



C A M B R I D G E A S S O C I A T E S L L C

AN INTRODUCTION TO DERIVATIVES

Copyright © 2003 by Cambridge Associates LLC. All rights reserved.

This report may not be displayed, reproduced, distributed, transmitted or used to create derivative works in any form, in whole or in portion, by any means, without written permission from Cambridge Associates LLC. Copying of this publication is a violation of federal copyright laws (17 U.S.C. 101 et seq.). Violators of this copyright may be subject to liability for substantial monetary damages. The information and material published in this report are confidential and non-transferable. This means that authorized members may not disclose any information or material derived from this report to third parties, or use information or material from this report, without the prior written authorization of Cambridge Associates LLC. An authorized member may disclose information or material from this report to its staff, trustees, or Investment Committee with the understanding that these individuals will treat it confidentially. Additionally, information from this report may be disclosed if disclosure is required by law or court order, but members are required to provide notice to Cambridge Associates LLC reasonably in advance of such disclosure. This report is provided for informational purposes only. It is not intended to constitute an offer of securities of any of the issuers that are described in the report. This report is provided only to persons that Cambridge Associates LLC believes to be "Accredited Investors" as that term is defined in Regulation D under the Securities Act of 1933. The recipient of this report may not provide it to any other person without the consent of Cambridge Associates LLC. Investors should completely review all Fund offering materials before considering an investment. No part of this report is intended as a recommendation of any firm or any security. Factual information contained herein about investment firms and their returns which has not been independently verified has generally been collected from the firms themselves through the mail. We can neither assure nor accept responsibility for accuracy, but substantial legal liability may apply to misrepresentations of results delivered through the mail. The CA Manager Medians are derived from Cambridge Associates LLC's proprietary database covering investment managers. Cambridge Associates LLC does not necessarily endorse or recommend the managers in this universe. Performance results are generally gross of investment management fees and do not include returns for discontinued managers.

Definition

Derivatives are financial instruments whose value is based on that of some underlying security, such as a bond or share of stock. In contrast, "traditional" financial instruments derive their value from claims on cash flows arising from economic activity. For example, a call option on a stock grants its holder the right but not the obligation to purchase the stock at a specified price (called the strike price) within a specified period of time. The value of the option therefore depends on whether the strike price is higher or lower than the price of the stock. In this sense, the value of the option is derived from that of the underlying security.

Today, the major types of derivative securities in use in financial markets are forward and futures contracts, swaps, and options. While not traditionally viewed as derivatives, mortgage-backed securities and structured notes are also discussed below. Although all of these are in common use in financial markets today, they are not all used to the same extent in investment portfolios. In fact, the types of derivative securities and investment strategies that resulted in the much-publicized losses in 1994 are not generally found in institutional investment portfolios. In addition, the ways in which derivatives are used vary widely among investment managers.

Most types of derivatives can be used to implement speculative strategies. However, probably the primary and most prevalent use of derivatives in investor portfolios is to hedge risk. A futures contract can be used, for example, to offset the risks inherent in a position in 30-year Treasury bonds by the assumption of an opposite position in the futures market. Currency forwards enable investors to hedge against movements in currency exchange rates. Similarly, firms that are significant sellers or purchasers of commodities can use commodity futures to protect themselves against adverse changes in commodity prices. A secondary use of derivatives is as an easy and inexpensive way to gain immediate exposure to a market. Speculators can use derivatives to leverage portfolios or assume risk exposures that could not otherwise be obtainable, but the presence of these speculators also serves to keep the underlying assets more efficiently priced.

- Both a **forward contract** and a **futures contract** are arrangements between two parties to buy or sell a predetermined amount of a given security or good on a specific future date at a specific price. Forward contracts are usually private or over-the-counter arrangements between counterparties. A **futures contract** may be differentiated from a forward contract in that it is traded on an organized exchange whose rules govern and specify the terms of the contract. A "good faith" deposit of cash collateral sufficient to meet specified margin requirements is required in advance and the contract is marked to market daily. Instead of a direct trading partner on the other side of the contract, the exchange clearinghouse is the counterparty to the transaction.

- A **swap** is an agreement between two parties to exchange a series of commitments (generally an obligation to make one or more payments or the right to receive one or more payments) over a specific time period. For example, financial institutions might use interest rate swaps to alter the duration of their loan portfolios to match the duration of their assets or multinational companies might use currency swaps to manage their exposure to exchange rate shifts.
- An **option** is the right, but not the obligation, to buy or sell a particular underlying asset, for a specific period of time. A **call option** gives the holder the right to buy the underlying asset over a specified period at a given price (called the strike price); the purchaser of the option may exercise this right. Conversely, a **put option** gives the holder the right to sell the underlying asset at a given price during a specified time. Call options enable investors to participate in the gains from an increase in price without having to incur the losses resulting from an adverse price movement. Put options, when held along with the underlying asset, enable investors to hedge price risk by setting a floor for the minimum price for which an investor can sell the underlying asset.
- A **mortgage-backed security (MBS)** represents ownership of an undivided interest in a mortgage pool. The principal return on the MBS is derived from the principal on the individual mortgages within the pool, while the interest return on the MBS is derived from the interest payments from the individual mortgages in the pool. Various types of mortgage-backed securities have been developed to provide exposure to these cash flows or to manage the risks of investing in mortgages. The more familiar of these derivatives include mortgage derivatives, collateralized mortgage obligations (CMOs), and floating rate classes or "floaters." A **mortgage derivative** is an MBS whose prepayment risk is greater than the value of the underlying collateral. A **CMO** is created by pooling mortgages or mortgage securities and dividing the cash flows into several tranches to allocate interest and principal cash flows among different investors. A **floater** is a form of CMO whose interest is paid at a rate that adjusts periodically to a prearranged level above a given index.
- A **structured note** is a security that has linked either or both interest and principal payments to some underlying asset or index by a formula.

Characteristics

Risk. Since derivatives merely transfer investment risks from one party to another, it follows that they can be used to increase as well as to reduce risk-to speculate as well as to hedge. In a typical derivatives transaction, an investor unwilling to bear a certain risk lays it off on a speculator who has gauged that the prospective return more than compensates for the risk-and the derivative security is simply the vehicle by which this risk is transferred. If the level of risk has been mispriced, or the risk taker happens to be holding the bag on that one occasion in a thousand when a low probability comes to pass, then the consequences can be severe-there is absolutely nothing new about that sort of equation. It

follows, then, that yield-enhancing derivative strategies must derive their enhancement at the cost of greater risk to the portfolio.

Additionally, there are specific risks to which the derivative holder is exposed:

- **Basis risk:** Incurring gains or losses due to a change in the relationship between the current cash price and a reference price, such as a forward price or the price of an index.
- **Counterparty risk:** The counterparty may default on the derivatives transaction.
- **Credit risk:** Financial loss as a result of default on the part of the issuer or the counterparty.
- **Liquidity risk:** Derivative spread transactions often depend upon continuing liquidity, which could be impaired during market dislocations.
- **Inactive, flat markets:** Several derivatives strategies depend upon volatility to generate profits.

Return. When derivatives are used as a hedge against adverse price or interest-rate moves, realizing a return is not the primary objective. Instead, the investor, in exchange for risk protection, gives up the opportunity to profit from beneficial changes in prices or interest rates. In contrast, when employed as a speculative strategy, derivatives can be used to enhance returns, though, as mentioned earlier, this comes with increased risk.

Pricing. The pricing of derivative instruments is best understood using no arbitrage¹ pricing models. Briefly, these models price a derivative security by constructing an investment strategy based on cash securities that exactly replicate the cash flows from the derivative position. Since the cash flows from the derivative position are identical to those from the constructed or "synthetic" position, any price differences would immediately be eliminated by arbitrageurs. Therefore, in this no arbitrage environment, their values have to be identical.

Futures contracts are priced based on a no-arbitrage model such that a buyer is indifferent between purchasing an asset in the cash market today or in the futures market for delivery at the settlement date of the futures contract. The relationship between the price of the asset today and the futures price is also dependent upon the degree to which cash-and-carry arbitrage is possible. Cash-and-carry arbitrage is predicated on the assumption that a profit can be made buying a futures contract, short selling the underlying asset, and investing the proceeds from the short sale. If assets are not fully loanable, or are costly or difficult to store, the futures price tends to be lower than the spot price.

¹ Arbitrage is the practice of earning economic profits by taking risk-free, fully hedged positions on mispriced securities.

Entering into a futures contract is a costless transaction (ignoring the margin requirement). At settlement of futures contract, the seller of the contract must deliver the underlying asset to the buyer of the futures contract for the futures price. Typically this settlement is done in cash, as most futures investors do not wish to take ownership of the underlying asset. In cash settlement, if the spot price of the asset is greater than the contract's futures price, the seller of the futures contract pays the buyer the difference between the two prices. Conversely, if the spot price of the asset is less than the contract's futures price, the buyer of the futures contract pays the seller the difference between the two prices. In other words, for every dollar the spot price is greater than the futures price, the seller loses one dollar and the buyer gains one dollar.

Options allow the holder to buy or sell the underlying asset at a price (the strike price) that may be different than that at which it is actually trading in the public market. The value of an option at maturity is the difference between the market price and the strike price at maturity, provided that the contract is "in the money." A call option is "in the money" when the strike price is lower than the market price, since the call option enables the holder to purchase the underlying asset at the lower strike price. A put option is "in the money" when the strike price is greater than the market price, since the put option enables the holder to sell the underlying asset at the higher strike price. If an option is not "in the money" at the time of expiration, the option will expire worthless, since the holder of a call option would not chose to purchase an asset at a higher price than is available in the market and the holder of a put option would not chose to sell an asset at a lower price than can be found in the market. Option sellers, therefore, set premiums that reflect the probability that the option will be exercised, since they are required to buy (or sell) the underlying security from the holder of the option should the option be exercised. The greater the probability that an option will be exercised, the greater the price of the option.

Options may be viewed as expensive or cheap relative to long-term normative options prices. For example, options prices increase with volatility. On October 19, 1987, when the S&P 500 dropped 508 points in one day, options on S&P 500 futures were very expensive. An experienced options trader would have sold into the market during that highly volatile period.

Common Uses of Derivatives

- Serves as a hedge against risk. For example, as discussed above, a futures contract can offset the risks inherent in the underlying asset by assuming the opposite position. Additionally, options hedge risk by enabling investors to limit losses beyond an option's strike price (plus the option premium), while enabling them to participate in investment gains.

- Implements investment strategies in a low cost and efficient manner. One of the primary advantages of trading standardized options and futures contracts in organized exchanges, and a major driving force behind their continuing growth and popularity, is that these markets are very liquid and have lower transactions costs than those of the underlying cash markets. As a result, it is often easier and more cost effective to implement investment strategies through derivative instruments.
- Can be used to construct portfolios whose risk and return characteristics could not otherwise be created.
- Provides leverage to a portfolio. Many derivative securities-like options and futures-are inherently leveraged in the sense that they can be used to obtain a given level of risk exposure with a lower cash outlay than would be required using cash securities. Mortgage derivatives such as CMOs and structured notes can also be highly leveraged. Because they provide such an easy way to leverage portfolios, derivatives are particularly appealing to speculators.

Issues to Consider

- Market for over-the-counter derivatives (vs. those trading on organized exchanges) is unregulated and illiquid.
- Derivative investments can be extremely volatile.
- Inherent leverage of many derivative securities magnifies risk exposure.
- Mortgage-backed security payment streams are highly sensitive to interest rate shifts.
- Some derivatives structures (particularly mortgage-backed derivatives) can be complex, making it difficult to understand easily the structure and the risks to which they expose the investor.

Implementation Issues

Institutions seeking to define the appropriate use of derivative securities in their investment portfolios must do so in the context of their overall investment objectives and tolerance for risk. Because derivatives provide the means by which risk is transferred among market participants, it is important to recognize that-despite the headlines-they can be extremely effective tools for **reducing** risk. For this reason, it would be shortsighted to constrain managers with appropriate expertise and well-defined strategies from using derivatives as part of their risk-management techniques.

The following blueprint outlines a process by which institutions can monitor and control derivatives risk:

Evaluate preferences for risk in the context of financial and investment objectives. A policy on the use of derivative securities must be developed in the context of a clear understanding of the institution's overall risk and return objectives. Derivative securities allow investors to gain exposure to the risks and returns underlying a staggering array of investment opportunities. It is the role of the institution to determine which opportunities and risks are suitable given its financial and investment objectives.

Decide where derivative use might be appropriate given overall objectives. Having evaluated its risk preferences and the suitability of various market opportunities or asset classes, the institution can proceed to evaluate where derivative use is appropriate. The benefits and risks of using derivative securities differ substantially across asset classes and depend on factors such as the liquidity, depth, and efficiency of the derivative markets in addition to the risks associated with the underlying cash markets. Some derivative securities (e.g., interest-rate futures or index options) are very liquid and provide cheap and easy means to tailor a portfolio's risk profile. In other instances, especially for investors with longer investment horizons, the cost of implementing a derivative-based strategy could be prohibitively high when compared to that of a cash market strategy.

Incorporate guidelines for derivatives use in manager guidelines. The guidelines should make clear the objectives of using derivatives, with specific references to different asset classes if necessary. The guidelines can also serve as a basis for monitoring the ongoing use of derivatives and the level of risk in investment portfolios

- Require that managers inform institutions before using derivatives. This step should be viewed as a way to formalize the process by which use of derivative securities is initiated and as a means of understanding the purpose, benefits, costs, and risks associated with the strategies proposed by the manager.
- Evaluate the competence of managers before giving them permission to use derivatives. This evaluation should include a review of previous experience with the use of derivatives, the evaluation of internal controls to ensure that derivative use is consistent with investment guidelines, and the evaluation of mechanisms to price portfolio positions in derivatives.
- Formulate manager-specific guidelines for derivative use in conjunction with the manager. Once the manager's purpose in using derivatives has been deemed consistent with the institution's investment objectives, and the manager's expertise has been reviewed, it is appropriate to formulate specific guidelines for the manager to define the appropriate boundaries of derivatives use. Such guidelines can include specifications on the use of leverage, concentration of portfolio risk, and maximum limits on derivative positions.

- Monitor derivative use by managers. Finally, the institution may wish to develop a process for monitoring the nature and the extent of the use of derivatives in its investment portfolios. This process can include periodic reports by managers on derivative securities positions and associated risks. Investment committees may also wish to consider hiring third parties to evaluate derivative risks in cases where they may be especially concerned about portfolio risk.