1

Functions and Structure of the Financial System

1.1 Functions of the Financial System

Finance is a human activity that deals with planning for the future. The financial sector of the economy is made up of markets in which promises of future payment are issued and assets are traded, the people and the firms making and assisting with these claims and exchanges, and the specialized facilities through which trading and other functions are carried out. It is embedded in a larger economic system shaped in part by how law and institutions, ranging from corporate organization to government regulations, have emerged historically. Finance is an important contributor to overall economic efficiency. Regions with developed and well-functioning financial systems tend to have higher economic growth.

The financial system carries out a number of functions aimed at improving the allocation of resources over time, between firms, and geographically, under conditions of constant change and profound uncertainty. It gathers resources from savers or lenders and transfers them to investors or borrowers, enabling people to defer consumption into the future and move resources to other places. Savers include households or firms with a surplus or resources; investors are households or firms using the resources to add to society's capital stock, including machines, supply chain organization, education, and consumer durables. The financial system helps people plan for the future, identify risks, and insure against adverse outcomes.

An **asset** is a good that provides value over time, rather than being consumed and disappearing in a moment. Assets include **financial instruments**, contracts, such as equity, debt, and derivatives contracts, as well as **real assets,** such as real estate and commodities.

Risk is the possibility of an unwanted event, encompassing the many ways in which people or companies become poorer or worse off, ranging from adverse price changes to bankruptcy to losing a lawsuit. The financial system facilitates managing, reducing, and sharing of risk, via forms of financing, providing insurance, and pooling and diversification of assets. For example, it is sometimes possible to **hedge** against a risk, that is, isolate it and offset its effects.

Assets have value or payoffs in an uncertain future, so their values today are influenced by how much time will pass before the future value is realized, what people think the future payoffs and their probabilities might be, and how they feel about the risks posed by that range of possibilities. If asset prices are set in more or less **efficient** financial markets, they will roughly reflect people's expectations, desires and fears about the future. The most important asset price is the, **interest rate**, which is the rate paid for borrowing money, expressed as a percent of the **principal, par value,** or **notional amount** of money borrowed per unit of time, generally annually.

Mechanisms to facilitate exchange of goods and services and for trading include the creation and use of **money** and other **media of exchange**, and more generally, of **liquid** assets. **Payment systems** also facilitate carrying out exchanges.

Many risks come bundled with benefits or with other risks. Forms of organization, such as the corporation and partnerships, and contracts, such as debt and equity, reduce risk and facilitate investment by pooling and sharing ownership and other claims on resources. Institutional structure is determined to a large extent by historical development.

In carrying out these functions of resource allocation, risk management, and facilitation of exchange, households and firms gather and create information. They identify opportunities for productive investment or allocation of capital. **Financial innovation** includes the discovery and implementation of new assets, such as securitization, derivatives, cryptocurrencies, and new techniques for disseminating information about prices and trading activity.

1.2 Market Participants, Intermediaries, and Governments

A number of terms are used to describe the variety of market participants, ultimately human beings, with all their disparate goals. Final consumers of financial services are called households, individuals, or investors. The term "agent" is used in two different senses: generally as a synonym for market participant and more specifically for one acting on behalf of another.

Firms that specialize in financial functions, such as banks, insurance companies, and investment managers, are called **financial intermediaries**. Their value added is nearly 8 percent of US gross domestic product (GDP).[1] Many are parts of large holding companies with subsidiaries operating internationally in widely varying functions. Most intermediaries carry out multiple functions and can be classified from both an institutional perspective, by type of firms, and from a functional perspective, by product or service, e.g. lending or facilitating transactions.

Many of these functions are carried out by financial firms "using their balance sheets" to transform assets and change their characteristics, by acquiring assets with one set of characteristics, and issuing liabilities with different characteristics that become the assets of other market participants. Intermediaries can separate and redistribute those characteristics in a way that better suits market participants at lower cost.

Maturity transformation changes the term to maturity of a debt contract by borrowing short-term and lending at longer term. In **credit transformation**, the credit quality of a debt contract is changed (and not necessarily raised). Monitoring, using **collateralization**, by which the borrower puts assets under the control of the lender, and using guarantees, may raise credit quality. **Risk distribution** and **transfer**, such as securitization, may create some securities with lower credit quality. The liquidity transformation carried out by banks and **money market mutual funds** (MMMFs) makes debt contracts function more like money and goes hand-in-hand with maturity transformation.

"What do banks do?" is a perennial question, with no universally accepted definitions. Older forms of banking, dating back to the medieval era, are referred to as **merchant banks**, which connect investors to investment possibilities, and generally also take an ownership stake. Modern **commercial banks** lend directly to households and companies and monitor their creditworthiness.

[1] The GDP share of the industry group Finance and Insurance was 7.8 percent in Q3 of 2022.

Banks may engage in **proprietary trading** of assets for their own accounts. **Investment banks** facilitate **market intermediation**, including securities issuance by companies, through **syndication**—arranging the securities' initial sale—and **underwriting**—assuming at least part of the price risk. The share of market compared to bank intermediation is higher in the United States than in continental Europe. Some banks also provide **custodial services** for clients, including custody of their customers' securities and cash balances, record keeping, and managing cash flows such as dividends and interest from investments.

Broker-dealers trade and invest in securities. **Dealers**, **market makers**, or **liquidity providers** take principal positions, using equity and borrowed funds to finance and execute securities trading. They take long or short positions and bear the market and credit risk of securities inventories, and are compensated through trading profits and interest. **Brokers** act as agents, facilitating trades and provide trading infrastructure without taking principal positions. They are compensated through fees, commissions, and may earn net interest by lending customer cash balances to other intermediaries at a higher rate than the broker pays.

Specialized intermediaries and mechanisms facilitate pooling investments. **Investment managers** and **management companies** manage investments on behalf of clients, whose portfolios remain in separate accounts. In the United States, **investment companies** are a legal form of pooled investment portfolio of securities and other assets in which investors own equity shares. **Open-end mutual funds**, the largest category of investment company, must calculate a **net asset value** (NAV) at the end of each day at which it issues or redeems shares at investors' initiative, adding or selling assets in its portfolio to match. The volume of investment in the fund is not limited, in contrast to **closed-end funds** trading in markets. **Money market mutual funds** (MMMFs) are a specialized type of mutual fund that invest in high credit quality, short-term money market instruments. **Exchange-traded funds** (ETFs) were introduced in the 1990s and differ from mutual funds in that investors buy and sell shares in the market, rather than in transactions with the fund itself. Large intermediaries act as **authorized participants**, buying and selling the constituent assets of an ETF and redeeming or issuing shares.

Institutional investors are large pools of assets that manage investments on behalf of others. They include investment management companies, pension funds, insurance companies, family offices, foundations, and endowments. Many are advised by consultants, such as McKinsey and Callan, that play a large role in their decision making. **Defined benefit pension funds** or plans are a form of employer-provided retirement benefit common in many countries. They provide for payments of a specified annual amount over the life of the retiree that is related to the years of work, average salary earned, and age at retirement. Many such plans are indexed for inflation. The benefits are disbursed out of funds that are financed by a combination of employer and employee payments and are invested. In a **defined contribution plan**, employees have an ownership claim on a portion of the fund, and future benefits depend on the fund's returns.

The financial system has evolved together with systems of government. In most of the world, government involvement with the financial system is carried out through the state itself and through **central banks**, which resemble commercial banks in some ways but are under some form of public ownership and government control. **Monetary policy** influences economic outcomes through interest rates, money markets, and control over the issuance of money. The legal structure within which financial intermediation is carried out is shaped by **regulatory policy**, the set of rules governing permitted, required, and prohibited actions and forms of organization.

Though these domains of state action are referred to as policy, suggesting a dispassionate process of evaluation and formulation, they are generally part of a larger political process. Historically, through

their evolution, and institutionally, through legal and corporate arrangements, central banks in many countries, including the United States, are not purely government-owned agencies but have some private-sector participation in their governance. Some regulatory powers, such as standard setting and licensing, are delegated to private-sector entities.

1.3 Assets and Markets

1.3.1 Money and Money Markets

Money encompasses a wide range of commonly accepted assets with stability of exchange value that provide money services, including:[2]

Payment services: can be exchanged for other goods or assets, or in settlement of debts.
Liquidity services: relative certainty as a **store of value**.
Nominal unit of account: prices and values that are most often measured in money units.

Money has its origins in a past so remote that there is little definitive evidence for its earliest forms. In one view, state sanction is needed for a **medium of exchange** to be widely accepted, for example, because it must be used to pay taxes or because the state distributes it widely. More likely, money is emergent, evolving gradually during prehistory as market participants gravitated to particular commodities as convenient means of exchange.

Money can take the form of a physical or digital object or **token**, based on its intrinsic value or confidence in its wide acceptance. In the historical era, until the Middle Ages, most money was in the form of coins or **specie** issued by governments. For most of the past millennium, money has also been account-based, meaning a liability of a government, central banks, financial intermediaries carrying out liquidity transformation, or even a nonfinancial business, its value dependent on the trustworthiness of the claim issuer. New forms of money have emerged recently, for example MMMF shares in the 1970s and cryptocurrencies in the current century.

Banks have historically been the largest issuers of claims used as money. The owner of an account with a positive balance could instruct a bank to transfer funds to another person's account at the same or at a different bank. A large part of the liabilities of central banks and commercial banks consist of **deposits**, book-entry liabilities that correspond to assets their owners can use to make payments or settle debts. Typically, commercial banks, government-owned enterprises, and a few other intermediaries that are allowed to issue deposits are authorized—and in many jurisdictions required—to hold deposits at a central bank, called **reserve balances**. In the United States, **federal funds**, or fed funds, are reserve balances at Federal Reserve (Fed) district banks that are traded or used to settle payments among banks.

Cash and close substitutes for cash, or **narrow money**, include currency and short-term central bank and commercial bank deposits that can be used for immediate payment. Some liquid short-term claims—**broad** or **near-money** and **money substitutes**—bear interest, including shorter-term government debt and bank deposits such as **certificates of deposit** (CDs). They are used less frequently as means of payment but may be readily sold for cash or used as collateral to borrow cash or other assets at reliably foreseeable values.

[2] Tobin (1958) defines it as "… a species we may call monetary assets—marketable, fixed in money value, free of default risk."

Many forms of money trade in money markets, which are among the highest-volume and the most active financial markets. They include **interbank lending**, **commercial paper**, and perhaps most importantly, **repo** markets.

1.3.2 Foreign Exchange

A **foreign exchange rate** is the price of currency issued in one jurisdiction in terms of another. Foreign exchange markets are among the largest financial markets in the world by many measures with, daily trading volume of $7.5 trillion.[3]

Appreciation (depreciation) of a foreign currency is a rise (fall) of its price in home or local currency units. Long positions in foreign currency and investments in foreign assets are exposed to appreciation of the home currency and depreciation of foreign currency. Short positions in foreign currency, such as future payment obligations for imported goods or repayment of borrowing in foreign currency, are exposed to depreciation of the home currency or appreciation of foreign currency.

1.3.3 Digital Currencies

Digital currencies are a relatively recent innovation in money and payments systems made possible by advances in technology and the rapidly declining cost of computers. They currently take several forms. A **cryptocurrency** is a means of exchange that relies on algorithms to preserve limited supply and scarcity and to maintain the ledger that documents ownership. Cryptocurrencies are different from most privately created forms of money used in the past in that they are not inside money, that is claims on a private issuer, but are added to the total stock of assets.

Stablecoins are digital assets with values pegged to that of another form of money. Some, such as Tether, are tied to the US dollar; others are tied to the value of a cryptocurrency. The values are promised by the issuer to be maintained either by issuing the stablecoin as a liability supported by asset reserves or through an algorithm asserted to maintain the pegged value.

Central bank digital currencies (CBDCs) are digital currencies issued by central banks or governments. They have not yet become widespread but are being widely considered. Benefits claimed for introducing CBDCs include reducing crimes committed using physical cash, such as tax evasion, money laundering, and dealing in contraband, and providing banking services to poor people.

The disadvantages include the potential for surveillance and government control of people's transactions. Substitution of CBDCs for bank deposits raises monetary policy implementation concerns and competitive concerns for commercial banks. Public acceptance of CBDCs is also not assured in countries with weak currencies, for example, the 2023 attempt by the Nigerian central bank to introduce a digital currency.

1.3.4 Equity, Loans, and Bonds

Equity is an ownership stake in a firm, a **residual claim** that pays or is worth the remaining value of the firm's assets after other claims have been met in full. Under the legal structure of firm organization prevailing since the 19th century, equity investors, or **shareholders**, enjoy **limited liability**, owing external claimants no more than the value of their investment.

[3] As of April 2022.

Money can be invested or lent for shorter or longer periods of time. The lender receives a claim in return, part of a larger category of **fixed-income debt instruments**. Some short-term claims are used as money to carry out transactions.

Debt instruments are highly diverse. **Loans** are bilateral contracts between a lender, often a single bank or nonbank loan originator, and the borrower. Many equity claims and most bonds are **securities**, subject to a body of law and regulation. The legal design of **debt securities** including **bonds** facilitates offering them to many potential lenders at issuance. Bonds are generally issued by larger corporations and by governments. The largest bond markets are those for sovereign debt, that of central governments, such as the market for US government bonds, or Treasurys.

Some longer-term claims can be bought and sold in **capital markets**. Loans and bonds differ primarily in how readily they trade. Loans are usually retained by the originator; bonds are designed to be traded. Large loans may be **syndicated**, with several lenders extending credit under a uniform agreement. Regulatory policy distinguishes between **public capital markets** subjected to more stringent requirements regarding accounting and disclosure, and accessible to the general public and **private markets** open only to **qualified**—institutional or wealthy—**investors**.

Securities are initially sold to investors by the issuers of the claims, directly or through intermediaries, in **primary markets**. In the stock market, a firm enters the public markets and opens ownership of its shares to a wider range of investors through an **initial public offering** (IPO). Once issued, investors trade them in **secondary markets**. Secondary markets also exist for syndicated and some other large loans.

In the US Treasury market, the benchmark 10-year note and other bonds, bills, and notes issued by the US federal government are initially sold on regular schedules through an auction process to a small set of **primary dealers**. Secondary market trading is carried out by a much wider set of dealers.

Corporations and the legal treatment of their funding sources took on their modern forms as the result of a long historical evolution of law and corporate institutions. Corporations began emerging in the Middle Ages and, by the 16th century, were structured to outlast a specific project, such as an overseas trading voyage. Among the important features of the modern corporation is permanence: in contrast to simple family businesses and partnerships, a corporation can survive even if the partners pass away, and owners' stakes can be sold to new owners.

Equity and debt claims began, as part of this evolution, to trade in secondary markets. Corporate forms of organization are capable of coordinating a much wider scope and greater complexity of operations and of distribution and pooling of risks, for example, the development of insurance. These institutional innovations then create a need for incentive alignment mechanisms, information generation, and **corporate control** to facilitate the vetting, selection, and monitoring of borrowers, managers, and other agents working on behalf of others.

Figures 1.1 and 1.2 illustrate recent developments in US loan and debt markets, with an outstanding value of $98.4 trillion in 2023. Federal, state, and local government are the largest category of borrowers, with over one-third of the total. Financial sector borrowing increased steadily until the global financial crisis, but its share has declined since. Until the **disintermediation** of the 1970s, banks and investment banks had been the predominant lenders but have been displaced by a combination of investment funds, the public sector, primarily through government-guaranteed residential mortgage loans, and, for a time, securitization.

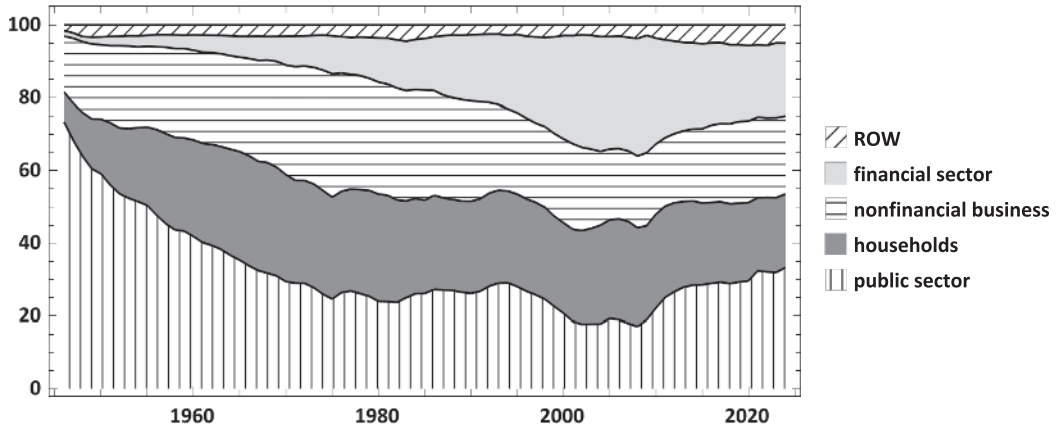

Figure 1.1 Who's borrowing in the United States, 1945–2023

Share in the total of each sector's outstanding borrowing in US markets via loans and debt securities, annual, percent. *Data source*: Federal Reserve Board, Financial Accounts of the United States (Z.1), Table D.3.

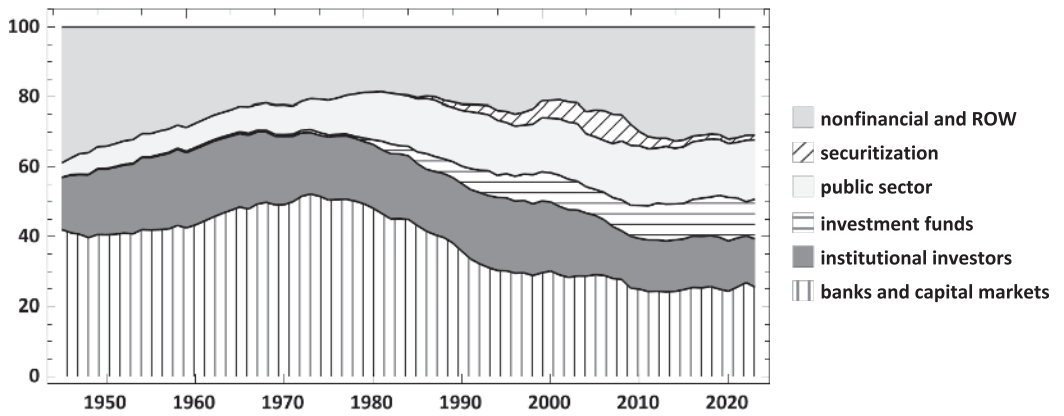

Figure 1.2 Who's lending in the United States, 1945–2023

Share of each sector in total lending via loans and debt securities in US markets, annual, percent. Banks and capital markets includes finance companies, brokers, and dealers. Institutional investors include insurance companies and private and public pension funds. Public sector includes assets held by the Federal Reserve and are held or guaranteed by government-sponsored enterprises (GSEs). Securitization includes nongovernment-guaranteed asset-backed securities (ABS). *Data source*: Federal Reserve Board, Financial Accounts of the United States (Z.1), Tables L.208 and L.214.

1.3.5 Spot and Derivative Assets

Spot markets involve an exchange of assets now and create no future obligation apart from fulfilling the terms of the exchange. A **derivative** is a financial instrument or contract agreed now but involving an exchange of assets in the future. A derivative's value and the counterparties' returns depend on the as-yet unknown future prices of another asset, called the **underlying asset**. Derivatives are widely used to establish a desired exposure to an underlying asset or to hedge an exposure.

One way to categorize the great variety of derivatives is by how their values are related to those of their underlying asset. The values of **futures, forwards, and swaps** have a linear and symmetric relation to that of the underlying price. A change in the underlying price has a proportional impact on the derivative's value. **Option** values have a nonlinear and asymmetric relation to the underlying price, depending on its current level and the direction and size of changes.

There are futures, forwards, and options on a wide variety of assets, including foreign exchange, stocks and stock indexes, bonds, and commodities. Fixed-income derivatives include **credit default swaps** (CDS). Derivatives can be classified by how they are traded, on an organized exchange or **over-the-counter** (OTC) and can be classified by underlying asset, a stock or stock index, a bond or interest rate, a commodity or a currency. Futures are traded on exchanges; forwards are traded OTC between dealers or their customers.

Measuring the size of derivatives markets is problematic because the aggregate and its composition by underlying asset differ greatly depending on the metric. The **notional** or **nominal principal amount outstanding** is the par value of existing contracts, generally a far larger number than the aggregate **net present value** (NPV) that accounts for offsetting payments. The **gross** notional outstanding includes many offsetting trades between pairs of counterparties and is much larger than the **net** amount.

As seen in Figure 1.3, by far the largest share of the OTC derivatives markets is that of interest rate swaps. Foreign exchange derivatives also have a large share, with credit, equity, and others making up the remainder.

Derivatives may be built into other assets as an element of a more complex security or portfolio. For example, **structured products** can be analyzed as a set of derivatives contracts on an underlying set of assets. A **callable** bond is bundled with a short call option on the bond through which the issuer can repay the bond prior to maturity. A **convertible** bond is bundled with a long out-of-the-money call; the bond can be exchanged for equity in the issuing firm if the stock price rises.

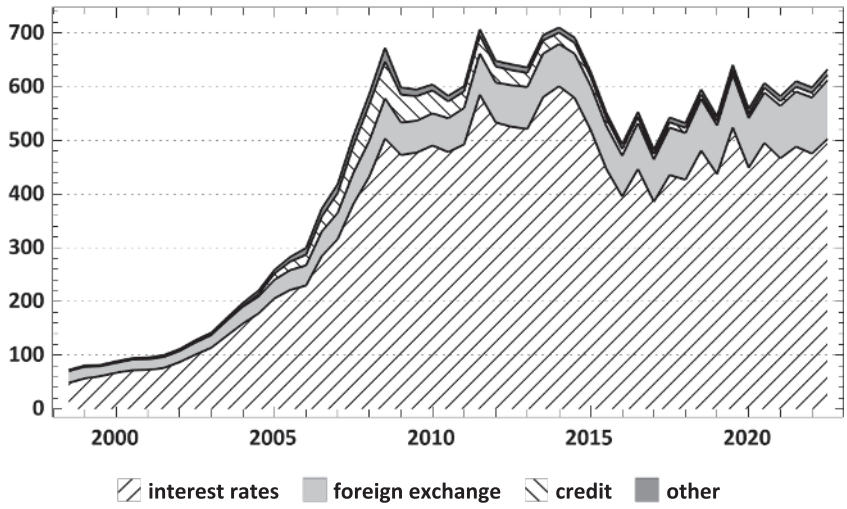

Figure 1.3 OTC derivatives markets 1998–2022

Notional amounts outstanding, G10 countries including Switzerland, trillions of US dollars, semiannual, H1 1998 to H1 2022. *Source*: BIS, Semiannual OTC derivatives statistics, Table D5, www.bis.org/statistics/derstats.htm.

1.3.6 Alternative Investments

The largest categories of alternative investments, which are outside the public stock and bond markets, are private funds: **hedge funds** and **private equity**. Both are usually organized as limited partnerships, with a general partner making investment decisions. Mergers and acquisitions of firms are often financed in large part by borrowing from banks and through bond issuance. More recently, a portion of this credit has been extended by **private credit** funds, which extend credit to private companies often owned by private equity funds, without taking ownership. Alternative investments also include funds investing in **real assets**, such as real estate, commodities, and forests. US private funds, according to regulatory data, managed $20.9 trillion in gross assets and $14.0 trillion in net assets in Q2 2023.

Most alternative investments are highly illiquid and have high investment fees and other costs compared to public-market and traditional investments. Institutional investors are the largest investors in alternatives. In recent years, **liquid alternatives**, mutual funds and ETFs employing typical alternative investment strategies, have been marketed to households.

Hedge funds are a loosely defined group of investment companies that are open, due to regulatory constraints, only to institutional investors and wealthy households but not to the general public. US hedge funds managed $5051.6 billion of gross assets at the end of 2023, more than three times as much as in 2012.[4] They are not subject to many restrictions on investment style and technique constraining other funds' ability to trade derivatives, take short positions, and borrow. This permits hedge funds to take more risk than other funds and to engage in strategies that cannot be carried out without these tools.

Hedge funds are an old form of investment company, dating back (at least anecdotally) to the late 1940s. For tax reasons, they are often organized in an onshore-offshore structure, in which several accounts have nearly identical investments. The offshore account is organized as a corporation and domiciled in a tax haven, a country that does not tax profits. The investors are then responsible for paying taxes where they reside. The onshore account, typically organized as a limited partnership, is domiciled in a developed country.[5] Its investors are entities, such as pension funds that are not obliged to pay profit taxes. Both accounts are managed in parallel by a hedge fund management company. Investors can withdraw funds but only on specified dates, and the manager may be permitted to limit withdrawals.

The hedge fund manager is compensated through a "2 and 20" structure. The management company organizes the fund and receives an annual management fee, often 2 percent of the fund's net asset value (NAV), the value of the investor assets it manages. A general partner, the owner of the management company, makes the investment decisions and receives a performance fee, typically 20 percent of the return, if the fund has positive returns as measured by the excess over the previous maximum value or "high water mark" of an investor's shares. In recent years, a number of hedge funds have accepted lower fees.

Most hedge funds are classified as following one of these strategies:

Equity funds take views on specific equity prices rising or falling.
Relative value seeks to exploit arbitrage opportunities in and between markets in all asset classes.

[4] The data are from the 2023 Securities and Exchange Commission Form PF annual report (https://www.sec.gov/files/2023-pf-report-congress.pdf) and from data provider BarclayHedge (https://www.barclayhedge.com/solutions/assets-under-management/hedge-fund-assets-under-management/).

[5] Some hedge funds are organized as limited liability corporations.

Macro strategies are based on views on central bank policy, foreign exchange rates, and other macroeconomic and political developments.

Event-driven strategies express views through stock and bond positions on events such as corporate mergers and acquisitions, defaults, and bankruptcies. They include activist funds, which attempt to directly influence corporate decisions.

The portfolios can be very concentrated or diversified, depending on the strategy. Many hedge funds are highly reliant on large broker-dealers for **prime brokerage** services including execution and financing of trades, safekeeping of securities, information and technology, and **capital introduction** to potential investors.

Private equity funds have grown rapidly since their origins in the 1970s and fall into two major categories: investing in **leveraged buyouts** (LBOs) and **venture capital**. Leveraged buyout funds acquire all or a controlling stake in the equity of publicly traded firms they identify as undervalued due to mismanagement, corporate structure, or other reasons. The equity purchase is funded largely by borrowing. Venture capital funds invest in new startup firms, with a view to eventually taking the firm public or selling their stakes at higher values.

Private equity funds are intended to be relatively short-lived compared to hedge funds, which are in principle perpetual. The private equity fund raises investor money in the form of immediate payments and commitments to make further investments up to some limit over the next few years, when called upon by the general partner. In the initial years of the fund, the general partner seeks investment opportunities and deploys the invested cash, and in later years, as the investments reach fruition, they are sold or taken public and cash is returned to investors. The fund is expected to last 10 to 12 years. The general partner is compensated with a share of the return, and the fund is structured so it can be treated for tax purposes as **carried interest** or capital gain rather than fee income.

The rise in assets of private equity funds has coincided with a sharp decline in the number of publicly traded companies and of IPOs in the United States, from a peak of 677 in 1997, to just 38 in 2022.[6] A number of explanations for this shift have been put forward. Technological change may have increased the economies of scale and scope that make a smaller firm more valuable as part of a larger one. Changes in regulation have increased the cost of entering public markets and of complying with public-market accounting and audit rules. Low interest rates have made private equity funds, which employ a large volume of debt to fund acquisitions, more attractive to some institutional investors.

1.4 Mechanics of Trading

1.4.1 Asset Positions and Risk Exposures

People hold assets because they anticipate some benefit over time. The expected benefit can be the cash flows the asset throws off (e.g. a stock or bond), its usefulness in a production process (crude oil), the ease with which it can be exchanged for goods or other assets (money), the consumable services it provides (a house), or from expected appreciation in value over time (bitcoin). Those expectations may all be disappointed, making assets risky.

[6] Statistics on IPO activity are available at https://site.warrington.ufl.edu/ritter/files/IPO-Statistics.pdf.

A **position** in an asset is a holding of x units of the asset. We'll denote its time-t price by S_t, its next-period (one day, week, month …) price by S_{t+1}, and so on. The current value of the position is xS_t.

There are different ways to understand an asset's value that may diverge from one another. It can be:

- an estimate of its "real" value, the **fundamental**, **intrinsic**, or **fair value**, possibly based on mathematical modeling,
- the market value, the price at which it can be bought or sold, or
- an accounting or book value, as ordained by recognized practices or law.

A **short position** in an asset, with $x < 0$, expresses the view that S_t will decline. A short position risks a loss if the price rises. Unlike a long position, a short position inherently involves borrowing. It is generally established by borrowing x units of the asset and selling it in the spot market, with the intent to buy an equal number of units and returning them to the lender at a future date. Short positions can also be expressed through derivatives trades, for example, selling a forward or futures, a long put or short call option on the asset, or a swap.

The cash flows of short positions are complex. The lender of an asset generally retains the right to interest and dividends. The short seller receives interest on the cash proceeds from the sale. The transaction is usually intermediated by a broker-dealer or custodial bank, which can obtain a fee for locating the asset. Its owner and lender may also receive a fee. There are different legal structures and mechanics for lending stocks and bonds, as well as across countries.

Portfolios are combinations of asset positions. With x_i denoting the number of units of asset i and S_{it} its time-t price, the value of each constituent position is $x_i S_{it}$ and the value of the portfolio is $\sum_i x_i S_{it}$. For example, with two positions, the portfolio value is $x_1 S_{1t} + x_2 S_{2t}$. For a portfolio consisting of long positions only, $x_i > 0$ for all i, asset i's **weight** in the portfolio is

$$w_i = \frac{x_i S_{it}}{\sum_i x_i S_{it}},$$

with $w_i > 0$ for all i, and $\sum_i w_i = 1$.

The definition of constituent weights is more complicated for a short and for a long-short portfolio. For a long-short portfolio with a zero net market value, $x_i \gtrless 0$ and $\sum_i x_i S_{it} = 0$, such weights can lead to potentially misleading understatements of the portfolio's risk. Weights may be defined in alternative ways to avoid division by zero, e.g. using absolute values:

$$w_i = \frac{|x_i| S_{it}}{\sum_i |x_i| S_{it}}.$$

In many cases, risk is assumed not by deliberately putting on a position but in the course of business, such as operating an airline or refining petroleum, in which case one may refer to a **risk exposure**. Airlines have a short risk exposure to the highly volatile price of gasoline: a rise in the price increases operating costs. An oil refiner's position is more complex, most often a long exposure to the price of gasoline and a short exposure to the price of crude oil because the difference between their prices, the **crack spread**, is directly related to its profit margin.

Not every risk exposure can be expressed in terms of the price of a specific asset. Rather, exposures may be to one or more **risk factors**, drivers of return derived from modeling and observation that don't coincide with prices of investible or identifiable assets, these exposures including macroeconomic factors. Analysis and measurement in finance, including market and credit risk modeling, is

often conducted using risk factors. Modeling is more tractable with a limited number of risk factors rather than myriad assets.

Hedging is the process of ridding a portfolio or business or household of exposures to risk factors that it doesn't desire or target. It is closely related to **insurance**, a contract in which one party agrees to compensate another for specified types of losses.

Market participants may have offsetting hedging needs, and forward and futures markets have grown to facilitate this redistribution of risk. An oil refiner, for example, may wish to focus on the efficiency of its refining process and rid itself of exposure to the prices of its main input and output. An oil producer is focused on discovering and extracting the resource, and an airline on safety and scheduling. If the oil refiner buys and and oil producer sells oil, and the oil refiner sells and the airline buys jet fuel for future delivery at agreed prices, all have reduced risk.

For an exposure taken on in the course of business, hedging decisions involve forecasts not only of the impact of changes in risk factor prices but also of the size of the exposure. For example, airlines found that they had put on too-large long positions in fuel when the Covid pandemic curtailed air travel, resulting in large losses from the direction of fuel prices and the collapse in revenue.[7]

1.4.2 Market Microstructure

Market microstructure describes the institutional arrangements that assist in overcoming frictions and using information efficiently to complete searches and execute trading. Very different mechanisms are used to effect transactions in different markets.

Most market participants are **price takers**, entering the market to buy or sell at the prevailing market-clearing price. Dealers, brokers, and many other market participants are **price makers**, specifying the prices at which they are willing to transact and the quantities they are willing to buy or sell at those prices.

Quote-driven trading systems rely on dealers or market makers, who maintain inventories of the asset, currencies, bonds or commodities, as well as money balances and stand ready to buy or sell given amounts at a given price. The **quote** consists of the **bid** price, at which dealers are prepared to buy, and the **offer** or **asking** price, at which they are prepared to sell. Both are stated for a specific amount. The difference between bid and offer prices is the **bid-ask spread**. The dealer may post the quote publicly or disclose it only upon inquiry to an established customer.

An **order-driven** system resembles an auction. In it, market participants declare or enter into the system a **limit order**, an amount of the good they wish to buy or sell and the price at which they are prepared to do so. At any point in time, buy and sell limit orders can be ranked from low to high price. Transactions take place when orders can be matched, with an offer to sell at a price no higher than the highest order to buy. The transaction is then effected for the smaller of the two amounts specified.

Quote-driven trading is prevalent in **over-the-counter** (OTC) markets, which include foreign exchange, bond, and many derivatives markets. Order-driven markets include most stock and futures markets. Stock trading in the United States and other advanced economies was once heavily concentrated in a few exchanges, but today it is highly fragmented. Stocks and some other assets

[7] Chong Koh Ping, "'Overhedging' Oil Prices Lands Some Coronavirus-Battered Global Airlines in Further Trouble," *Wall Street Journal*, May 15, 2020, https://www.wsj.com/articles/overhedging-oil-prices-lands-some-coronavirus-battered-global-airlines-in-further-trouble-11589555843.

have historically traded primarily though no longer exclusively on **exchanges**, which are centralized loci of trading. Most trading in securities, commodities, and derivatives contracts was executed by people on exchanges or using telephones in OTC markets, but that is now becoming a relic.

With the advent of **electronic** and **algorithmic trading systems**, the distinction between OTC and exchange trading has blurred. Algorithmic trading is conducted automatically, as instructed by a computer program. Brokers and exchanges may use a **central limit order book** (CLOB), a standard market structure for electronic trading systems, to match trades. It consolidates orders from different sources and applies a set of rules to match trades. **Alternative Trading Systems** (ATS) is a regulatory term for non-exchange trading platforms. ATS, or "dark pools," have been used primarily for trading between dealers but are increasingly used for trades between dealers and customers as well.

Exchanges and ATS are registered with the **Securities and Exchange Commission** (SEC) and report executed stock trade data, but are regulated differently. Exchanges are obliged to make bids and offers public through the **National Best Bid and Offer** (NBBO) system. Under the SEC's 2005 **Regulation NMS** (RegNMS), they must send arriving orders to the exchange displaying the best price. ATS and other market makers are only required to report trades after execution.

Nonprofessional investing has also grown as a share of trading volume. Regulatory changes permitting fee competition contributed to the growth of retail trading, primarily of stocks and stock options. Discount brokerages such as Charles Schwab, E*Trade, and Ameritrade arose in the 1970s to serve the retail market. As brokerage volumes grew, low- and eventually zero-commission online stock trading became feasible. Index funds, which first appeared in the 1970s, were particularly cost efficient. The introduction and widespread adoption of electronic trading further massively cheapened trading. Zero-fee mutual funds and exchange traded funds (ETFs) followed, and brokerages began offering zero-commission stock trading.

The move to zero-fee and zero-commission trading has also been enabled by a shift in the sources of brokerage revenue. The decline in trading fees and commissions is offset by net interest on customers' cash balances, stock lending fees, and **payment for order flow** (PFOF) by wholesale market makers that execute the trades.

Electronic trading has been prevalent in foreign exchange markets for many years, and accounts for about 75 percent of trading volume. It is now also becoming more prominent in bond markets as information technology becomes cheaper and knowledge of how best to design and implement the systems grows. Bond markets are still heavily reliant on human traders, but the volume of trades on systems, such as BrokerTec, TradeWeb, and MarketAxess, has been growing rapidly.

ATS and CLOBs have become particularly important for the most recently issued and heavily traded US Treasury securities. These markets could soon more closely resemble the stock market, in which trade orders, including those from non-intermediaries, may be routed for execution to many places within the larger trading system rather than within one platform. Disruptions to the Treasury market in recent years may accelerate the push toward ATS.[8] Some firms that operate ATS platforms, such as Citadel Securities, have also entered the corporate bond market.

1.4.3 Payment Systems

Money is part of a larger set of ways in which exchanges are effected. People and firms routinely transfer money among one another for myriad reasons, including exchanges of goods for money

[8] See Chapter 20 below.

and for settling securities trades and debt obligations. These transfers are often made via retail and wholesale payment systems, which help market participants economize on the stock of money they hold to conduct transactions.

Payment systems generally don't function instantaneously although there has been progress in that direction. In the past, only hand-to-hand cash payments were completed close to instantly. Most payments are made at a distance and require time and a series of verification steps. The imperfect simultaneity of payments by the two parties leads to a type of short-term credit extension by at least one. The introduction of cryptocurrencies, and particularly CBDCs, are sometimes viewed as paths to speeding up and improving payments systems, conflating two sets of issues.

Like most aspects of finance, payments systems have been evolving and speeding up with communication and information technology. More time-consuming, but well-established means include checks to effect bank transfers and credit cards, introduced in the mid-20th century. Credit card operators extend short-term credit to purchasers and pay vendors and merchants almost immediately. An electronic network connects merchants to the card operator. In an **electronic bank transfer** (EBT), no written instruction is needed. Checks, EBTs, and credit cards were originally used primarily by businesses and wealthy people but are now routine in retail transactions.

Large-value or **wholesale payments systems** are used to move money among banks. Most operate during normal business hours and on trading days. Many of these systems are operated by central banks, since payments are ultimately settled by transfers of balances at central banks. The Fed provides payments services to approved banks and other financial institutions, most prominently **Fedwire Securities Service** (Fedwire), a system for intraday US dollar funds and securities transfers between banks. The **Clearing House Interbank Payments System** (CHIPS) is a similar, privately operated system for intraday payments. These wholesale systems permit bank transfers to be completed within a day. The **Automated Clearing House** (ACH) system is an older and slower system operated by banks and the Fed, and efforts are underway to speed up its settlement times. The **Society for Worldwide Interbank Financial Telecommunication** (SWIFT) messaging service opens these and other national systems up to international transactions.

An increasing volume of payments are being completed within one day, or even nearly instantaneously. PayPal introduced direct **person-to-person** (P2P) payment systems used primarily for exchanges among households and small businesses. Alipay and Zelle also provide same-day payments to nonbank users. Most are ultimately settled through commercial banks, which still takes a discrete amount of time.

1.4.4 Clearing and Settlement

Once payments, trades, and exchanges have been agreed upon by market participants, they have to be completed; the handshake has to be followed by the exchange of an asset or a good for money or for another asset. There are several steps involved, intertwined with the operation of money markets and requiring specialized procedures, systems, and personnel. This post-trade processing is sometimes called the back-office operations or "plumbing" of the financial system.

The initial step is **clearing** in which the counterparties to a trade confirm its terms. The counterparties match trade records with one another, each entering the trade onto the firm's books and records. In payment systems, it is the step in which payment instructions are conveyed between the banks or other intermediaries involved. The final step is **settlement**, transferring securities, money, or other assets and making final payments between market participants and intermediaries.

Trades generally settle some time after the **trade date**. The time to settlement varies across markets and jurisdictions.

In markets with a great deal of activity, there may an additional step between clearing and settlement: **netting**, or cancelling offsetting trades. **Gross settlement** occurs via transfer of the gross amounts due, without netting, and **net settlement** occurs at specific times, such as end of day, via the transfer of the net amount of money or asset due. Netting is easier if money or traded assets are fungible, meaning it is irrelevant which units of the asset you own.

Most settlement and netting occurs via large-scale systems. For example, the **Depository Trust and Clearing Corporation** (DTCC) operates settlement systems or platforms for securities and some derivatives. Obligations vis-à-vis the clearing platform replace bilateral contracts, a process called **central clearing**. DTCC and similar platforms employ **delivery versus payment** (DVP) settlement, in which it is ensured that delivery occurs if and only if payment occurs. In derivatives markets, efforts at **trade compression** and central clearing, accelerated in recent years by regulatory **mandatory clearing**, have reduced the disparity between gross and net notional volumes of derivatives outstanding.

Fedwire, in which the Fed settles payments between banks, and TARGET, a similar large-value interbank funds transfer system operated by the European Central Bank (ECB), are **real-time gross settlement** (RTGS) systems. Final settlement of payments is effected continuously without netting. CHIPS, the private payments platform operated by US banks, in contrast, computes a net amount due or owed by each participating institution and makes a corresponding transfer at the end of each business day. FedNow is a payment system introduced by the Fed that plans to work through banks to offer same-day payments to retail and small business clients.

Even short settlement times introduce risk and are potentially costly. Most electronic retail and business payments settle through the ACH system for transmitting and carrying out payment instructions, with a few days between the time one account is debited and the receiving account credited. Most foreign exchange spot trades settle two business days after the trade date ("T+2"), as do most bond trades.[9] US government bond trades are settled one day after the trade date ("T+1"). The settlement cycle for securities is subject to regulation, and in the United States, the standard time for stock settlement was shortened to T+1 as of mid-2024.

In some markets, the settlement cycle for a trade may not be completed because one party is unable to deliver securities it has sold, events called **failures to deliver**, or **fails**. In US Treasury markets, where fails are more common, they may arise for a number of reasons related to the way in which US debt is distributed to investors and to the mechanisms by which they are used as collateral. Fails may also occur because of the failure of an intermediary. In stock markets, a **naked short** is a less common form of short position in which the asset is sold without first borrowing it. A fail may occur if a naked short position cannot be covered by borrowing the stock by the settlement date.

Further Reading

On the link between financial and economic development, see Levine (2005), recently updated in Levine (2021). A functional approach to analysis and regulation of the financial system was introduced by Merton (1995). Tobin (2018) provides an overview of financial intermediation.

[9] USD trades against the Canadian dollar settle in one day.

Goetzmann (2016) is a history of monetary and financial institutions. Baskin and Miranti (1997) describe the evolution of the modern corporation since its emergence in the medieval era. Harris (2020) focuses on the evolution of limited liability.

Adrian and Mancini-Griffoli (2021) and Makarov and Schoar (2022) provide overviews of digital currencies, and Prasad (2021) places them in the larger context of the functions of money in the financial system. See Chen and Siklos (2022), Dowd (2024), and Genc and Takagi (2024) on CBDCs.

Chaboud et al. (2023) and McGuire et al. (2022) provide up-to-date overviews of the foreign exchange and related derivatives markets, relying in part on the Bank for International Settlement's Triennial Central Bank Survey.

Chambers et al. (2018) is a nontechnical overview of alternative investments. Ivashina and Lerner (2019) is an introduction to private equity. Cai and Haque (2024) discuss private credit.

Kahn and Roberds (2009) is an introduction to payment systems, and Kahn and Roberds (2001) to settlement risk and the CLS system.