means to acquire a direct ownership interest in a specific commodity, such as oil or other natural resources. Oil trust units were first introduced to retail investors by Salomon Brothers. Holders of Commodity Trust Units are, in effect, owners of a prepaid, cash-settled call option on a specified commodity. The trust itself holds one or more prepaid forward contracts (see the definition of *forward contract* in the Other Derivatives Products section), which guarantee delivery to the trust of a specific quantity of a commodity at a future date and location. The trust agreement provides that the trustee will sell the commodity upon expiration of the trust and distribute the cash proceeds to unit holders.

Grantor trusts have been used in a number of forms for many public offerings over the past several years. The biggest advantage of this structure is that it is not subject to federal income tax as long as there is only one type of own-

ership interest held by the trust and the trustee has no power to alter the investment objective.

Contingent Value Rights (CVRs)

Although contingent payment securities can take a variety of forms, most publicly traded CVRs provide a preset maximum cash payment if the underlying security fails to reach a certain target price on the maturity date. CVRs have generally been used by acquiring companies as a "sweetener" (along with cash or other consideration) to encourage stockholders of a target company to relinquish control of their stockholdings in exchange for a minority interest in a proposed new and usually larger publicly traded, merged entity. By essentially guaranteeing a future price for the new merged entity securities, the acquiring company is able to take control of the target company without having to tender cash for all of the target company's outstanding common stock. If the newly issued stock advances up to or above the target price on the expiration date, the investor will benefit from the price appreciation of the underlying stock, but the investor's CVR will expire worthless.

Like put options, CVRs gain in value as the price of the underlying stock weakens. On the other hand, CVRs differ from put options in that CVRs provide for a preset maximum cash payment that cannot be exceeded regardless of how little the new company's stock may appreciate or how much it may fall below the target price.

Americus Trust Units

Between 1986 and 1987, a series of separate and distinct five-year unit investment trusts were created to allow stockholders of 27 major blue chip companies to exchange their stockholdings for an equivalent number of trust units, which, at the option of the unit holder, could then be split into two separate securities known as PRIMES and SCORES. The idea was based on the proposition that a certain portion of the market price of a stock reflects the premium investors pay for the potential capital appreciation of the stock.

PRIMES represent the income-producing, dividend, or yield component of the stock unit. The holder of a PRIME thus retained the right to all dividends, dividend increases, and full voting and subscription rights, up to the termination date. At the end of the five-year term, the holder of a PRIME was entitled to the market value in shares of the underlying common stock, up to a stipulated dollar amount called the *termination claim.* Any capital appreciation or capital gains beyond the termination claim becomes the property of the SCORE holders. Thus, when first issued, SCORES are much like out-of-the-money calls, entitling the holder to all capital appreciation, if any, in the market price of the stock in excess of the specified termination claim. As with any call warrant or option-like product, if the price of the underlying common stock does not close above the strike or termination claim at the end of the

prescribed term, the SCORE expires worthless. Although subsequent IRS tax rulings[29] no longer make this type of investment economically viable, other structures are currently being developed to replicate the economic equivalent of PRIMES and SCORES.

Bond Yield Warrants

Warrants based on bond yields allow investors to speculate on the direction of interest rates without being fully invested in fixed-income instruments. Since bond yields increase and decrease with interest rates, a yield decrease warrant will become more valuable as interest rates decline. The interest rate benchmark for these instruments can be the 30-year U.S. Treasury Bond (a.k.a. the U.S. Long Bond) or any other widely used measure of interest rates throughout the world. As yields increase, intrinsic value is lost at the same rate per basis point. The market price of bond yield warrants, like other warrants and options, is typically higher than the intrinsic value to account for any time value remaining to expiration. In addition to being exchange-traded, bond yield warrants, like other listed warrants, may also be exercised by investors on any business day prior to expiration. Bond yield warrants are an example of instruments that require strong economic research forecasts to be successfully marketed.

Preference (Preferred) Equity Redemption Cumulative Stock (PERCS)

PERCS[30] are much like PRIMES except that they are issued by a corporate entity in order to raise additional equity capital and are marketed as an alternative to the purchase of the issuer's common stock. From an economic perspective, owning a PERCS is much like owning a common stock with an embedded long-dated call—what options traders usually refer to as a *buy-write* strategy. Although initially priced on the basis of the issuer's common stock, PERCS carry a higher dividend than that paid on the common stock, in return for a limit or *cap* (usually 35 to 40 percent) on the possible appreciation of the common stock until expiration (usually two to three years from issuance). Because of their preferred status in the event of bankruptcy and the cumulative nature of their dividend, PERCS are generally regarded as somewhat less risky than common stock. Nevertheless, since PERCS automatically convert to common stock at expiration (up to a maximum of one common

[29] Although the first series of Americus Trust Units were issued under a "no action" letter from the IRS, the IRS later imposed existing rules, among others, that treated the initial transfer of shares from an investor to an Americus Trust as a taxable event, making such a transfer equivalent to the sale of a security, thereby generating a taxable gain or loss and thus providing a disincentive to the investor to transfer shares to a trust.

[30] "PERCS" and "Preferred Equity Redemption Cumulative Stock" are trademarks of Morgan Stanley & Co.

share for each PERC), investors still have market risk and would incur a loss if, on the day of expiration, the market price of the common was below their initial PERC cost. Finally, the issuer can redeem PERCS before mandatory conversion at prices set forth in the prospectus.

Index-Linked Notes

Index-linked notes are *hybrid*[31] instruments that provide investors with principal preservation and potential equity participation. Such instruments go by a variety of acronyms (MITTS, SIGNS, PENS, SPINS, SMART Notes, etc.) and are basically the economic equivalent of a zero-coupon bond with an embedded stock index option in a single security called a *unit.* Unlike traditional debt instruments, which usually have fixed returns, these instruments provide little or no interest in exchange for the possibility of the appreciation (in the case of an embedded *call* option) or depreciation (in the case of an embedded *put* option) of an index (stock or other asset class). Each unit delivers back to investors their entire principal investments at the maturity date (usually five to seven years) plus some multiple (more or less than 100 percent) of the appreciation, if any, of an underlying index, such as the S&P 500, the S&P MidCap 400, the Dow Jones Industrial Average, and the Nikkei 225. The issuer gets the use of the net offering proceeds for the life of the instrument, free of any current interest obligations. The discounted present value of the instrument forms the so-called zero component of the instrument, with the remaining balance used for creating the embedded option. Index-linked notes can be either senior or subordinated unsecured debt obligations of the issuer and are used in private OTC (see definition below) transactions as well as those that are listed and traded on an exchange.

Equity-Linked Notes

Equity-linked notes are also hybrid instruments that can be linked to the performance of a single stock. These instruments are designed for investors seeking a fixed rate of return together with the possibility of appreciation if the stock to which the instrument is linked increases above a certain specified level. Since these instruments seldom guarantee a fixed amount at maturity, they frequently pay a relatively high current yield. Equity-linked instruments may take a variety of forms. Those listed to date are noncallable, issued at a price keyed to the underlying common stock with a specified coupon and limited price appreciation potential. Higher-than-market coupon rates are intended to compensate investors for the limited participation in future stock price appreciation.

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[31] The term *hybrid* in this context refers to a derivative security that embodies elements of two or more underlying securities, in this case, a debt instrument and an option on an equity index.

Convertible Capital Securities

Convertible capital securities are similar in many respects to preferred purchase units used to raise capital primarily by bank holding companies. Generally issued in small denominations, convertible capital securities usually have 30- to 50-year maturities and are launched at a rate to attract income-oriented investors. These securities differ from usual long-term debt in that the issuer has the right at any time to reduce the initial interest rate to a newly prescribed lower rate. Should this occur, however, holders have the option either to accept the lower rate or to convert their holdings into perpetual preferred stock, which pays dividends equivalent to the initial higher rate. From the issuer's perspective, subordinated debt represents Tier II balance sheet capital with fully tax-deductible interest payments. If the issuer lowers the interest rate, holders, whose foremost concern is income, will have the economic incentive to convert to perpetual preferred stock, which, in turn, is categorized non-tax-deductible Tier I balance sheet capital. Since such dividends are not deductible, an issuer is not likely to force conversion by lowering the interest payment unless it requires additional permanent capital.

Other Derivative Products

Although this chapter focuses on the more usual types of listed equity derivative securities, there are many other types of structured derivative financial products, including a wide variety of private market OTC instruments, such as futures, forwards, a wide variety of OTC options, credit derivatives, weather derivatives, asset-linked certificates of deposit, and swaps. *OTC instruments* include custom-made financial contracts that address specific market objectives of professional and institutional investors. *Futures* are contractual obligations to take delivery of a specified product on a specific date. However, such delivery rarely takes place. Economic gains or losses on futures contracts are usually conveyed monetarily. Futures embody standardized terms, such as the deposit of margin so as to bind the contract, and the daily mark-to-market of positions. They are contracts that generally provide a source of speculation or protection from price exposure. Unlike futures, *forward* contracts are prepaid instruments that generally provide a source of delivery of the underlying commodity. *Swaps* are contracts between two parties to exchange cash flows based on a reference price and an amount of an underlying asset. Typically, parties to a swap transaction seek to exchange floating-rate for fixed-rate debt. The variety of swap-based financial transactions has proliferated across a broad spectrum of creditworthy counterparties around the world.

Table 21.2 highlights those equity derivative instruments that are currently traded on securities exchanges in the United States.

Table 21.2 U.S. Listed Equity Derivative Securities

Issuer (Trading Symbol)	*Underwriters/Financial Advisors*	*Exchange*
Equity Index-Linked Notes		
Merrill Lynch Company		
MITTS on S&P 500 (MIE, MIM, MIX, IEM, MLF)	Merrill Lynch & Co.	NYSE, AMEX
MITTS on Dow Jones Industrial Average (DJM)	Merrill Lynch & Co.	NYSE
MITTS on Nikkei 225 Stock Average (JEM)	Merrill Lynch & Co.	NYSE
MITTS on Russell 2000 (RUM)	Merrill Lynch & Co.	AMEX
MITTS on Major 11 International (EEM)	Merrill Lynch & Co.	AMEX
MITTS on Major 8 European (MEM)	Merrill Lynch & Co.	AMEX
MITTS on Healthcare/Biotech (MLH)	Merrill Lynch & Co.	AMEX
MITTS on Top 10 Yield (MTT)	Merrill Lynch & Co.	AMEX
MITTS on CBOE Technology Index	Merrill Lynch & Co.	CBOE
Amex Hong Kong Index Bond (HKN.A)	Merrill Lynch & Co.	AMEX
Japan Index bond (MJP.A)	Merrill Lynch & Co.	AMEX
Oil Trust SMART Notes (MOI.F)	Merrill Lynch & Co.	AMEX
Salomon Smith Barney Holdings, Inc.		
S&P 500 (XSB, YSB, ZSB, XPN.A, ASB, NSB, KSB)	Salomon Smith Barney, CIBC Oppenheimer	CBOE, NYSE, AMEX
Dow Jones Industrial Average (DSB)	Salomon Smith Barney, CIBC Oppenheimer	CBOE
Nikkei 225 Stock Average (NXS)	Salomon Smith Barney, CIBC Oppenheimer	CBOE, NYSE
Morgan Stanley Dean Witter & Co.		
PEEQS on S&P 500 (MPQ)	Morgan Stanley Dean Witter	AMEX
BRIDGES on S&P 500 (BGS)	Morgan Stanley Dean Witter	NYSE
BRIDGES on Dow Jones (BDJ)	Morgan Stanley Dean Witter	NYSE
1% Telecommunication Notes (TBB.A)	Morgan Stanley Dean Witter	AMEX
The Bear Stearns Companies, Inc.		
S&P 500 (BSL)	Bear Stearns	CBOE
Paine Webber Group Inc.		
S&P MidCap 400 (SIS)	Paine Webber	AMEX
GS Financial Products		
Nikkei 225 Notes (6SN.A)	Goldman, Sachs	AMEX
Lehman Brothers Holdings		
Global Telecom SUNS (SXT)	Lehman	AMEX
Equity Linked Notes		
Morgan Stanley Dean Witter & Co.		
PERQS on Telebras (TBM)	Morgan Stanley Dean Witter	AMEX
PERQS on Applied Materials (APP)	Morgan Stanley Dean Witter	AMEX
PERQS on Sony (SPS)	Morgan Stanley Dean Witter	AMEX
Lehman Brothers Holdings		
YEELDS on Cisco Systems (YCS)	Lehman	AMEX
Salomon Smith Barney Holdings		
TARGETS on Cisco Systems (TCX)	Salomon Smith Barney	CBOE
TARGETS on Lucent (TLU)	Salomon Smith Barney	CBOE
Merrill Lynch Group		
ProGros on Oracle (OPG)	Merrill Lynch	AMEX
ProGros on Telebras (PGT)	Merrill Lynch	AMEX
Telebras (MBN.A)	Merrill Lynch	AMEX
3% Honda Motor (HML)	Merrill Lynch	AMEX
5% Travelers Group (TLN.A)	Merrill Lynch	AMEX

(continues)

Table 21.2 Continued

Issuer (Trading Symbol)	*Underwriters/Financial Advisors*	*Exchange*
U.S. Domestic Index Warrants		
Salomon Smith Barney Holdings		
Ten+ Call Warrants (TPW.WS)	Salomon Smith Barney	CBOE
Merrill Lynch Company		
Russell 2000 Call Warrants (RIM.WS)	Merrill Lynch	AMEX
Lehman Brothers Holdings		
Select Technology Index Calls (LET.WS)	Lehman	CBOE
International Index Warrants		
IFC Asia Tiger 100 Calls (ACW.WS)	CIBC Oppenheimer	CBOE
IFC Japan Export Index Calls (JXC.WS)	CIBC Oppenheimer	COBE
Commodity-Indexed Preferred Securities		
J.P. Morgan & Co. Inc.		
J.P. Morgan Crude Oil Index (JPO)	J.P. Morgan	AMEX
Preference Stock		
Morgan Stanley PERCS	Morgan Stanley et al. (20+ issues)	NYSE
Merrill Lynch STRYPES	Merrill Lynch (5+ issues)	NYSE, AMEX
Merrill Lynch TOPrS	Merrill Lynch (10+ issues)	NYSE, AMEX
Convertible Capital Securities		
Bankers Trust		
7 5/8% 2033 (BDN)	Bankers Trust	AMEX
7 1/2% 2033 (BTB)	Bankers Trust	AMEX
Trust, Trust Preferred, and Other Structured Securities (19+ issues and issuers)		AMEX

CONCLUSION

The development of derivative securities is an evolutionary process of continuous change and adaptation to market circumstances and investor demands. Financial engineering as a new science is also evolving. It is full of assumptions, predictions, hypotheses, and the subtle interpretation of events. The success of derivative securities is drawn from their popularity with investors, issuers, and risk managers. As a result, the financial community is forging ahead in developing new and innovative instruments that reduce risk, enhance yields, and solve financial problems in global markets.

The future of derivative securities in the United States hinges on the regulatory environment. Various regulators, politicians, and government and industry groups in the United States and Europe have spent the last several years engaged in a comprehensive review of regulations and policies affecting derivative securities. Recently proposed rules and studies would place limits on the quantity and types of derivative instruments that banks as well as securities firms and their affiliates may issue. Other areas of concern to regulators and

certain policymaking bodies include an examination of the capital adequacy of issuers, investor risk disclosure, position limits, margin treatment, and customer investment suitability. Any new regulations that emerge to govern the creation and sale of derivative products will directly affect financial engineering in the United States. As with many regulations, a balance is necessary between perceived and actual regulatory risks, the assessment of those risks and the possibility of discouraging financial innovation, risk management, and U.S. development of this promising new area of the capital markets.

The creators of custom-made derivative financial products usually have the ability to execute transactions globally, across many different asset classes. However, the cost of entry into many areas of derivative business will remain prohibitive for many entities, not only in terms of capital requirements but in terms of international trading capabilities and computer and research support, as well as finding and retaining the necessary financial engineering, sales, trading, and risk management professionals.

APPENDIX: OPTIONS AS SPORT[32]

Understanding how option prices change in response to change in other variables can be tricky. The Greek (delta, gamma, and theta) and pseudo-Greek (vega) names used to measure option sensitivities do not necessarily make things clearer. Options do, however, make intuitive sense if they can be viewed in an easily understood framework, such as the sport of basketball. Please note that the following examples involve references to hypothetical bets on the performance of imaginary terms. The examples are used strictly to help explain option pricing concepts, and are not meant as an endorsement of pure speculation or betting. Rather, options are instruments that investors can use to tailor their portfolios to their own expectations and to reduce or increase risk.

Delta (Probability of an Option Expiring In-The-Money)

An option's delta is its most frequently observed characteristic. *Delta* is, strictly speaking, a hedge ratio, but it also generally approximates the likelihood that an option will finish its life in-the-money (e.g., that a call option will expire with the underlying asset at a higher price than the call's strike). A nearly exact analogy in a basketball game is the probability that one of the teams will win.

Suppose Teams A and B are about to play and the game is considered a *toss-up.* Before the game starts, each team has an equal chance of winning. With *options,* 50 percent is a typical delta for an at-the-money option with a

[32] Extracted from materials provided by and published with the permission of Bill Feingold, co-founder, Hinsdale Capital Management. New York, 1994, 1999.

relatively short term to expiration, say three months. The fact that the option is at-the-money (i.e., the underlying asset's price is equal to the option's strike price) is important for preserving the basketball analogy because each team is neither ahead nor behind, just as the option is neither in-the-money nor out-of-the-money.

Suppose that in a basketball game, Team A is a heavy favorite. It has a delta of 80 percent. Since the game has not yet begun, we must still say that the option is at-the-money. How can an at-the-money option have such a high delta? It can if there is strong reason to believe the underlying asset will exceed the strike price at expiration. (We will continue to use calls in our example, although the logic can also be used for puts.) What might be the rationale for such a belief?

Consider a 10-year at-the-money call option on an index of non-dividend paying stocks. Because the opportunity cost of keeping money in stocks for this long a period is quite high (money invested in risk-free securities could easily double in value because of compounding interest over a 10-year period), it seems highly unlikely to expect the stock index to have a lower nominal value at the end of the period than at the beginning. Just as Team A is heavily favored to beat Team B, a 10-year at-the-money call option is heavily favored to finish in-the-money. Consequently, the delta, or the approximate probability of the option being in-the-money in 10 years, will be much greater than neutral (50 percent is neutral). Note that this logic clearly does not apply to short-term options, since their value is dictated by price moves over a handful of days and the randomness of these moves will dominate the relatively minor amount of forgone interest income over such a short period of time.

Gamma (Rate of Increase of the Probability of an Option Expiring In-The-Money)

Suppose now that the basketball game is under way and one of the teams has taken the lead. It makes sense that the team in front now has a higher probability of winning than it did at the beginning of the game and that the greater the team's lead, the more the odds have swung in its favor. Moving back to options, this is equivalent to a stock going up and raising the delta of what was originally an at-the-money call. But how much should the delta go up? In option language, this is measured by *gamma,* which is much higher as the option nears expiration than at the beginning of its life. But if this is Greek to you, go back to basketball!

Let's look again at a basketball game in which the teams are considered to have even odds. The game starts and Team A wins the jump ball, scoring on a quick layup. It leads 2 to 0. Realistically, Team A has only a marginally higher chance of winning than it did before the game started; perhaps now its delta is 51 percent instead of 50 percent. In other words, its gamma is 1 percent. Nothing significant has happened. But skip ahead to the last minute of the game. The score is tied 76–76 with just seconds to play. Each team's delta should be around 50 percent. When Team A scores right before the end of the

game, its delta goes up from 50 percent to 98 percent, a much higher rate of increase, or gamma, than when it scored the first basket of the game. Of course, if the game had been one-sided throughout, with Team A dominating the game, the last basket before the buzzer would not have affected the delta at all. This example shows how gamma is at its highest for near-the-money options approaching expiration. A single favorable move in the underlying stock makes it almost certain to finish in-the-money, while an unfavorable move makes it virtually certain to expire worthless. On the other hand, using the basketball game example, buying a long-dated option gives you the luxury of scoring your way out of a bad start. You still have plenty of time to catch up.

Theta (Time Decay of an Option)

Consider two five-minute stretches in an imaginary basketball game between Teams A and B. In each case, Team A begins the first five-minute stretch leading by eight points, and the margin is unchanged at the end of the stretch. Let's say the first stretch was early in the game, beginning with 17 minutes left in the first half and ending with 12 minutes to go in the half. The second five-minute stretch, on the other hand, begins with six minutes left in the game and ends with only one minute left.

In each case, Team B fails to score and reduce its point deficit as time passes. How much should the value of a bet on Team B fall? Let's imagine an initial pregame bet of $1.00 that Team B will win. In the first case, after Team B has quickly fallen behind by eight points early in the game, that bet loses some of its value but is probably still worth around $0.85. Almost the whole game is left, and perhaps Team A just happened to be the first team to have a hot streak (equivalent to a noticeable move in the underlying asset very early in the life of an option). After more time has passed and Team B's point deficit remains at eight points, the value of the bet on Team B will have fallen more, from perhaps $0.85 to $0.80. The 5-cent drop in the value of the bet on Team B over a five-minute stretch early in the game (or 1 cent per minute) is the theta (or loss of value per unit of time passing) of a bet on the losing team.

Now let's look at the second example, in which Team B trails by eight points late in the game. Clearly, time is a huge factor now; Team B's failure to gain any ground should cause a big drop in the value of a bet on it, say from $0.20 to $0.01. In this case the theta would be $0.19 over five minutes, or almost $0.04 per minute—a much higher theta than earlier in the game when the theta was only $0.01 per minute.

In other words, when a given amount of time passes with nothing happening to the value of the underlying security, the amount by which an option's value decays depends primarily on how far the option is from expiration. When expiration is still relatively far off, the passage of some time will have a modest negative effect on the option. But as expiration approaches, the passage of that same absolute amount of time will cause a much larger drop in the option's value, in both absolute and percentage terms.

Notice that this example uses the losing team. This was not arbitrary. The winning team wants time to pass without the score changing, assuming it is concerned only with winning and not with the margin of victory. If a bet on the losing team has properties similar to those of owning an option, a bet on the winning team must be similar to the position of someone who has written (sold) an option. Such a person is said to have "sold volatility" and wants the score of the basketball game or, in the case of options, the price of the underlying asset to remain as it is.

Vega (Amount of Option Price Change for Each Percent Change in Volatility)

Vega is not a real Greek letter, and in some sense it is an artificial measure of how option values change. This is because vega is defined as the amount an option's value changes if its *implied volatility* changes by one percentage point. However, the only way to find implied volatility is to look at the market price of the option and determine the volatility based on the price. In other words, there is a bit of a chicken-and-egg problem. Is the option expensive because volatility is high, or is implied volatility high because the option is expensive?

On the other hand, this description is a bit unfair to vega. Volatility, as represented in numerical terms, is usually defined as the annual standard deviation of price changes in the underlying security. To simplify, this means that a $100 stock with a volatility of 30 percent can be expected to have a price between $130 and 170 at the end of a year.[33] The key is that a given level of volatility has different implications for likely absolute price changes for different periods of time. The longer the time, the more a stock can be expected to move up or down.

Now let's go back to basketball. First, imagine Team A, whose best player always scores 20 points per game; he almost never does better or worse. He has very low volatility, and so does his team when he is playing. Let's say the team's volatility with "Steady Eddie" is 10 percent. It scores on average 60 points per game, with a range of 54 to 66 points. But the team also has a talented freshman named "Wild Thing," who can score 40 points when he is hot but on a bad night might not score any points. With Wild Thing replacing Steady Eddie, the team still scores an average of 60 points, but now the team's

[33] A bit of pure math is necessary here. Time does not influence option prices linearly but as a square root function. Consider two options, identical in all respects except that one has twice as much time to expiration as the other. The option with the longer duration will not be worth twice as much as the shorter one. The factor is, instead, the square root of 2, or about 1.4. This may make intuitive sense to you when you think about the economic principle of diminishing marginal returns. If not, don't worry about it. Getting back to our stock, after six months the stock can be expected to have a price range centering roughly on 100, with the lower end around 30/1.4, or 21 points below the center, and the upper end a similar amount higher (i.e., a six-month range of $79 to $121).

volatility is, say, 30 percent instead of 10 percent. The team might score between 42 and 78 points. If the team expects to be able to hold its opponent's score under 50 points, it should go with Steady Eddie, but against a high-scoring opponent expected to score 75 points or more, the team has to take its chances with Wild Thing. Before the start of the game, Team X's coach has to assess the possible scoring potential of Wild Thing and Steady Eddie.

But what if the team makes a mistake in scouting Team B? Let's say Team A goes with Steady Eddie and finds itself unexpectedly far behind at halftime, say by 45 to 30. Team A now expects Team B to score 30 points in the second half, so they know they (Team A) will need more than a total of 75 points (more than 45 points in the second half) to win. With Steady Eddie, the best the team can reasonably hope to score is 34 points in the second half, which is unlikely to be enough to win.

At halftime the coach turns to Wild Thing. But before the coach can speak, the freshman, who knows option theory, says, "It's too late, coach. You only get a half game of my volatility now, and the best we can score in the second half with me playing is probably 43 points, which won't quite do it. Increasing our volatility from 10 percent to 30 percent for half a game only increases our upside potential from 10 percent to 30 percent for a half game only. That only increases our upside potential by 9 points (i.e., [(18 – 6)/1.4] = 9). If you had put me in when the game started, then you could have increased our upside potential by 12 points. Volatility is like fine wine, coach. You've gotta give it time."