Contents

Chapter 1

Introduction

There four components of economy that we will investigate:

1. Households
2. Product market
3. Labor market
4. Financial intermediaries

There are two aspects of financial analysis:

1. valuating assets
2. managing assets : Objective + Valuation = Decision

The two factors that make finance interesting are time and risk. Six principle of finance:

1. No free lunches.
2. Other things equal, individuals:
    - Want more money than less (non-satiation)
    - Prefer money now to later (impatience)
    - Prefer to avoid risk (risk aversion)
3. All agents act to further their own self-interest
4. Financial market prices shift to equalize supply and demand
5. Financial markets are highly adaptive and competitive
6. Risk-sharing and frictions are central to financial innovation

1.1 Corporate finance

To carry on business, a corporation needs **assets** that needs to be paid for. Corporations pays for these assets by selling claims on them, which are called **financial assets** or **securities**. An *investment decision* involves purchase of assets, managing assets , rist management and etc. A *Financial decision* involves sale of securities, paying those obligation, paying the shareholde and etc.

1.1.1 Investment decision

Capital investments generate future cash returns that might last for a short amount of time or decades. Most investment decisions are as small as, for example, buying a new equipment. Corporation prepare an annual **capital budget**, listing the major projects approved for investment. These investment decision are called **capital budgeting** or **capital expenditure (CAPEX)**.

1.1.2 Financing decision

A corporation can raise money from lender or from shareholders. If it borrows from the lender then it has to pay back the debt with interest. When the money comes from shareholders, they a get a share of stock and therefore get a fraction of future profits. The shareholders are *equity investors*, who contribute *equity financing*. The choice between debt and equity financing is called the **capital structure** decision.

The decision to pay dividends or share buyback is called the *payout decision*.

Market capitalization is equal to number share outstanding times the price of each share.

1.2 Corporation

A corporation is legal entity. A corporation is owned by its shareholde but is legally distince from them. Therefore, the shareholders have **limited liability**.

sole proprietorship usually a small business where the owner face unlimited liability.

partnership A small business that have many owners each may face unlimited liability, or in case of *limited liability partnership* or *limited liability companies* all limited liability.

Larger companies with hundreds of thousands shares and many shareholders, it is impossible to manage directly. Therefore, they need to have professional manager to control the business. This is the *seperation of ownership and control*. The goal of managers is to make the shareholders richer and a common way to do this is maximizing the market value of the company.

An investment is prefered to dividend if the rate return of the investment is higher than the rate of return dividend when invested by the shareholders. The minimum rate of return is called *hurdle rate* or *cost of capital*. It is an **opportunity cost of capital** as it depends on the investment opportunities available to investors in the market.

Chapter 2

Present value relations

2.1 Cashflows and Assets

Cashflow is the flow of cash :). Asset is a sequence of cashflows.

$$\text{Asset}_t = \{\text{CF}_t, \text{CF}_{t+1}, \ldots\}$$

The value of an asset is a function of its cashflows.

$$\text{Value of asset}_t = V_t(\text{CF}_t, \text{CF}_{t+1}, \ldots)$$

There are two distinct cases we valuating an assets

- with no uncertainty; all the cashflows are known
- with uncertainty;

2.1.1 No uncertainty

A **numeraire** date should be picked, typically $t = 0$, then cashflows are converted to **present value**

$$V_0(\text{CF}_1, \text{CF}_2, \ldots) = \left(\frac{\$_1}{\$_0}\right) \times \text{CF}_1 + \left(\frac{\$_2}{\$_0}\right) \times \text{CF}_2 + \ldots$$

then the **net present value** is

$$V_0(\text{CF}_0, \text{CF}_1, \ldots) = \text{CF}_0 + \left(\frac{\$_1}{\$_0}\right) \times \text{CF}_1 + \ldots$$

1. when there is up front investment CF_0 is negative.
2. Note that any CF_t can be negative (future costs).

$$\begin{aligned}
\$_0 &= (1+r)\$_1 \\
\$_0 &= (1+r)^2\$_2 \\
&\vdots \\
\$_0 &= (1+r)^T\$_T
\end{aligned}$$

where r is **opportunity cost of capital** and $\frac{\$_t}{\$_0}$ is called the **discount factor**.

2.2 Perpetuity

It is a paper that pays C cashflow annually till the end of time. The present value of a perpetuity is calculated as follow, assuming the interest rate is constant r and the perpetuity pays from the first year:

$$\begin{aligned}\text{PV} &= \frac{C}{r+1} + \cdots + \frac{C}{(r+1)^n} + \dots \\ &= \frac{C}{r+1}\frac{1}{1-\frac{1}{r+1}} = \frac{C}{r+1}\frac{r+1}{r} \\ &= \frac{C}{r}\end{aligned}$$

Now suppose C grows with grows rate g, then the present value is

$$\begin{aligned}\text{PV} &= \frac{C}{r+1} + \frac{C(1+g)}{(1+r)^2} + \cdots + \frac{C(1+g)^{n-1}}{(r+1)^n} + \dots \\ &= \frac{C}{r+1}\frac{1}{1-\frac{1+g}{r+1}} = \frac{C}{r+1}\frac{r+1}{r-g} \\ &= \frac{C}{r-g}, \quad r > g\end{aligned}$$

2.3 Annuity

It is a paper that pays a cashflow C for a period T. Assuming the assumption made above, for the present value of annuity is

$$\begin{aligned}\text{PV} &= \frac{C}{r+1} + \cdots + \frac{C}{(r+1)^T} \\ &= \frac{C}{r+1}\frac{1-\frac{1}{(r+1)^T}}{1-\frac{1}{r+1}} \\ &= \frac{C}{r} - \frac{C}{r(1+r)^T}\end{aligned}$$

It is like holding out to perpetuity for T days and then selling. Equivalently, buy a perpetuity today and give a perpetuity at time T.

2.4 Compound

Let r be the **Annual Percentage Rate** amd n be the periods of compounding. Then, out of convention, $\frac{r}{n}$ is the per-period rate for each period and thus the **Effective Annual Rate** is

$$r_{\text{EAR}} = \left(1 + \frac{r}{n}\right)^n - 1$$

Also, continuous compounding happens when you let $n \to \infty$ which means

$$r_{\text{EAR}} = e^r - 1$$

2.5 Inflation

measures the purchasing value of money. Different from time-value of money which says that money will be worth less over time. Hence, inflation also depends on the price of goods. Suppose you have wealth W_0 today and W_t at time t and the inflation changes at a constant rate of π. Then

$$(1 + r_{\text{nominal}})^k = \frac{W_t}{W_0}$$

is the **nominal** return, which tells how much your money changed in this period as a number. But to figure out how much it actually changed, that is how much more/less you can consume, we have

$$\begin{aligned}
(1 + r_{\text{real}})^k &= \frac{W_t}{W_0} \frac{1}{(1+\pi)^k} \\
&= \frac{(1 + r_{\text{nominal}})^k}{(1+\pi)^k} \\
\implies r_{\text{real}} &= \frac{1 + r_{\text{nominal}}}{1+\pi} - 1 \\
&\simeq r_{\text{nominal}} - \pi
\end{aligned}$$

which is the **real** return.

Chapter 3

Fixed Income Security

Fixed-income securities are financial claim with promised cashflows of known fixed amount paid at fixed dates. They include

Treasury securities bills, notes, and bonds.

Federal agency securities issued by federal agencies.

Corporate securites Commercial paper, medium-term notes, corporate bonds, ...

Municipal securities

Mortgage-backed securites

Derivatives CDO's , CDS's, ...

As it is not easy to figure out the value of these securites every minute, they trade less often and thus are less liquid.

A fixed-income security is issued by an **issuer** which typically is a government, corporation , bank , or etc. An issuer issues these securities and get funding, in return they are obliged to pay the security with interest. An **investor** buys the bonds and loan the fund needed. **Intermediaries** are institution that facilitate trade of these bonds.

Coupons and strips

Law of one price: two identitical cashflows must have the same price.

Arbitrage: If two identitical have different cashflows, one can buy the cheaper and sell the more expensive and at the end of the makes some money with no further obligation.

Duration. Convexity. And then taylor series to approximate price based on the yield.

Indexed bonds make payment with respect to inflation.

Chapter 4

Equity

Equity is an ownership position in a corporation. Payout to common stock are dividends, in two forms:

1. Cash dividends
2. Stcok dividends

Unlike bonds, payouts are uncertain in both magnitude and timing. Key characteristics of common stock:

1. Residual claimant to corporate assets (after bondholders)
2. Limited liability
3. Voting rights
4. Access to public markets and ease of shortsales

Primary markets

Venture Capital company issues shares to special investment partnerships, investment instituition, and wealthy individuals

IPO A company issues shares to the general for the first

4.1 Valuation Models

$$\begin{aligned} P_t &= \frac{\mathbb{E}[D_{t+1}]}{1+r_{t+1}} + \frac{\mathbb{E}[D_{t+2}]}{(1+r_{t+2})^2} + \dots \\ &= \sum_{k=1}^{\infty} \frac{\mathbb{E}[D_{t+k}]}{(1+r_{t+k})^k} \end{aligned}$$

Where P_t is the price , D_t cash divident, $\mathbb{E}[\cdot]$ the expectation operator, r_t risk-adjusted discount rate for cashflow, all at time t. Note that the price does not depend on previous or future price. In other word

$$PV(\text{share of stock}) = PV(\text{expected future dividends per share})$$

A basic model is the *Gordon growth model* in which we assume

$$r_{t+k} = r \qquad \mathbb{E}[D_{t+k}] = D(1+g)^{k-1}$$

Then

$$P_t = \sum_{i=1}^{\infty} \frac{\mathbb{E}[D_{t+k}]}{(1+r_{t+k})^k} = \sum_{i=1}^{\infty} \frac{D(1+g)^{k-1}}{(1+r)^k} = \frac{D}{r-g}$$

Then the discount rate, in this case called *market capitalization rate* and *cost of equity capital* is

$$r = \underbrace{\frac{D}{P_t}}_{\text{divident yield}} + g = \frac{D_0(1+g)}{P_t} + g$$

However, it is clear that growth can not continue indefinitely (unless under inflationary circumstances) and therefore firms may have multiple stages of growth.

Growth stage : rapidly expanding sales, high profit margins, and abnormally high growth in earnings per share, many new investment opportunities, low dividend payout ratio

Transition stage growth rate and profit margin reduced by competition, fewer new investment opportunities, high payout ratio

Mature stage earnings growth, payout ratio and average return on equity stabilizes for the remaining life of the firm

4.2 Dividend forecast

Earning is the total profit, net income.

Earning per share

$$EPS = \frac{\text{Net Income} - \text{Preferred dividend}}{\text{Number of outstanding share}}$$

Payout ratio is the ratio of dividend to EPS

$$\text{Payout Ratio} = \frac{DIV}{EPS}$$

Plowback Ratio

$$\text{Plow back ratio} = 1 - \text{payout ratio} = 1 - \frac{DIV}{EPS}$$

Retain Earnings

$$\text{Retained Earning} = \text{Earning} - \text{Dividends}$$

Book value cumulative retain earnings.

Return on book equity

$$ROE = \frac{\text{Earning}}{\text{Book value}}$$

P/E

$$P/E = \frac{\text{Market Capitalization}}{\text{Earning}} = \frac{\text{Price}}{EPS}$$

Forward P/E ratio is

$$\frac{\text{Price}}{EPS(\text{estimated})}$$

for next year usually and the Trailing P/E ratio is calculated as

$$\frac{\text{Price}}{EPS(TTM)}$$

trailing tweleve month.

If the growth rate of the firm is higher than the interest rate then investor pay for that growth that is

$$P_0 = PVNG + PVGO = \frac{EPS_1}{r}$$

Chapter 5

Forward and Futures Contract

5.1 Forward contract

A **forward contract** is a commitment to purchase at a future data a given amount of a commodity or an asset at a price agreed on today. The price fixed now for future exchange is the **forward price**. The buyer of the underlying is said to be **long** the forward. The seller is called to be **short** the forward contract.

The properties of a forward contract:

1. Customized
2. Non-standard and traded over the counter (not on exchanges)
3. No money exchanges hands until maturity
4. Non-trivial counterparty risk

5.2 Futures Contract

Two main problems of forward contract is illiquidity and counterparty risk. A **futures contract** is an exchange-traded, standardized, forward-like contract that is marked to market daily. This contract can be used to establish a long (or short) position in the underlying asset.

The properties of a futures contract:

1. Customized
2. Non-standard and traded over the counter (not on exchanges)
3. No money exchanges hands until maturity
4. Non-trivial counterparty risk