Understanding Derivatives:
Markets and Infrastructure

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Derivatives Overview

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What are derivatives? *Derivatives are financial instruments that transfer risks from one party to another. They are called derivatives because they derive their value from the value of something else—an underlying right or interest. Underlying rights or interests include bonds and loans, which involve interest rate, credit, and currency risks, and commodities and equities, which involve price risks. Underlying rights or interests can also be groups of assets, such as equity, credit, or commodity indexes, or relationships between prices, such as the spread between two benchmark oil prices*

Similar to non-derivatives transactions such as stock or bond trades, derivatives transactions have a long side and a short side. The party that is long is analogous to a buyer—in effect, the long side benefits from a price increase subsequent to the initiation and agreement of the transaction. The party that is short is analogous to a seller—the short side benefits if the price falls. But unlike other market transactions, derivatives transactions do not involve changes in ownership of the underlying right or interest at the time a transaction is agreed, although some derivatives provide for delivery of a specific asset at a specified future date.

Credit default swaps (CDS) are an example of a derivative instrument. Suppose an investor owns a bond and is concerned that the issuer of the bond might default. To protect against the risk of default, the investor buys a CDS from a swap dealer. According to

the terms of the CDS, if the bond issuer were to default, the dealer that sold the CDS would compensate the investor for the loss of value of the bond. The result is that the investor is no longer exposed to the risk of issuer default, so the credit risk of the bond has effectively been transferred from the bondholder to the swap dealer. The bondholder is still exposed to changes in value of the bond that result from interest rate changes, that is, interest rate risk. The CDS investor is, however, exposed to the risk that the dealer that sold the default protection instrument might default.

Derivatives differ from underlying rights or interests in that derivatives typically transfer a single risk—often called a *market risk*—while underlying rights or interests are typically bundles of risks. A bond, for example, is a bundle of interest rate, credit, and possibly currency risks, but a derivative instrument written on a bond typically transfers only one of the risks. So, in the above example, the CDS transferred the credit risk of the bond to the dealer, but left the interest rate risk with the bondholder.

Derivatives also make it possible to transfer risks over time. Commodity futures markets, for example, transfer commodity price risk over time within a market by allowing a buyer or seller to lock in the price of a commodity to be bought or sold on a future date. Another example is interest rate swaps, which transfer interest rate risk between money and capital market instruments by transforming floating-rate cash flows into fixed-rate cash flows and vice versa.

Types of Derivatives Markets

Derivatives markets can be sorted into three categories. First, *listed derivatives* involve the trading of highly standardized contracts through a central venue known as an *exchange* and, typically, the clearing and settlement, or "booking" of transactions with a central counterparty (CCP), also known as a *clearinghouse*. The contract specifications for listed derivatives are typically standardized to a relatively high degree, which facilitates trading and enhances liquidity. At the same time, execution through an exchange facilitates price discovery and transparency and affords anonymity of trade counterparties. The clearinghouse becomes the counterparty to all trades by a legal replacement of bilateral trades between anonymous counterparties with those between the clearing participants and the clearinghouse (through novation or equivalent legal process). As a result, the credit

risk is standardized among clearing participants, and their risk is with the clearinghouse and vice versa.

A second category is *over-the-counter (OTC) derivatives*, which involve the bilateral trading of customized transactions privately negotiated and booked between the contracting parties. OTC derivatives differ from listed derivatives in several ways. First, although OTC transactions involve some standardization of terms, the presumption is that contracting parties are free to negotiate terms that fit their individual risk preferences. Second, instead of executing trades through an exchange, contracting parties execute transactions with dealers, who in turn trade with each other. Third, booking of transactions between contracting parties means that OTC derivatives involve direct exposures between the parties. These exposures lead to *counterparty credit risk*, which must be managed by the parties.

A third category, which will assume increasing importance in the future, is *cleared OTC derivatives*, which involve the bilateral trading of standardized transactions that are privately negotiated but booked with a CCP. Booking of transactions with a CCP means that dealers do not have direct counterparty credit exposure to each other but to the clearinghouse. Standardization need not be as extensive as in the listed derivatives markets, but a high degree of standardization is nonetheless necessary to facilitate risk management by the relevant CCP.

Types of Derivative Instruments

Derivative instruments fall broadly into two categories, namely, forward-based instruments and options. Forward-based instruments (sometimes known as delta-one instruments, whereby delta one means that the change in the price of the derivative closely tracks the change in the price of the underlying right or interest) have symmetrical rights and obligations between the parties and have the effect of locking in a price or rate of an exchange that will take place on an agreed future date. They fall into three main product types. First, *forward contracts* allow parties to agree to the terms of an exchange that will take place at a future date. An example is a currency forward in which parties might agree today to exchange EUR 1.0 million for USD 1.3 million 60 days from today. Second, *futures contracts* are standardized forwards that are traded on an exchange. An example is a soybean futures contract in which parties agree to deliver a

certain amount of soybeans at a certain price in the future. And third, *swaps* are OTC agreements to exchange cash flows at regular intervals over an agreed period according to terms agreed on today; in effect, a swap is a sequence of forwards. A bank and its client might agree, for example, that over the next five years, the client will pay the bank 5% per year on $1.0 million in semiannual installments, while the bank will pay the client the three-month USD Libor rate on the same amount in quarterly installments.

Options are derivatives contracts that have price behavior that is nonlinear due to the asymmetrical nature of the rights and duties between the buyer (also known as the holder) and the seller (also known as the option writer) of the contract. The simplest options are puts and calls that convey the right to sell the underlying right or interest at a fixed price (strike or exercise price) over some period of time (the put option) or the right to buy the underlying right or interest at a fixed price over some period of time (the call option). The asymmetry of the above definition should be noted: The buyer of the option (long) has the right but not the obligation to sell or buy, which implies that the seller of the option (short) has a corresponding contingent obligation to buy or sell the underlying right or interest if the buyer chooses to exercise. Forward-based obligations (forwards and futures), in contrast, have symmetrical rights and obligations for both the long and short parties. The buyer of an option will exercise the option to buy or sell only if the option is *in-the-money.* That is, a party that is long a call option will exercise only if the current underlying price is higher than the exercise price, while a party long a put option will exercise the option to sell only if the underlying price is below the exercise price. In the case of exchange-traded options, most options are typically closed out by an offsetting trade because profits or losses can be realized at any time prior to expiration, and an offsetting trade is generally less costly than exercising the option and then trading the underlying right or interest. Some options are *cash settled* (meaning that physical delivery of the underlying right or interest is not required) at the price of the underlying right or interest (often an index) upon exercise or at expiration.

In the market, whether exchange-traded or OTC, puts and calls are bought and sold as separate contracts. However, it is quite common for trading strategies to include combinations of puts or combinations of calls with different expirations (time or calendar spreads), different exercise prices (vertical spreads), a mix of different expirations and exercise prices (diagonal spreads), or, indeed, combinations of

puts and calls together (straddles, strangles, butterfly spreads, and other dual options). Some options are "flex" in that, for example, the exercise price may cover a range of choices. Terms vary from several minutes to many years, and some options can be exercised at any time by the holder (American style exercise) or can be exercised only at the time of expiration (European style). The pricing of options is complex because inputs include the time to expiration, interest rates, volatility, and, of course, the current price of the underlying right or interest. There are various analytical approaches to valuing options, and many online data services calculate theoretical options prices (also known as the premium), the volatility of the underlying right or interest implied by the current option price, and other options-related data known as the "Greeks," in reference to the symbols used in option-pricing formulas that were first articulated in the early 1970s by Fischer Black and Myron Scholes (Black and Scholes, 1973; for a discussion, see McDonald, 2006).

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How Do Forward Contracts Transfer Risk?

To see how forward-based contracts transfer risk, consider the following example of an OTC forward. Suppose an electrical equipment manufacturer is concerned about the rising price of copper and would like to lock in a purchase price of copper. The manufacturer consults a swap dealer, and the two decide to enter into a copper price forward that will settle three months from today. From the manufacturer's point of view, the transaction is a forward copper purchase of a hypothetical (*notional*) quantity of 1,000 metric tons at an agreed forward price of $6,000 per metric ton. If, on the settlement date, the market price of copper is, say, $6,500 per metric ton, the manufacturer pays $6,500,000 to buy copper at the market price. At the same time, the dealer will pay the manufacturer $500,000 (the difference between $6,500 and $6,000 on 1,000 tons). The manufacturer has a net outflow of $6,000,000, or $6,000 per metric ton. But suppose the price of

copper on the settlement date were $5,200 per metric ton. In this case, the manufacturer pays $5,200,000 for the copper, but pays the dealer $800,000—that is, the difference between $5,200 and $6,000 per ton—on the forward. Again, the effective price is $6,000. In summary, the manufacturer has locked in the forward price of $6,000 per ton, regardless of which way the copper price moves. In other words, the manufacturer has passed on copper price risk to the dealer.

The above example was of a *cash-settled* forward, in which one party compensates the other for the net amount of price change. But it also could have involved *physical settlement*, that is, actual delivery of the copper against payment. If the forward were physically settled, the manufacturer would agree to pay $6,000,000 to the dealer, and the dealer would agree to the delivery of 1,000 metric tons of copper to the client on the settlement date. Again, regardless of which way the price moves, the manufacturer would lock in the price of $6,000 per ton.

Using the above example of the electrical equipment manufacturer concerned about the rising price of copper, assume the manufacturer were to decide instead of using a forward contract to buy a call option on 1,000 metric tons of copper from the swap dealer, with expiration three months from today. The terms of the option are as follows. First, the strike price is $6,000 per metric ton, so the client will have the right but not the obligation to buy copper at the strike price. Second, the option is European style and can be exercised three months from today. Third, the option premium is $150 per ton, so the client pays the dealer $150,000 today. Suppose that, three months later, the market price of copper is $6,500 per ton so the option is in-the-money. The client would exercise the option, and the dealer would pay the client the $500 per ton difference between the current price of $6,500 and the strike price of $6,000; effectively, the price of copper is capped at $6,000 (ignoring the premium). But suppose instead that the market price on the exercise date was only $5,200. In this case, the option would be out-of-the-money, so the client would not exercise the option to buy but would benefit from buying copper at the lower market price.

The examples of the copper forward and copper call option suggest the motivations for choosing one or the other. The forward allowed the client to lock in a price of copper: If the market price rises above the forward price, the dealer pays the client, but if the price falls below the forward price, the client pays the dealer. Either way,

the client has locked in the forward price and has thereby transferred its price risk to the dealer. The option, in contrast, protected the client from a rising price, but allowed the client to benefit from a fall in the price. But this asymmetry comes at a price: Unlike a forward, an option always requires the buyer to pay a premium (in other words, the price of the option) to the seller.

Types of Derivatives Trading

Derivatives transactions are often classified according to the objectives of the transacting parties. One objective is *hedging*, which involves the transfer of an unwanted risk to another party. An agricultural chemical company, for example, might want to lock in a price of soybeans for future purchase rather than face the risk of changes in the price. A long hedge means that the hedger will be compensated not only for unfavorable price movements but for favorable movements as well; the hedger has traded away price risk by locking in, for better or worse, a fixed price.

A second objective is *speculation*, which involves taking on risk from another party in order to profit from price changes. In the long soybean hedge example, the party on the other side of the trade might be a speculator hoping to profit if the price of soybeans falls. By acting as a source of liquidity to potential hedgers, speculators are a necessary part of a market.

A third objective is *dealing*, or *market making*, which means facilitating risk transfer by intermediating between hedgers and speculators and earning a spread between the two. In a sense, dealers may be considered hedgers because, upon taking on a risk from one customer, a dealer will generally hedge the risk with another customer or in underlying right or interest markets. But while dealers generally run hedged portfolios (books) of transactions, they also engage in speculation in order to provide liquidity to the market. For example, if one client wishes to establish a hedge position with a dealer but the dealer cannot immediately find an offsetting transaction, the dealer might nonetheless enter into the transaction, in effect holding a speculative (*open*) position on the unhedged portion of the trade.

Role of the Clearinghouse

A clearinghouse in the derivatives trading context is known as a central counterparty (CCP), which is a type of financial market infrastructure (BIS, 2012). The CCP performs three functions. First, by means of novation or an equivalent legal process, as described earlier, at the clearing participant level, the CCP acts as buyer to every seller and seller to every buyer for derivatives transactions submitted by its members. Second, it acts as guarantor by assuming the credit risk of cleared transactions. And third, it provides multilateral netting of transactions. In all CCPs, only CCP participants (member firms) *book* (i.e., clear) trades directly with the CCP; nonmember firms, in contrast, must access the clearinghouse through the intermediation of a clearing member participant. By their nature, CCPs do not take on market risk—absent a clearing member default—for every transaction with a positive value, there must be an equal and offsetting transaction with a negative value.

CCPs exist to clear many types of financial transactions, including equities (stocks), fixed-income securities, and derivatives—both exchange-traded and OTC.

Comparison of Exchange-traded and OTC Markets

In exchange-traded markets, one finds standardized products—equities and derivatives are the most common exchange-traded products. Exchange-traded markets typically involve a large number of trading parties, both professional and retail, compared with OTC markets. An important feature of exchange-traded markets is the *fungibility* of the contracts, which allows for the initiation of a position by an opening trade and the subsequent closure of the position by an offsetting trade.

Exchange-traded markets also involve a high degree of transparency, which is typically enforced by detailed trade reporting requirements. The high degree of transparency and large numbers of transactions lead to extensive price discovery in futures markets.

In contrast to exchange-traded markets, OTC markets involve a large number of customized products. However, there are limits to customization: In any OTC market, there are generic,

"vanilla" contracts that are more liquid than more customized products. Further, OTC markets involve a relatively small number of trading parties, which are almost entirely institutional and rarely retail. Finally, OTC markets typically involve a relatively small number of large transactions.

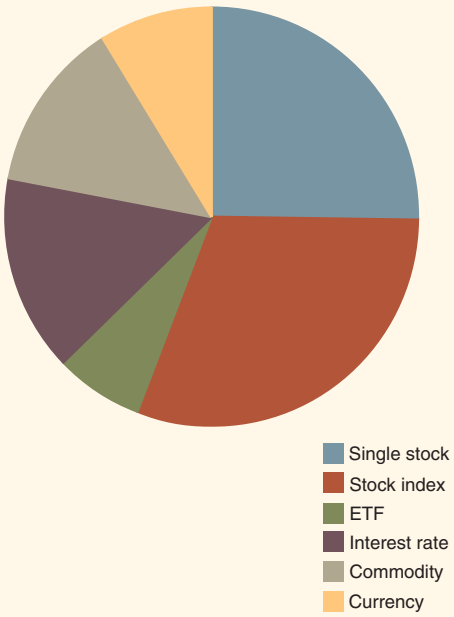
OTC markets also exhibit low levels of transparency compared with futures markets. This is largely because many of the risks traded in OTC markets are customized, illiquid, and difficult to trade among highly informed traders. Further, OTC markets provide limited price discovery; indeed, OTC trading relies heavily on price

Box 1 – How Are Derivatives Transactions Measured?

Exchange-traded Derivatives

Measuring exchange-traded derivatives transactions is fairly straightforward. Transactions are measured by the number of traded contracts (trades have both a buyer and seller, so only one side is counted) and the amount of open interest. Open interest is the total number of contracts that are not closed or delivered.

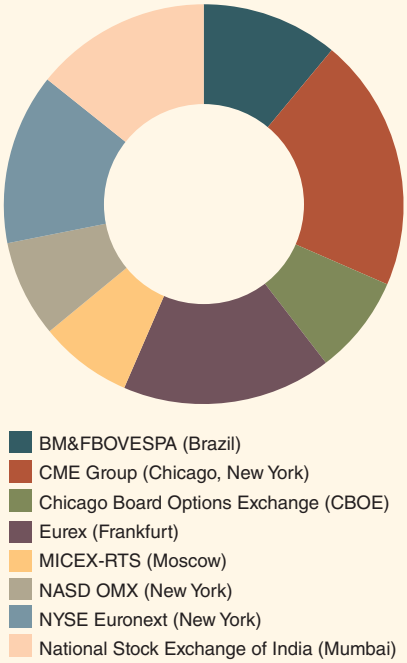
1. 2012 Futures & Options Trade Volume by Type of Product



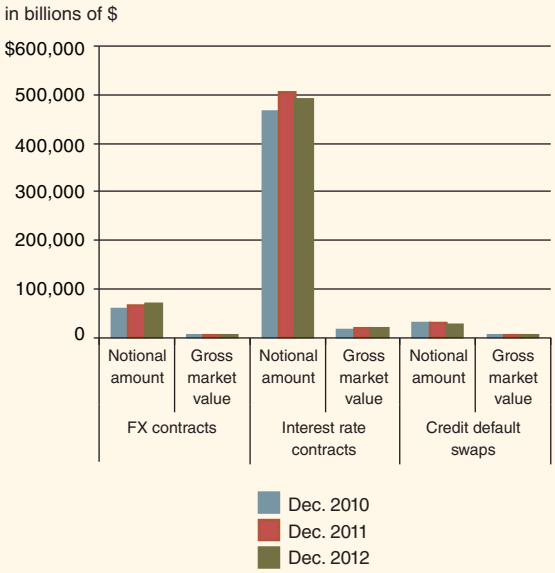
For traders, open interest can reveal useful information about a particular contract. For example, if a contract has a lot of open interest, it is an indication that there will be a considerable volume of trading to close out contracts prior to delivery. In that sense, open interest can be a good indication of potential trading liquidity. Open interest is also telling when compared with volume—a lot of trading volume in a contract with little open interest may indicate heavy "day trading," whereby traders are not taking positions in a contract but rather are opening and closing positions within one day.

Figures 1 and 2 are based on publicly available trading volume data from the World Federation of Exchanges (WFE), which is a source for derivatives market statistics reported by the exchanges that are members of the WFE.[1] There are several different ways of

2. Exchanges with Over One Billion Contracts Traded in 2012



3. Notional Amounts and Gross Market Value of OTC Derivatives by Risk Category



representing trading volume—by type of contract (figure 1), by geographic region, by exchange group, or by individual exchanges. Exchange groups are often global because subsidiaries of a group may be located on different continents. To give a sense of the geography of market liquidity, figure 2 shows trading volume by individual exchanges. Not all exchanges report open interest, so the figures show trading volume only.

Over-the-Counter Derivatives

Measuring OTC derivatives trades is somewhat more complex, because an OTC derivatives trade or swap typically has two parts—the monetary amount that the trade counterparties agree to swap and the principal amount or *notional value* upon which the swap is based. Notional values are reported by the Bank for International Settlements (BIS) (see figure 3), but these amounts make the OTC market seem much bigger than the actual values that change hands.[2]

Another way to measure OTC trades is to think about the mark-to-market value of open positions. This measure is called *gross market* value, which is the estimated amount that could be received or paid for unwinding a transaction (replacement value) on the reporting date. As shown in figure 3, these amounts are a small percentage of notional amounts, ranging from about 2% to 6% of notional value.[3]

[1]Data are available at www.world-exchanges.org/statistics. The Futures Industry Association (FIA) is also a good source of data; see www.futuresindustry.com.

[2]The exception to this reporting is cross-currency interest rate swaps, where notional amounts are actually swapped.

[3]For a useful discussion of OTC terminology, see ISDA (2008).

information generated by exchange-traded markets. For example, the pricing of credit default swaps relies on the prices of corporate bonds, many of which tend to be illiquid. Longer-dated OTC derivatives (some up to 50 years) require special pricing that is not available from exchange-traded markets.

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