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

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:

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

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

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

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

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

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

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

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

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

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.