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*A Step-by-Step Guide to Forwards, Futures, Swaps and Options*

SECOND EDITION

ANDREW M. CHISHOLM

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Second Edition

**Andrew M. Chisholm**

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Dedicated to the memory of Mirek Piskáček

Profit . . . attaches to the creation of new things, to the realisation of the future value system. Without development there is no profit, and without profit no development. For the capitalist system it must be further added that without profit there would be no accumulation of wealth.

Joseph Schumpeter

# Contents

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# 1

# The Origins and Growth of the Market

## DEFINITIONS

A **derivative** is an asset whose value is derived from that of some other asset, known as the **underlying**.

As an example, suppose you agree a contract with a dealer that gives you the **option** to buy a fixed quantity of gold at a fixed price of $100 at any time in the next three months. The gold is currently worth $90 in the world spot market. (A spot market is where a commodity or financial asset is bought or sold for immediate delivery.)

The option contract is a derivative and the underlying asset is gold. If the value of gold increases then so too does the value of the option, because it gives you the right (but not the obligation) to buy the metal at a fixed price. This can be seen by taking two extreme cases. Suppose that soon after the option contract is agreed the spot value of the gold specified in the contract rises to $150. Alternatively, suppose the price collapses to $50.

- **Spot Price Rises to $150**. If this happens you can exercise (take up) the option, buy the gold for $100 via the option and then sell the gold at a profit on the open market. The option has become rather valuable.
- **Spot Price Falls to $50**. It is much cheaper to buy the gold in the spot market than to acquire it by exercising the option. Your option is virtually worthless. It is unlikely that it will ever be worth exercising.

As discussed in Chapter 8, because an option contract provides flexibility (it does not have to be exercised) an initial fee has to be paid to the dealer who writes or creates the option. This is called the **option premium**.

Derivatives are based on a very wide range of underlying assets. This includes metals such as gold and silver; commodities such as wheat and orange juice; energy resources such as oil and gas; and financial assets such as shares, bonds and foreign currencies. In all cases, the link between the derivative and the underlying commodity or financial asset is one of value. An option to buy a quantity of IBM shares at a fixed price is a derivative because if the underlying IBM share price increases then so too does the value of the option.

## DERIVATIVES BUILDING BLOCKS

In the modern world there is a huge variety of different derivative products. These are either traded on **organized exchanges** or agreed directly with dealers in what is known as the **over-the-counter** (OTC) market. The good news is that the more complex structures are constructed from simple building blocks – forwards and futures, swaps and options. These are defined below.

### Forwards

A forward contract is made directly between two parties. In a **physically delivered** forward contract one party agrees to buy an underlying commodity or financial asset on a future date at an agreed fixed price. The other party agrees to deliver that item at the stipulated price. Both sides are obliged to go through with the contract, which is a legal and binding commitment, irrespective of the value of the underlying at the point of delivery.

Some forward contracts are **cash-settled** rather than through the physical delivery of the underlying. This means that the difference between the fixed price stipulated in the contract and the actual market value of the underlying commodity or financial asset at the expiry of the contract is paid in cash by one party to the other.

Since forwards are privately negotiated, the terms and conditions can be customized. However, there is a risk that one side might default on its contractual obligation unless some kind of guarantee can be put in place.

### Futures

A futures contract is essentially the same as a forward, except that the deal is made through an organized and regulated exchange rather than being negotiated directly between two parties.

In a physically delivered contract one side agrees to deliver a commodity or asset on a future date (or within a range of dates) at a fixed price, and the other party agrees to take delivery. In a cash-settled futures contract the difference between the fixed price and the actual market value of the underlying at expiry is settled in cash.

Traditionally there are three key differences between forwards and futures, although as discussed later the distinctions have blurred somewhat in recent years. Firstly, a futures contract is guaranteed against default. Secondly, futures are standardized, in order to promote active trading. Thirdly, profits and losses on futures are realized on a daily basis to prevent them from accumulating. The process is explained in detail in later chapters.

### Swaps

A swap is an agreement made between two parties to exchange payments on regular future dates, where each payment leg is calculated on a different basis.

For example, suppose that a US company has to make interest payments on a euro loan over the next five years. Unfortunately its income is in US dollars, so it is exposed to changes in the exchange rate between the euro and the dollar. The firm can enter into a **currency swap** with a bank, in which the bank gives it the euros it needs on the required dates to make its loan payments. In return it makes payments to the bank in US dollars.

Although it is often considered as one of the most basic derivative products, a swap is actually composed of a series of forward contracts. Chapter 6 illustrates this fact with the example of an interest rate swap contract.

### Options

A call option gives the holder the right to buy an underlying asset by a certain date at a fixed price. A put option conveys the right to sell an underlying asset by a certain date at a fixed price. As noted above, the purchaser of an option has to pay an initial fee called a premium

**Table 1.1** Summary of four basic options strategies

| Strategy | Premium | Characteristic |
|---|---|---|
| Buy a call | Pay | Right to buy the underlying at a fixed price. |
| Write a call | Receive | Obligation to deliver the underlying if exercised. |
| Buy a put | Pay | Right to sell the underlying at a fixed price. |
| Write a put | Receive | Obligation to take delivery of the underlying if exercised. |

to the seller or writer of the contract. This is because the option provides flexibility for the purchaser – it need never be exercised.

Table 1.1 summarizes the four basic options strategies. Note that the most money the buyer of an option can ever lose on the deal is the initial premium paid for the contract. This is the case for a call and for a put option.

## MARKET PARTICIPANTS

Derivatives have a very wide range of applications in business as well as in finance and banking. There are four main types of participants in the derivatives market: dealers, hedgers, speculators and arbitrageurs. However the same individuals and organizations may play different roles in different market circumstances.

### Dealers

Derivatives contracts are bought and sold by dealers working for banks and securities houses. Some contracts are traded on exchanges, others are OTC transactions.

In a large investment bank the derivatives function is now a highly specialized affair. Marketing and sales staff speak to clients about their needs. Experts help to assemble solutions to those problems using combinations of forwards, swaps and options. Any risk that the bank assumes as a result of providing tailored products for clients is managed by the traders who run the bank's derivatives books. Meantime, risk managers keep an eye on the overall level of risk the bank is running; and mathematicians – known as 'quants' – devise the tools required to price new products.

Originally large banks tended to operate solely as intermediaries in the derivatives business, matching buyers and sellers. Over time, however, they assumed more and more risk themselves.

### Hedgers

Corporations, investors, banks and governments all use derivative products to hedge or reduce their exposure to market variables such as interest rates, share prices, bond prices, currency exchange rates and commodity prices.

The classic example is the farmer who sells a futures contract to lock into a price for delivering a crop on a future date. The buyer might be a food processing company that wishes to fix a price for taking delivery of the crop in the future, or a speculator.

Another typical case is that of a company due to receive a payment in a foreign currency on a future date. It enters into a forward contract to sell the foreign currency to a bank and

receive a predetermined quantity of domestic currency. Or it purchases an option which gives it the right but not the obligation to sell the foreign currency at a set rate.

### Speculators

Derivatives are very well suited to speculating on the prices of commodities and financial assets and on market variables such as interest rates, stock market indices and currency exchange rates. Generally speaking, it is much less expensive to create a speculative position using derivatives than by trading the underlying commodity or financial asset. As a result, the potential returns are that much greater.

A classic case is the trader who believes that increasing demand or reduced supply is likely to boost the market price of oil. Since it would be too expensive to buy and store the physical commodity, the trader buys exchange-traded futures contracts agreeing to take delivery of oil on a future delivery date at a fixed price. If the oil price rises in the spot market, the value of the futures contracts will also rise and they can be sold back into the market at a profit.

In fact if the trader buys and then sells the futures contracts before they reach the delivery point the trader never has to take delivery of any actual oil. The profit from the trades is realized in cash.

### Arbitrageurs

An arbitrage is a deal that produces risk-free profits by exploiting a mispricing in the market. A simple example occurs when a trader can buy an asset cheaply in one location and simultaneously arrange to sell it in another for a higher price. Such opportunities are unlikely to persist for very long, since arbitrageurs would rush in to buy the asset in the 'cheap' location, thus closing the pricing gap.

In the derivatives business arbitrage opportunities typically arise because a product can be assembled in different ways out of different building blocks. If it is possible to sell a product for more than it costs to buy the constituent parts, then a risk-free profit can be generated. In practice the presence of transaction costs often means that only the large market players can profit from such opportunities.

In fact many so-called arbitrage deals constructed in the financial markets are not entirely risk-free. They are designed to exploit differences in the market prices of products which are very similar, but not completely identical. For this reason they are sometimes (and more accurately) called **relative value** trades.

## SUPPORTING ORGANIZATIONS

There are, in addition, many individuals and organizations supporting the derivatives market and helping to ensure orderly and efficient dealings. For example, those who are not members of a futures and options exchange have to employ a broker to transact or 'fill' their orders on the market. A broker acts as an agent and takes an agreed fee or commission. The smaller brokers operate through larger banks and securities houses.

Trading in derivatives generally is overseen and monitored by government-appointed regulatory organizations. For example, the US Commodity and Futures Trading Commission (CFTC) was created by Congress in 1974 as an independent agency to regulate commodity futures and options markets in the United States.

Market participants have also set up their own trade bodies, such as the International Swaps and Derivatives Association (ISDA) which promotes best practice in the OTC derivatives industry and develops and publishes legal documentation. (Chapter 20 discusses the widely-used ISDA Master Agreement.)

Trade prices on exchanges are reported and distributed around the world by electronic news services such as Reuters and Bloomberg. Finally, information technology companies provide essential infrastructure for the derivatives market, including systems designed to value derivative products, to distribute dealer quotations and to record and settle trades.

## EARLY ORIGINS OF DERIVATIVES

The history of derivatives goes back a very long way. In Book One of his *Politics*, Aristotle tells a story about the Greek philosopher Thales who concluded (by means of astronomical observations) that there would be a bumper crop of olives in the coming year. Thales bought options on a large number of olive presses. He was not obliged to exercise the contracts if the harvest was poor – in which case his losses would have been restricted to the original price paid for the options.

In the event the harvest was excellent. Thales exercised his options and was then able to rent out the olive presses to others at a substantial profit. Some argued that this proves that philosophers can easily make money if they choose to, but that their minds are focused on higher things. Aristotle (who knew a thing or two about philosophy) was rather less impressed. He thought Thales' scheme was based on cornering or monopolizing the market for olive presses rather than any particularly brilliant insight into the prospects for the olive harvest.

Forwards and futures are equally ancient. In medieval times sellers of goods at European fairs signed contracts promising delivery on future dates. Commodity futures can be traced back to rice trading in Osaka in the 1600s. Feudal lords collected their taxes in the form of rice, which they sold in Osaka for cash. Successful bidders were issued with vouchers that were freely transferable. Eventually it became possible to trade standardized contracts on rice (similar to modern futures) by putting down a deposit that was a relatively small fraction of the value of the underlying rice.

The Osaka rice market attracted speculators, as well as hedgers who were seeking to manage the risks associated with fluctuations in the market value of the rice crop.

**Tulip Mania and the Amsterdam Market**

The tulip mania in sixteenth-century Holland, which saw bulbs being bought and sold in Amsterdam at hugely inflated prices, also saw the introduction of trading in tulip forwards and options. The bubble burst spectacularly in 1637. Derivatives on shares also appeared on the Amsterdam Stock Exchange by the seventeenth century. Traders could deal in call and put options which provided the right to buy or to sell shares on future dates at predetermined prices.

London superseded Amsterdam as Europe's main financial centre, and derivative contracts started to trade in the London market. The development was at times controversial. In the 1820s problems arose on the London Stock Exchange over trading in call and put options. Some members condemned the practice outright. Others argued that dealings in options greatly

increased the volume of transactions on the exchange, and strongly resisted any attempts at interference.

The committee of the exchange tried to ban options, but it was eventually forced to back down when it became clear that some members felt so strongly about the matter that they were prepared to subscribe funds to found a rival exchange.

## DERIVATIVES IN THE USA

Stock options (options on individual shares) were being traded in the US as early as the 1790s, very soon after the foundation of the New York Stock Exchange.

The next big step forward followed the foundation of the Chicago Board of Trade (CBOT) in 1848 by 83 Chicago merchants. The earliest forward contract (on corn) was traded on the CBOT in 1851 and the practice rapidly gained in popularity.

In 1865, following a number of defaults on forward deals, the CBOT formalized grain trading by developing standardized agreements called **futures contracts**. The exchange required buyers and sellers operating in the grain markets to deposit collateral called **margin** against their contractual obligations. Futures trading later attracted speculators as well as food producers and food-processing companies.

Trading volumes in the US expanded as new exchanges were formed in the late nineteenth and early twentieth centuries. The New York Cotton Exchange (later part of the New York Board of Trade) was founded in 1870. The Chicago Butter and Egg Board was founded in 1898, becoming the Chicago Mercantile Exchange (CME) in 1919. It became possible to trade futures contracts based on a wide range of commodities and (later) metals.

**ICE**

IntercontinentalExchange® (ICE) acquired the New York Board of Trade in 2007, which is now renamed ICE Futures U.S.® ICE also acquired the International Petroleum Exchange in 2001, now renamed ICE Futures Europe. ICE is a public company founded in 2000 and is a constituent of the S&P 500 index of top US shares.

Futures on financial assets are much more recent in origin. CME launched futures contracts on seven foreign currencies in 1972. In 1977 the CBOT introduced 30-year US Treasury Bond futures contracts, and in 1982 it created options on these futures contracts (see Chapters 4 and 12). In 1981 CME introduced a Eurodollar futures contract based on short-term US dollar interest rates, a key hedging tool for banks and traders. It broke new ground in being settled in cash rather than through the physical delivery of a financial asset (see Chapter 5).

The Chicago Board Options Exchange (CBOE) started up in 1973, founded by members of the CBOT. It revolutionized stock option trading by creating standardized contracts listed on a regulated exchange. Before that stock options in the USA were traded in informal over-the-counter markets. The CBOE first introduced calls on 16 underlying shares and later in 1977 launched put option contracts. Chapter 10 explores such products.

In 1983 the CBOE introduced options on the S&P 500 index of major US shares. In 1997 it launched options on the Dow Jones Industrial Average. By good fortune, just as the CBOE was starting up, the standard option pricing model developed by Black, Scholes and Merton was published. It became possible to value options on a common and consistent basis. The model is discussed in Chapters 13 and 14, and is set out in Appendix A.

**CME Group**

The two giant Chicago-based exchanges CBOT and CME finally merged in 2007. The combined entity is called CME Group. The group also includes the New York Mercantile Exchange (NYMEX). Its shares are listed on the US electronic stock market NASDAQ. CME Group revenues in 2009 totalled $2613 million.

## OVERSEAS DEVELOPMENTS, INNOVATION AND EXPANSION

Based on US developments, the London International Financial Futures and Options Exchange (LIFFE) was set up in 1982. After a 1996 merger with the London Commodity Exchange it also began to offer a range of commodity futures contracts.

LIFFE was acquired by Euronext in 2002, which in turn merged in 2007 with the holding group that operates the New York Stock Exchange. Now NYSE Liffe is the global derivatives business of NYSE Euronext Group and operates derivatives markets in London, Amsterdam, Brussels, Lisbon and Paris.

NYSE Liffe's great rival in Europe is Eurex, which was created in 1998. It is jointly operated by Deutsche Börse AG and SIX Swiss Exchange and is a fully electronic market, without a physical trading floor. More than two billion contracts were traded on Eurex in 2008.

As the exchanges have continued to expand their operations, over-the-counter trading in forwards, swaps and options has also experienced an explosion of growth. The first interest rate swap was agreed as late as 1982.

The statistics at the end of this chapter show how rapidly the global derivatives market has grown and diversified. In the OTC market nowadays dealers offer a wide array of more complex derivatives, including later-generation option products with exotic-sounding names such as barriers, cliquets and digitals. These products are discussed in later chapters, with practical examples, and are also summarized in Appendix B.

## AN EXAMPLE OF RECENT INNOVATION: WEATHER DERIVATIVES

Food producers and companies such as utilities have long been able to insure against natural catastrophes such as hurricanes or floods. By contrast weather derivatives, first introduced in the OTC market in 1997, can be used to hedge against the business risks associated with less extreme events. These include an unusually cold winter or high rainfall in the summer months.

**Some Weather-Related Risks**

1. An energy provider could suffer from lower sales in a warm winter or a cooler summer.
2. Energy users could face higher heating (cooling) costs in cold winters (warm summers).
3. A grain producer may be affected by an unusually hot summer that decreases crop yields.
4. A tourist and leisure business may be faced with lower revenues in a cold or rainy summer.