1

Financial Contracts

My friend Jerry lives in a small town, the same town in which he was born and raised. Because Jerry's parents are no longer alive and many of his friends have left, he is seriously thinking of packing up and moving to a larger city. However, Jerry recently heard that there is a plan to build a major highway that will pass very close to his hometown. Because the highway is likely to bring new life to the town, Jerry is reconsidering his decision to move away. It has also occurred to Jerry that the highway may bring new business opportunities.

For many years, Jerry's family was in the restaurant business, and Jerry is thinking of building a restaurant at the main intersection leading from the highway into town. If Jerry does decide to build the restaurant, he will need to acquire land along the highway. Fortunately, Jerry has located a plot of land, currently owned by Farmer Smith, that is ideally suited for the restaurant. Because the land does not seem to be in use, Jerry is hoping that Farmer Smith might be willing to sell it.

If Farmer Smith is indeed willing to sell, how can Jerry acquire the land on which to build his restaurant? First, Jerry must find out how much Farmer Smith wants for the land. Let's say $100,000. If Jerry thinks that the price is reasonable, he can agree to pay this amount and, in return, take ownership of the land. In this case, Jerry and Farmer Smith will have entered into a *spot* or *cash transaction*.

In a cash transaction, both parties agree on terms, followed immediately by an exchange of money for goods. The trading of stock on an exchange is usually considered to be a cash transaction: the buyer and seller agree on the price, the buyer pays the seller, and the seller delivers the stock. The actions essentially take place simultaneously. (Admittedly, on most stock exchanges, there is a settlement period between the time the price is agreed on and the time the stock is actually delivered and payment is made. However, the settlement period is relatively short, so for practical purposes most traders consider this a cash transaction.)

However, it has also occurred to Jerry that it will probably take several years to build the highway. Because Jerry wants the opening of his restaurant

to coincide with the opening of the highway, he doesn't need to begin construction on the restaurant for at least another year. There is no point in taking possession of the land right now—it will just sit unused for a year. Given his construction schedule, Jerry has decided to approach Farmer Smith with a slightly different proposition. Jerry will agree to Farmer Smith's price of $100,000, but he will propose to Farmer Smith that they complete the transaction in one year, at which time Farmer Smith will receive payment, and Jerry will take possession of the land. If both parties agree to this, Jerry and Farmer Smith will have entered into a *forward contract*. In a forward contract, the parties agree on the terms now, but the actual exchange of money for goods does not take place until some later date, the *maturity* or *expiration date*.

If Jerry and Farmer Smith enter into a forward contract, it's unlikely that the price Farmer Smith will want for his land in one year will be the same price that he is asking today. Because both the payment and the transfer of goods are deferred, there may be advantages or disadvantages to one party or the other. Farmer Smith may point out that if he receives full payment of $100,000 right now, he can deposit the money in his bank and begin to earn interest. In a forward contract, however, he will have to forego any interest earnings. As a result, Farmer Smith may insist that he and Jerry negotiate a one-year *forward price* that takes into consideration this loss of interest.

Forward contracts are common when a potential buyer requires goods in the future or when a potential seller knows that a supply of goods will be ready for sale in the future. A bakery may need a periodic supply of grain to support operations. Some grain may be required now, but the bakery also knows that additional grain will be required at regular intervals in the future. In order to eliminate the risk of rising grain prices, the bakery can buy grain in the forward market—agreeing on a price now but not taking delivery or making payment until some later date. In the same way, a farmer who knows that he will have grain ready for harvest at a later date can sell his crop in the forward market to insure against falling prices.

When a forward contract is traded on an organized exchange, it is usually referred to as a *futures contract*. On a futures exchange, the contract specifications for a forward contract are standardized to more easily facilitate trading. The exchange specifies the quantity and quality of goods to be delivered, the date and place of delivery, and the method of payment. Additionally, the exchange guarantees the integrity of the contract. Should either the buyer or the seller default, the exchange assumes the responsibility of fulfilling the terms of the forward contract.

The earliest futures exchanges enabled producers and users of physical commodities—grains, precious metals, and energy products—to protect themselves against price fluctuations. More recently, many exchanges have introduced futures contracts on financial instruments—stocks and stock indexes, interest-rate contracts, and foreign currencies. Although there is still significant trading in physical commodities, the total value of exchange-traded financial instruments now greatly exceeds the value of physical commodities.

Returning to Jerry, he finds that he has a new problem. The government has indicated its desire to build the highway, but the necessary funds have not

yet been authorized. With many other public works projects competing for a limited amount of money, it's possible that the entire highway project could be canceled. If this happens, Jerry intends to return to his original plan and move away. In order to make an informed decision, Jerry needs time to see what the government will do. If the highway is actually built, Jerry wants to purchase Farmer Smith's land. If the highway isn't built, Jerry wants to be able to walk away without any obligation.

Jerry believes that he will know for certain within a year whether the highway project will be approved. As a result, Jerry approaches Farmer Smith with a new proposition. Jerry and Farmer Smith will negotiate a one-year forward price for the land, but Jerry will have one year to decide whether to go ahead with the purchase. One year from now, Jerry can either buy the land at the agreed-on forward price, or he can walk away with no obligation or penalty.

There is much that can happen over one year, and without some inducement Farmer Smith is unlikely to agree to this proposal. Someone may make a better offer for the land, but Farmer Smith will be unable to accept the offer because he must hold the land in the event that Jerry decides to buy. For the next year, Farmer Smith will be a hostage to Jerry's final decision.

Jerry understands Farmer Smith's dilemma, so he offers to negotiate a separate payment to compensate Farmer Smith for this uncertainty. In effect, Jerry is offering to buy the right to decide at a later date whether to purchase the land. Regardless of Jerry's final decision, Farmer Smith will get to keep this separate payment. If Jerry and Farmer Smith can agree on this separate payment, as well as the forward price, they will enter into an *option contract*. An option contract gives one party the right to make a decision at a later date. In this example, Jerry is the buyer of a *call option*, giving him the right to decide at a later date whether to buy. Farmer Smith is the seller of the call option.

Deciding whether to buy the land for his restaurant is not Jerry's only problem. He owns a house that he inherited from his parents and that he was planning to sell prior to moving away. Before hearing about the highway project, Jerry had put up a "For Sale" sign in front of the house, and a young couple, seeing the sign, showed enough interest in the house to make an offer. Jerry was seriously considering accepting the offer, but then the highway project came up. Now Jerry doesn't know what to do. If the government goes ahead with the highway and Jerry goes ahead with his restaurant, he wants to keep his house. If not, he wants to sell the house. Given the situation, Jerry might make a proposal to the couple similar to that which he made to Farmer Smith. Jerry and the couple will agree on a price for the house, but Jerry will have one year in which to decide whether to actually sell the house.

Like Farmer Smith, the couple's initial reaction is likely to be negative. If they agree to Jerry's proposal, they will have to make temporary housing arrangements for the next year. If they find another house they like better, they won't be able to buy it because they might eventually be required to purchase Jerry's house. They will spend the next year in housing limbo, a hostage to Jerry's final decision.

As with Farmer Smith, Jerry understands the couple's dilemma and offers to compensate them for their inconvenience by paying an agreed-on amount.

Regardless of Jerry's final decision, the couple will get to keep this amount. If Jerry and the couple can agree on terms, Jerry will have purchased a *put option* from the couple. A put option gives one party the right to decide whether to sell at a later date.

Perhaps the most familiar type of option contract is insurance. In many ways an insurance contract is analogous to a put option. A homeowner who purchases insurance has the right to sell all or part of the home back to the insurance company at a later date. If the home should burn to the ground, the homeowner will inform the insurance company that he now wishes to sell the home back to the insurance company for the insured amount. Even though the home no longer exists, the insurance company is paying the homeowner as if it were actually purchasing the home. Of course, if the house does not burn down, perhaps even appreciating in value, the homeowner is under no obligation to sell the property to the insurance company.

As with an insurance contract, the purchase of an option involves the payment of a *premium*. This amount is negotiated between the buyer and the seller, and the seller keeps the premium regardless of any subsequent decision on the part of the buyer.

Many terms of an insurance contract are similar to the terms of an option contract. An option, like an insurance contract, has an *expiration date*. Does a homeowner want a six-month insurance policy? A one-year policy? The insurance contract may also specify an *exercise price*, how much the holder will receive if certain events occur. This exercise price, which may also include a deductible amount, is analogous to an agreed-on forward price.

The logic used to price option contracts is also similar to the logic used to price insurance contracts. What is the probability that a house will burn down? What is the probability that someone will have an automobile accident? What is the probability that someone will die? By assigning probabilities to different occurrences, an insurance company will try to determine a fair value for the insurance contract. The insurance company hopes to generate a profit by selling the contract to the customer at a price greater than its fair value. In the same way, someone dealing with exchange-traded contracts may also ask, "What is the probability that this contract will go up in value? What is the probability that this contract will go down in value?" By assigning probabilities to different outcomes, it may be possible to determine the contract's fair value.

In later chapters we will take a closer look at how forwards, futures, and options are priced. For now, we can see that their values are likely to depend on or be derived from the value of some *underlying* asset. When my friend Jerry wanted to enter into a one-year forward contract to buy the land from Farmer Smith, the value of the forward contract derived from (among other things) the current value of the land. When Jerry was considering buying a call option from Farmer Smith, the value of that option derived from the value of the forward contract. When Jerry was considering selling his house, the value of the put option derived from the current value of the house. For this reason, forwards, futures, and options are commonly referred to as *derivative contracts* or, simply, *derivatives*.

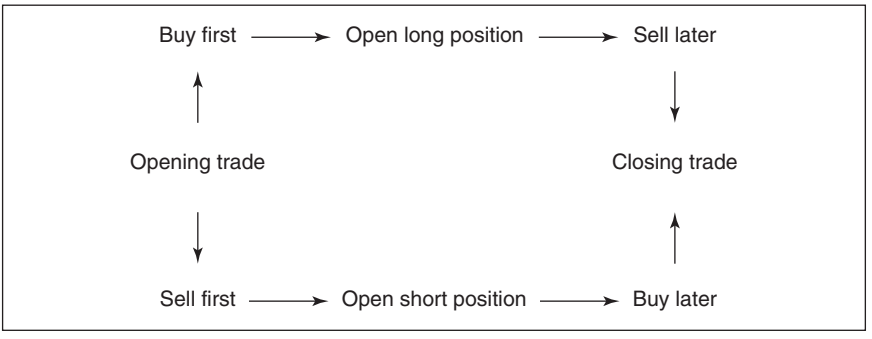
There is one other common type of derivatives contract. A *swap* is an agreement to exchange cash flows. The most common type, a *plain-vanilla interest-rate swap*, is an agreement to exchange fixed interest-rate payments for floating interest-rate payments. But a swap can consist of almost any type of cash-flow agreement between two parties. Because swaps are not standardized and therefore most often traded off exchanges, in this text we will restrict our discussion to the most common derivatives—forwards, futures, and options.

Buying and Selling

We usually assume that in order to sell something, we must first own it. For most transactions, the normal order is to buy first and sell later. However, in derivative markets, the order can be reversed. Instead of buying first and selling later, we can sell first and buy later. The profit that results from a purchase and sale is usually independent of the order in which the transactions occur. We will show a profit if we either buy first at a low price and sell later at a high price or sell first at a high price and buy later at a low price.

Sometimes we may want to specify the order in which trades take place. The first trade to take place, either buying or selling, is an *opening trade*, resulting in an *open position*. A subsequent trade, reversing the initial trade, is a *closing trade*. A widely used measure of trading activity in exchange-traded derivative contracts is the amount of *open interest*, the number of contracts traded on an exchange that have not yet been closed out. Logically, the number of long and short contracts that have not been closed out must be equal because for every buyer there must be a seller.

If a trader first buys a contract (an opening trade), he is *long* the contract. If the trader first sells a contract (also an opening trade), he is *short* the contract. Long and short tend to describe a position once it has been taken, but traders also refer to the act of making an opening trade as either *going long* (buying) or *going short* (selling).



A long position will usually result in a debit (we must pay money when we buy), and a short position will usually result in a credit (we expect to receive money when we sell). We will see later that these terms are also used when trading multiple contracts, simultaneously buying some contracts and selling others. When the total trade results in a debit, it is a long position; when it results in a credit, it is a short position.

The terms *long* and *short* may also refer to whether a trader wants the market to rise or fall. A trader who has a long stock market position wants the stock market to rise. A trader who has a short position wants the market to fall. However, when referring to derivatives, the terms can be confusing because a trader who has bought, or is long, a derivative may in fact want the underlying market to fall in price. In order to avoid confusion, we will refer to either a long or short contract position (we have either bought or sold contracts) or a long or short market position (we want the underlying market to rise or fall).

Notional Value of a Forward Contract

Because a forward contract is an agreement to exchange money for goods at some later date, when a forward contract is initially traded, no money changes hands. Because no cash flow results, in a sense, there is no cash value associated with the contract. But a forward contract does have a *notional value* or *nominal value*. For physical commodities, the notional value of a forward contract is equal to the number of units to be delivered at maturity multiplied by the unit price. If a forward contract calls for the delivery of 1,000 units at a price of $75 per unit, the notional value of the contract is $75 × 1,000 = $75,000.

For some forward contracts, physical delivery is not practical. For example, many exchanges trade futures contracts on stock indexes. But it would be impractical to actually deliver a stock index because it would require the delivery of all stocks in the index in exactly the right proportion, which in some cases might mean delivering fractional shares. For financial futures, where the contract is not settled through physical delivery, the notional value is equal to the cash price of the index or instrument multiplied by a point value. A stock index that is trading at 825.00 and that has a point value of $200 has a notional value of 825.00 × $200 = $165,000.

The point value of a stock index or similar contract is set by the exchange so that the contract has a notional value that is deemed reasonable for trading. If the point value is set too high, trading in the contract may be too risky for most market participants. If the point value is set too low, transaction costs may be prohibitive because it may require trading a large number of contracts to achieve the desired result.

Settlement Procedures

What actually happens when a contract is traded on an exchange? The settlement procedure—the manner in which the transfer of money and ownership of a contract is facilitated—depends on the rules of the exchange and the type of contract traded.

Consider a trader who buys 100 shares of a $50 stock on an exchange. The total value of the stock is 100 × $50 = $5,000, and the buyer is required to pay the seller this amount. The exchange, acting as intermediary, collects $5,000 from the buyer and transfers this money to the seller. At the same time, the exchange takes

delivery of the shares from the seller and transfers these to the buyer. This is essentially a cash transaction with the exchange making both delivery and payment.

Suppose that the stock that was originally purchased at $50 per share subsequently rises to $60. How will the buyer feel? He will certainly be happy and may mentally record a profit of $1,000 (100 shares times the $10 increase per share). But he can't actually spend this $1,000 because the profit is *unrealized*—it only appears on paper (hence the term *paper profit*). If the buyer wants to spend the $1,000, he will have to turn it into a *realized* profit by going back into the marketplace and selling his 100 shares to someone else at $60 per share. This *stock-type settlement* requires full and immediate payment, and all profits or losses are unrealized until the position is closed.

Now consider what happens when a futures contract is traded on an exchange. Because a futures contract is a forward contract, there is no immediate exchange of money for goods. The buyer pays no money, and the seller receives none. But by entering into a forward contract, both the buyer and the seller have taken on future obligations. At contract maturity, the seller is obligated to deliver, and the buyer is obligated to pay. The exchange wants to ensure that both parties live up to these obligations. To do this, the exchange collects a *margin deposit* from each party that it holds as security against possible default by the buyer or seller. The amount of margin is commensurate with the risk to the exchange and depends on the notional value of the contract, as well as the possibility of price fluctuations over the life of the futures contract. An exchange will try to set margin requirements high enough so that the exchange is reasonably protected against default but not so high that it inhibits trading.

For example, consider the futures contract calling for delivery of 1,000 units of a commodity at a unit price of $75. The notional value of the contract is $75,000. If the exchange has set a margin requirement for the contract at $3,000, when the contract is traded, both the buyer and seller must immediately deposit $3,000 with the exchange.

What happens if the price of the commodity subsequently rises to $80? Now the buyer has a profit of $\$5 \times 1{,}000 = \$5{,}000$, whereas the seller has a loss of equal amount. As a result, the exchange will now transfer $5,000 from the seller's account to the buyer's account. This daily *variation* credit or debit results from fluctuations in the price of the futures contract as long as the position remains open. *Futures-type settlement*, where there is an initial margin deposit followed by daily cash transfers, is also known as *margin and variation settlement*.

A futures trader can close out a position in one of two ways. Prior to maturity of the futures contract, he can make an offsetting trade, selling out the futures contract he initially bought or buying back the futures contract he initially sold. If the position is closed through an offsetting purchase or sale, a final variation payment is made, and the margin deposit is returned to the trader.

Alternatively, a trader may choose to carry the position to maturity, at which time *physical settlement* will take place. The seller must make delivery, and the buyer must pay an amount equal to the current value of the commodity. After delivery and payment have been made, the margin deposits will be returned to the respective parties. In our example, the original trade price was $75. If the price of the commodity at maturity is $90, the buyer must pay $\$90 \times 1{,}000 = \$90{,}000$.

It may seem that the buyer has paid $15 more per unit than the original trade price of $75. But recall that as the futures contract rose in price from $75 to $90, the buyer was credited with $15 in the form of variation. The total price paid, the $90 final price less the $15 variation, was indeed equal to the agreed-on price of $75 per unit.

Futures contracts such as stock indexes, which are not settled through physical delivery, can also be carried to maturity. In this case, there is one final variation payment based on the underlying index price at maturity. At that time, the margin deposits are also returned to the parties. These types of futures, where no physical delivery takes place at maturity, are said to be *cash-settled*.

A futures trader must always have sufficient funds to cover the margin requirements for any trade he intends to make. But he should also have sufficient funds to cover any variation requirements. If the position moves against him and he does not have sufficient funds, he may be forced to close the position earlier than intended.

There is an important distinction between margin and variation. Margin[1] is money collected by the exchange to ensure that a trader can fulfill future financial obligations should the market move against him. Even though deposited with the exchange, margin deposits still belong to the trader and can therefore earn interest for the trader. Variation is a credit or debit that results from fluctuations in the price of a futures contract. A variation payment can either earn interest, if the variation results in a credit, or lose interest, if the variation results in a debit.

Examples of the cash flows and profit or loss for a series of stock and futures trades are shown in Figures 1-1 and 1-2, respectively. In each example, we assume that the opening trade was made at the first day's settlement price so that there is no profit and loss (i.e., a P&L of zero) at the end of day 1. For simplicity, we have also ignored any interest earned on credits or interest paid on debits.

We make this very important distinction between stock-type settlement and futures-type settlement because some contracts are settled like stock and some contracts are settled like futures. It should come as no surprise that stock

Figure 1-1 Stock-type settlement.

	Stock price	Trade	Cash flow credit (+) debit (-)	Current stock position	Cumulative realized P&L	Unrealized P&L
Day 1 (opening trade)	$53	buy 1,200 shares	–$53 x 1,200 = –$63,600	long 1,200 shares	0	0
Day 2	$57	sell 500 shares	+$57 x 500 = +$28,500	long 700 shares	($57–$53) x 500 = +$2,000	($57–$53) x 700 = +$2,800
Day 3	$51	no trade	0	long 700 shares	+$2,000	($51–$53) x 700 = –$1,400
Day 4 (closing)	$54	sell 700 shares	+$54 x 700 = +37,800	0	+$2,000 + ($54–$53) x 700 = +$2,000 + $700 = +$2,700	0

[1] A margin requirement for a professional trader on an equity options exchange is sometimes referred to as a *haircut*.

Figure 1-2 Futures-type settlement.

contract size: 1,000 units margin, per contract: $3,000						
	Futures price (per unit)	Trade	Current futures position	Margin requirement	Variation	Cumulative realized P&L
Day 1 (opening trade)	$75	sell 9 futures	short 9 futures	9 x $3,000 = $27,000	0	0
Day 2	$77	no trade	short 9 futures	9 x $3,000 = $27,000	($77–$75) x –9 x 1,000 = –$18,000	–$18,000
Day 3	$74	buy 2 futures	short 7 futures	7 x $3,000 = $21,000	($74–$77) x –9 x 1,000 = +$27,000	–$18,000 +$27,000 =+$9,000
Day 4	$70	buy 4 futures	short 3 futures	3 x $3,000 = $9,000	($70–$74) x –7 x 1,000 = +$28,000	+$9,000 +$28,000 =+$37,000
Day 5 (closing)	$80	buy 3 futures	0	0	($80–$70) x –3 x 1,000 = –$30,000	+$37,000 –$30,000 =+$7,000

is subject to stock-type settlement and futures are subject to futures-type settlement. But what about options? Currently, all exchange-traded options in North America, whether options on stock, stock indexes, futures, or foreign currencies, are settled like stock. Options must be paid for immediately and in full, and all profits or losses are unrealized until the position is liquidated. In stock option markets, this is both logical and consistent because both the underlying contract and options on that contract are settled using identical procedures. However, on U.S. futures options markets, the underlying contract is settled one way (futures-type settlement), while the options are settled in a different way (stock-type settlement). This can sometimes cause problems when a trader has bought or sold an option to hedge a futures position. Even if the profits from the option position exactly offset the losses from the futures position, the profits from the option position, because the options are settled like stock, are unrealized. But the losses from the futures position will require an immediate cash outlay to cover variation requirements. If a trader is unaware of the different settlement procedures, he can occasionally find himself with unexpected cash-flow problems.

The settlement situation on most exchanges outside North America has been simplified by making option and underlying settlement procedures identical. If the underlying is subject to stock-type settlement, then the options on the underlying are subject to stock-type settlement. If the underlying is subject to futures-type settlement, then the options are subject to futures-type settlement. Under this method, a trader is unlikely to have a surprise variation requirement on a position that he thinks is well hedged.

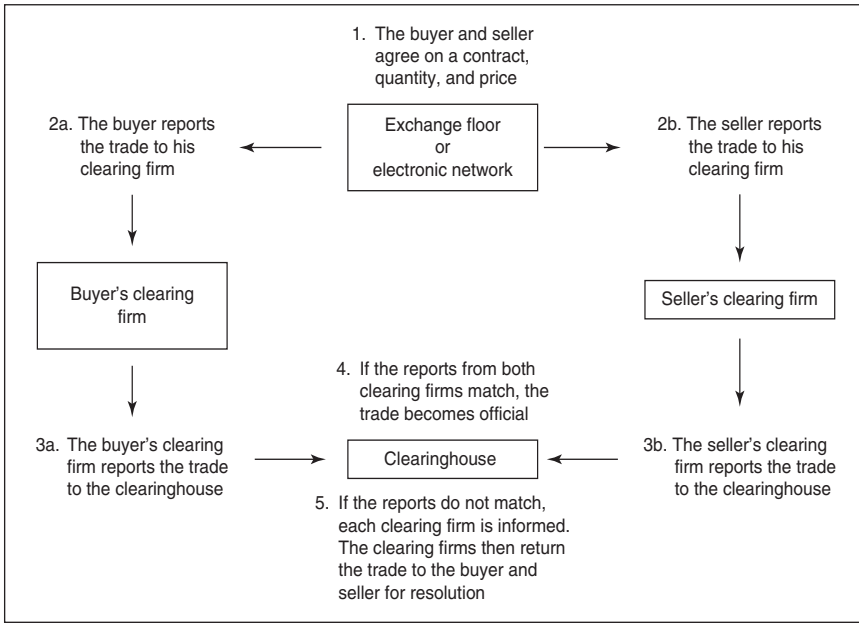
In this text, when presenting option examples, we will generally assume the settlement convention used in North America, where all options are subject to stock-type settlement.

Market Integrity

Anyone who enters into a contract to buy or sell wants to be confident that the *counterparty* will fulfill his responsibilities under the terms of the contract. A buyer wants to be sure that the seller will deliver; a seller wants to be sure that the buyer will pay. No one will want to trade in a marketplace if there is a real possibility that the counterparty might default on a contract. To guarantee the integrity of an exchange-traded contract, exchanges assume the responsibility for both delivery and payment. When a trade is made on an exchange, the link between buyer and seller is immediately broken and replaced with two new links. The exchange becomes the buyer from each seller. If the buyer defaults, the exchange will guarantee payment. The exchange also becomes the seller to each buyer. If the seller defaults, the exchange will guarantee delivery.

To protect itself against possible default, an exchange will establish a *clearinghouse*. The clearinghouse may be a division of the exchange or a completely independent entity and is responsible for processing and guaranteeing all trades made on the exchange.[2] The clearinghouse assumes the ultimate responsibility for ensuring the integrity of all exchange-traded contracts.[3]

Figure 1-3 The clearing process.



[2] In the United States, the two largest derivatives clearinghouses are the Options Clearing Corporation, responsible for processing all equity option trades, and the CME Clearing House, responsible for processing all trades made on exchanges falling within the CME Group. For instruments other than derivatives, such as stock and bonds, the Depository Trust and Clearing Corporation provides clearing services for many U.S. exchanges.

[3] Although the exchange and clearinghouse may be separate entities, for simplicity, we will occasionally use the terms interchangeably.

The clearinghouse is made up of member *clearing firms*. A clearing firm processes trades made by individual traders and agrees to fulfill any financial obligation arising from those trades. Should an individual trader default, the clearing firm guarantees fulfillment of that trader's responsibilities. No individual may trade on an exchange without first becoming associated with a clearing firm.

As part of its responsibilities, a clearing firm will collect the required margin from individual traders and deposit these funds with the clearinghouse.[4] In some cases, the clearinghouse may permit a clearing firm to aggregate the positions of all traders at the firm. Because some traders will have long positions while other traders will have short positions in the same contract, the clearinghouse may reduce the margin deposits required from the clearing firm. At its discretion, and depending on market conditions, a clearing firm may require an individual trader to deposit more money with the clearing firm than is required by the clearinghouse.

The current system of guarantees—individual trader, clearing firm, and clearinghouse—has proven effective in ensuring the integrity of exchange-traded contracts. Although individual traders and clearing firms occasionally fail, a clearinghouse has never failed in the United States.

[4] We noted earlier that, in theory, there is no loss of interest associated with a margin deposit. In practice, the amount of interest paid on margin deposits will vary by clearing firm and is typically negotiated between the clearing firm and the individual customer.