1 Introduction and Background

1.1 Why Do We Have Financial Markets?

The purpose of financial markets can be broadly defined to be to channel funds from savers to borrowers. Individuals have a preference for **consumption smoothing**, both intertemporal (saving and dissaving over time so that consumption is less affected by time-varying income) and intratemporal, i.e., across states of nature (to avoid or mitigate the effects of disaster or large price swings). Diversification of **idiosyncratic** (individual specific) liquidity risks enables the mobilization of society's savings for long-term projects (which may often be the most productive). There is economic efficiency and growth if entrepreneurs with productive ideas/projects borrow from savers with inferior investment opportunities of their own (households are typically net savers; firms are net borrowers; government can be either, it depends on revenues versus expenditures). To provide the **insurance** or **hedging** demanded by some requires that someone, perhaps called **speculators**, take the other side thereby enabling the **risk transfer**. Ultimately these transactions can increase welfare, so financial markets are not necessarily in total a **zero sum game**.

The productive capacity of the economy is linked to real assets, to land, buildings, machinery, technology and knowledge, and goods and services production. Financial assets are pieces of paper and/or electronic entries that do not contribute directly to the productive capacity of the economy; they are titles to income generated by real assets. Real assets constitute net wealth and generate the net income of the economy. Financial assets define the allocation of wealth and income among households. Financial assets are liabilities of the issuers and so aggregation of household and firm balance sheets leaves only real assets as the net wealth. Domestic net worth can be obtained by summing the value of residential and nonresidential real estate, equipment and software, inventories, and consumer durables. **Human capital** (education and health) is also part of a nation's wealth but its stock is difficult to value. Households own real assets such as houses and consumer durables but also financial assets such as bank deposits, life insurance and pension reserves, corporate and noncorporate equity, debt instruments, mutual fund shares, etc. Savings are the part of current income that is not consumed. Investing is about which assets to acquire with the saved income.

The efficiency of the capital allocation process matters. A country can save and invest a large proportion of its output, but if the financial system allocates it inefficiently, a shortfall in growth and welfare ensues. Some examples of inefficiencies might include: preferential flow of credit to Party members' companies, poor funding options for small and medium sized enterprises (SMEs), and poor legal systems

such as those that allow **insider trading** with impunity. There is some evidence that enforcement of insider trading laws reduces the cost of equity/capital (Bhattacharya and Daouk (2002)).

Some authors have distinguished between two types of financial systems: **bank-based** systems (China, Germany, Japan, etc.) and **market-based** (US, UK, etc.). In the bank-based system, credit is primarily obtained through the banking system, whereas in the market-based system, borrowers derive much credit from issuing securities to raise funds. Levine (2002) describes the relative merits of both systems and their relative prevalence in different places over time. He argues that it is unclear which system is superior and that the distinction may not be very useful in determining sources of growth; instead the legal and institutional environment matters more.

Securities markets are physical or virtual venues where demand meets supply. Ideally, they guide scarce resources towards their most productive use. Investors analyze companies and bid prices up or down, which influences the cost of capital (both debt and equity). Ultimately, this determines which companies will live and which will die. Ideally, this enables efficient **risk management** – the slicing and dicing of risks and their transfer to parties most willing to bear them – which improves household welfare and reduces firms' cost of capital. A key feature of security markets is that they allow the separation of ownership and management. A small business can be owner-managed. A large corporation has capital requirements that exceed the possibilities of single individuals, and possibly has hundreds of thousands of shareholders. They elect the board of directors, which hires managers who, ideally, run the business efficiently and maximize its value for the shareholders. In principle, this separation ultimately leads to improvement of economic efficiency and welfare. However, conflicts of interests arise often in financial markets, and this can lead to negative outcomes.

The **principal-agent problem** is a classic example. Shareholders want the most productive projects, i.e. those with the highest positive "net present value," to be undertaken. Instead, managers may pursue their own interests: empire building, taking excessive risks to generate short-term profits and ignoring long-term consequences, keeping inefficient suppliers in exchanging for kickbacks, engaging in corporate book cooking, etc. Some well known recent examples include: WorldCom, Enron, and Parmalat. Arthur Andersen, the demised accounting company, received more income from consulting for Enron during the 1990s than from auditing it. Enron used special purpose entities and vehicles to get debt off its books, and the auditor might have been lenient to protect its consulting profits. In principle, boards of directors may force underperforming managers out. They may design compensation contracts that align incentives, or they may not. Security analysts, large shareholders, and creditors monitor the management, and they can sometimes affect the direction it takes. Some other examples of conflicts of interest include: optimistic security research in exchange for investment banking business (hence information barriers between corporate finance operations and retail or trading business); trading against or ahead of clients (**front running**); and insider trading where insiders or their proxies trade ahead of product news, earnings announcements, and merger and acquisition deals.

The financial crisis of the late 2000s demonstrated a range of weaknesses in the financial markets architecture including **moral hazard** where executives had incentives towards taking excessive risks: big profits yield big bonuses; big losses do not coincide with negative bonuses. Government bailouts were needed to stabilize the system with large future fiscal consequences. Additional regulation and supervision were introduced. Many fines were issued to investment banks for misconduct. Turner (2009) provides some analysis of what happened.

1.2 Classification of Financial Markets

We can classify financial markets into the following: **money markets** – debt instruments with maturity < 1 year; **bond markets** – debt instruments with maturity ≥ 1 years; **stock/equity markets** – shares of listed companies; **foreign exchange markets** – currency pairs; **derivatives markets** – futures contracts, options; **commodity markets** – pork bellies, copper, etc. We will discuss these different markets and the instruments that they trade below.

1.2.1 Money Market

The money market is a subsector of the fixed-income market. Small investors can invest via money market mutual funds. Instruments include:

Treasury bills (T-bills). Highly liquid short-term government debt. Sold at a discount from the stated maturity value (investors' earnings are the face value minus purchase value).

Certificates of deposit (CDs). Time deposit with a bank which cannot be withdrawn prior to maturity but can be traded.

Eurodollar CDs. Dollar-denominated but issued by a foreign bank or a foreign branch of a US institution, hence not Fed-regulated (likewise Euroyens). Nowadays, there's nothing European about the prefix although the origin of the term goes back to US$ deposits in European banks after WWII.

Commercial paper. Short-term unsecured debt of large companies (instead of direct bank borrowing).

Bankers' acceptances. Payment order (time draft, postdated cheque) endorsed as accepted by a bank and hence bearing its credit rating. Frequently used in international trade to substitute creditworthiness of the bank rather than that of an unknown trading partner (e.g. an exporter selling products to an unknown importer receives acceptance from the importer's bank to pay in 90 days). Traded at a discount (depends on interest rates and the bank's credit quality); the holder may keep it until maturity or sell it in the open market or to the bank.

Repurchase agreements (repos, RPs). Agreement to sell a security now and buy it back later (at a higher price). Effectively collateralized borrowing (although legally distinct since there is automatic ownership transfer). Reverse repo: effectively collateralized lending (repo for the counterparty).

There are some well known and often-quoted money market rates:

The **Federal funds rate**. Commercial banks required to hold a certain minimum amount of Fed Funds on reserve accounts with the Federal Reserve (depending on customer deposits). Banks with excess funds lend to banks with a shortage, usually overnight. Nowadays not just to meet reserve requirements but a general source of funding.

LIBOR (London Interbank Offered Rate). Unsecured funds rate in the wholesale money market. Important reference rate for global money markets. Calculated for several currencies and maturities. This "calculation" was the subject of a recent investigation that uncovered some abuse of the system by the participants whose quotes defined the rate.

Money market securities tend to have low risk but they are not riskfree, and they may carry different risk premia. Also, differences in the ease of trading can result in additional premia. During the credit crunch in the late 2000s, a lack of trust in counterparties led to a severe upward jump in risk premia, and some segments of money markets completely froze, i.e. became illiquid. Large-scale intervention by central banks was needed to slowly restore credit conditions and the ability of corporations to obtain funding.

1.2.2 Bond Market

Bonds are contracts that specify fixed payments of cash at specific future dates. They are a big market: US Treasury Securities $\$21 \times 10^{12}$ outstanding in 2017; Japanese securities $\$10.46 \times 10^{12}$ outstanding in 2013. There are several types of bonds in the US market: **zero coupon bonds** (single payment at a specified future time), also known as zeros; **T-bills** with original maturities of less than a year; **coupon bonds** (these have coupon payments c expressed as a percentage of redemption value, which is set equal to \$100; coupon is paid every six months (or year) until maturity at which date the holder receives \$100); **notes** with original maturities from one to ten years; **bonds** with original maturities more than ten years. There are also options on bonds, futures, swaps, swaptions, cap, floor, collar, etc. In the UK, government debt securities are called gilts (or gilt-edged securities) and may have maturity up to 50 years. Treasury Inflation-Protected Securities (TIPS) in the USA and Index-Linked Gilts in the UK are both designed to deliver returns protected against inflation. Types of bonds also include:

Federal agency debt. Ginnie Mae, Fannie Mae, Freddie Mac – US mortgage-related agencies that issue securities and channel the raised funds to savings and loans institutions that lend it to individual mortgage borrowers; they back the majority of US mortgages. They are supposed to improve the availability of credit for housing and make it less dependent on local conditions. Government guarantees (explicit for Ginnie Mae, implicit for the other two which are now under conservatorship) improve credit rating and thus reduce the cost of borrowing. The financial crisis of the late 2000s revealed that there were enormous taxpayer liabilities from this insurance.

Eurobonds. Bonds denominated in a currency other than that of the country in which they are issued. In contrast, some bonds are issued abroad in local currencies:

Yankee bonds: dollar-denominated bonds sold in the USA by non-US issuers;
Samurai bonds: yen-denominated bonds sold in Japan by non-Japanese issuers.

Municipal bonds. Issued by states, cities, counties, or other local governments. They have a tax-exempt status and so high-tax-bracket investors often hold them.

Corporate bonds. Wide spectrum of credit quality; default risk different from government bonds. Secured bonds are those with specific collateral. Unsecured bonds are also known as debentures in the USA (in the UK debentures are often secured). Junior (subordinated) bonds/debentures have lower-priority claim to the firm's assets than existing senior debt (bonds/debentures or loans) and are hence more risky. **Callable bonds** give the firm the option to repurchase the bonds at a stipulated call price. **Convertible bonds** give the holder the option to convert each bond into a stipulated number of shares.

Asset-backed securities. Bonds or notes collateralized by a pool of underlying assets, assets such as home equity loans (hence mortgage-backed securities), credit cards, auto loans, and student loans. Cash flows can be directly passed through to investors after administrative fees have been subtracted (pass-through securities). Alternatively, cash flows can be carved up according to specified rules (structured securities). **Securitization** converts a pool of loans to asset-backed securities (ABS). Banks originate loans backed by assets, service them for a fee but pass them through to ABS holders. The innovation is that the availability of funds is not dependent on local credit conditions, which means better terms for borrowers. Investment banks create special purpose vehicles (SPVs), which are "bankruptcy remote," to isolate a loans pool, segment it by credit risk, and issue structured securities against it. Infamous CDOs (collateralized debt obligations) are structured asset-backed securities with cash flows dependent on the underlying fixed-income assets. There is a separation between the originator and the distributor – incentives to earn fees through volume regardless of credit quality (credit risk was not borne by the originator, the consequence of which was exacerbated by rating errors and conflicts of interest).

1.2.3 Equity Market

Common stocks and equities. Each share of common stock (i.e. a piece of the firm) entitles the owner to one vote at the AGM (annual general meeting) and to a share in the financial benefits of ownership. Shareholders elect the board of directors which selects and oversees managers who run the corporation on a day-to-day basis. Shareholders not attending the annual meeting can vote by proxy, empowering another party to vote in their name. A **proxy fight or contest** is when some shareholders attempt to replace the management which fights back via other shareholders and various defensive tactics (generally hard and the real threat to management comes from takeovers).

Common stock is a residual claim: if liquidation happens, the residual claimants are the last in the line for the proceeds from the assets. Common stock is sometimes called junior equity (subordinated to preferred stock). **Limited liability** is where the maximum loss is the original investment, unlike owners of unincorporated businesses whose creditors can (unless the business owners have taken out directors' liability insurance) lay claim to their personal assets (their house, car, furniture, favorite mug). If the stock is **listed** at and hence traded on a public stock exchange or traded **over the counter** (OTC), then it is publicly traded equity. If it is not **publicly traded**, then it is called **private equity**. Common stocks usually pay dividends to shareholders several times a year. Alternatively, companies can repurchase their stock, which should raise its price and lead to a capital gain for the shareholders.

Preferred stocks. Features of both equity and debt (hybrid securities like convertible bonds; preferred equity and subordinated debt are also known as mezzanine finance/capital). Promises to pay a fixed amount each year and carries no voting power, hence similar to perpetuities (perpetual bonds, infinite-maturity bonds). The difference is that the firm retains discretion over dividend payments; there is no contractual obligation. Dividend payments are cumulative, i.e. unpaid dividends cumulate and must be paid in full before any dividends are paid to common stockholders. May be redeemable (like callable bonds), convertible (into common stock at a pre-specified conversion ratio), or adjustable-rate (dividend rate tied to market interest rates). Unlike coupon payments on bonds (and interest on bank loans), dividends from preferred stocks are not tax-deductible expenses for the corporation.

Depository receipts. Represent ownership of a predefined number of foreign shares (depositary shares; preferred shares or bonds also possible) held by a domestic depositary bank (through its foreign branch or local custodian bank), which issues the receipts. Listed on a domestic exchange or traded OTC, they are an easier and cheaper way for investors to get exposure to foreign securities. Typically denominated in US$, but also euros, so that they carry a foreign exchange risk for most of the interested parties. They make it easier for foreign firms to satisfy otherwise stringent security registration requirements for listing their securities e.g. in New York or London. Global depository receipts (GDRs) in one or more markets outside of the USA; American depository receipts (ADRs) in the USA.

Market indices reflect the broader valuation of the stock market as a whole, some narrower (a few dozen securities), some broader (thousands of securities), such as the Dow 30, S&P500, and Russell 5000. There are different weighting schemes, which we will discuss more below. **Exchange-traded funds** (ETF's) allow investors to trade an asset whose return mimics the return on broad indices, for example the SPDR ETF tracks the S&P500.

Why are securities publicly held and traded? Firms raise equity and debt capital for investment and growth; governments issue debt to finance deficits. There can be a public offering – primary offering sold to the general public – or private placement (nonpublic) – primary offering, sold to one or a few institutional investors (banks, insurance companies, mutual funds, pension funds, etc. A **seasoned equity offering** (SEO) is the selling of additional equity of publicly traded

corporations. An **initial public offering** (IPO) is the selling of shares to the public for the first time. Public offerings of stocks and bonds are typically managed by more than one investment bank. There are various ways of doing it. Typically, there is an underwriting syndicate headed by a lead underwriter(s) or manager(s). They give advice on the terms of selling securities. There is a preliminary prospectus (also known as a **red herring** prospectus since it is a statement in red that has not been approved yet), then a road show to publicize the offering and gauge demand (which is entered in a book; hence this is called bookbuilding); once it is approved by the Securities and Exchange Commission (SEC), there is a final prospectus that states the offering price. There is a **tombstone announcement** (upright rectangle like a cemetery tombstone) in the financial press. Commercial banks accept deposits and provide loans to firms. Investment banks are engaged in the securities business. Universal banks do both. Underwriters typically buy the securities from the issuer for less than the offering price and resell them to the public (their compensation is through the underwriting spread). This procedure is called **firm commitment**. Some alternative contracts that are used include: **best-efforts deal** – cheaper, not really underwriting since banks do not bear the risk of not selling the entire issue; **all-or-none deal** – the stock must be bought in its entirety, or not at all (raising funds for only half a factory is no good); and **auction-based offering** – e.g. modified Dutch auction, **OpenIPO**, used by Google – attempt to avoid the usual initial underpricing of IPOs (issuer may feel money has been left on the table in addition to explicit IPO costs) and provide fairer access (online) to investors across the board (rather than favour large institutional investors who can "flip" their allocations for profit).

Trading of already-issued securities among investors takes place in the **secondary market**, in which the number of outstanding securities is not affected, as there is just a transfer of ownership. The performance of the secondary market is important for the primary market and affects the cost of raising capital. Liquidity of public issues implies a greater willingness to commit funds because there is a well functioning market for you to exit your position. This ultimately implies a lower cost of long-term capital for the issuer.

Equity futures market. The E-mini S&P, often abbreviated to **E-mini** (despite the existence of many other E-mini contracts), and designated by the commodity ticker symbol ES, is a stock market index futures contract traded on the Chicago Mercantile Exchange's (CME) Globex electronic trading platform. The notional value of one contract is 50 times the value of the S&P500 stock index. It was introduced by the CME on September 9, 1997, after the value of the existing S&P contract (then valued at 500 times the index, or over $500,000 at the time) became too large for many small traders. The E-mini quickly became the most popular equity index futures contract in the world. Hedge funds often prefer trading the E-mini over the big S&P since the latter still uses the open outcry pit trading method, with its inherent delays, versus the all-electronic Globex system. The current average daily implied volume for the E-mini is over $200 billion, far exceeding the combined traded dollar volume of the underlying 500 stocks. Following the success of this product, the exchange introduced the E-mini NASDAQ-100 contract, at one fifth of the original NASDAQ-100 index based contract, and many other

"mini" products geared primarily towards small speculators, as opposed to large hedgers. In June 2005 the exchange introduced a yet smaller product based on the S&P, with the underlying asset being 100 shares of the highly-popular SPDR exchange-traded fund. However, due to the different regulatory requirements, the performance bond (or margin) required for one such contract is almost as high as that for the five times larger E-mini contract. The product never became popular, with volumes rarely exceeding ten contracts a day. The E-mini contract trades 23 hours a day from 5:00pm – 4:15pm the next day (excluding the 3:15pm – 3:30pm maintenance shutdown), five days a week, on the March quarterly expiration cycle.

1.3 Types of Markets and Trading

Here, we discuss some of the details of trading.

Definition 1 *Brokered markets. Brokers with special knowledge offer search services for a fee, matching supply with demand. Some examples include: the real estate market; the primary market for securities (investment bankers act as brokers between issuers and investors); and the 'upstairs' market for large blocks of listed shares where brokers locate counterparties to conduct trade off exchange.*

Definition 2 *Dealer markets. Dealers (market makers) trade for their own account, build an inventory of assets, and make markets by quoting bid prices at which they are willing to buy and ask or offer prices at which they are willing to sell. Investors just look up and compare prices quoted by dealers. Dealers maintain liquidity by providing immediacy for those who want to trade (hence quote-driven market). For example OTC market, i.e. a decentralized network of brokers and dealers who negotiate sales of securities (not a formal exchange).*

Definition 3 *Electronic auction markets. All traders converge to a single (physical or "electronic") venue to buy and sell. They submit orders that are executed if and when matching orders arrive, nowadays by a computer system called the matching engine. This is called an order-driven market. Investors need not search across dealers to find the best price (and do not need to pay such intermediaries).*

The leading trading venues include the following:

NASDAQ – OTC market – dealers quote prices and brokers execute trades on behalf of their clients by contacting dealers with an attractive quote. Before 1971, all OTC

quotations were recorded manually and published daily on so-called **pink sheets**. In 1971, the National Association of Securities Dealers Automated Quotation (NASDAQ) developed to link brokers and dealers in a computer network where prices could be displayed and revised. Originally it was just a quotation system, not a trading system (direct negotiation between brokers and dealers is still required). Nowadays, it has an electronic trading platform that allows electronic execution of trades without the need for direct negotiation, and the bulk of trades is executed that way.

New York Stock Exchange (NYSE, the Big Board). Trading in each security used to be managed by a specialist who maintains a limit order book for that security but steps in as a dealer when liquidity is insufficient (he should maintain a fair and orderly market) and earns commissions and the bid–ask spread. Floor trading – brokers representing their clients come to the relevant specialist on the floor of the exchange (each security has a unique specialist but specialists make a market in multiple securities). Electronic trading (the vast majority) – electronic trading platform enabling direct submission of orders to specialists over the computer network and their automatic execution. Trades of very large blocks that cannot be handled by specialists "downstairs" on the floor are negotiated and matched by specialized brokers "upstairs" (such brokerages known as "block houses").

The NYSE also operates a corporate bond exchange, the electronic trading platform Automated Bond System. However, the vast majority of bond trading (even for NYSE-listed bonds) occurs in the OTC market. There is a network of bond dealers linked by an electronic quotation system. Dealers may not carry an extensive inventory of the wide range of bonds available. They provide a brokerage service by locating counterparties. The market in many issues is quite "thin" and trading is infrequent.

London Stock Exchange (LSE). Until 1997 it operated similarly to NASDAQ with an automated quotations system for an OTC market with security firms acting as broker-dealers. Now it is mostly electronic limit order book trading although some transactions (large blocks, less liquid securities) continue to be carried out through dealers.

There has been recent development of electronic trading replacing human to human trading: the development of **algorithmic trading** strategies and **high frequency trading (HFT)**. This has coincided with reduced costs of trading and communication, information availability, online brokerage (lower commissions), etc. **Reg NMS** (National Market System) in the USA and **MiFID** (Market in Financial Instruments Directive) in Europe permitted and encouraged the introduction of new electronic venues for trading equities. In the USA, new exchanges were created such as Direct Edge, BATS, etc. In the UK, likewise with Chi-X.

Dark pools and **broker crossing networks** are electronic venues with no **pre trade transparency**, i.e. the order book is not visible to participants. Price is usually determined by the midpoint of the prevailing bid and ask prices on some reference **lit exchange**. The purpose of these venues is to facilitate trading of large blocks of securities in relative secrecy, thereby avoiding price impact.

There are a number of different types of orders that traders can use in electronic markets:

A **market order** is a buy (bid) or sell (ask) order that is to be executed immediately at the current market price. There are also price-contingent orders such as **limit orders** – these are executed only above or below a stipulated price limit. Bid – buy at or below a stated price. Ask – sell at or above a stated price. Limit orders may not execute if they are not competitive and/or the market moves away.

Stop orders – not executed until the market price reaches a stipulated limit. Stop-buy order – buy at or above a stated price. Stop-loss order – sell at or below a stated price.

Iceberg orders are limit orders with only a fraction of the order visible to other participants. If part of the order is executed, some of the remaining quantity may become visible.

Pegged orders – price driven by a reference price such as the midpoint of the bid–ask spread on some other trading venue.

Orders may also be limited by time. Day orders expire at the end of the trading day. Open orders (good-till-cancelled, fill-or-kill) – remain in force for up to six months unless cancelled.

There have been **institutional changes**, including the demutualization of stock exchanges at the turn of millennium (they became listed companies in their own right, often listed on their own markets). Competition was introduced between exchanges due to MiFID in Europe in 2007 and earlier in the US by reg NMS in 2005. Smart order routing technology facilitated linking market places together and enabling competition between and within market places. Competition between liquidity providers replaced essentially monopoly provision of market making. The decimalization of tick size in the US come in at the end of the 1990s. Transnational mergers between exchanges have also come about – NYSE Euronext, LSEG – NYSE Euronext bought by ICE of Atlanta.

There has also been **globalization of investment**. Emerging market economies and their stock markets have seen substantial growth. The ten biggest stock markets in the world by market capitalization in (US$ millions), according to the World Federation of Exchanges (FESE), at the end of 1999 and 2010 are shown in Table (1.1). The top four positions have not changed (ignoring the name branding changes), although both NASDAQ and Tokyo have seen declines in market capitalization over the decade, and NYSE and LSE have both seen only relatively modest increases in the market value. The striking feature of the 2010 picture is that positions 6–10 have been taken by emerging economy stock markets, like China, India, and Brazil, and the smaller European ones have been replaced by these larger capitalized exchanges, which have evidently grown enormously throughout the decade. The growth of these emerging market exchanges has been due to the increase in market capitalization of their domestic firms, and this is likely to continue for the foreseeable future.

1.3.1 Margin Trading

Investors can borrow part of the purchase price of a security from a broker (broker's call loan) and the security serves as a collateral, provided they have a margin account