Financial Education - basics

basics

Dec 10, 2025

CONTENTS

This book is meant to collect some notes about financial instruments and methods for financial education, and mainly focused asset allocation.

This material is part of the **basics-books project**. It is also available as a .pdf document.

Main goal

The ultimate goal of this material is to develop an understanding of how to manage personal savings efficiently, in line with one's own reasonable objectives.

To achieve this, some intermediate goals include:

- gaining knowledge of the **macroeconomic environment**
- familiarizing with some of the most common **investment tools** (mainly bonds and stocks);
- getting used to some **common-sense** and **investing principles**: minimizing certain costs when conditions are equal, risk/reward, diversification, liquidity, and other constraints/inefficiencies
- learning **what not to do**
- and once the poor choices have been ruled out, evaluating the reasonable options for building and managing an investment portfolio, using mainly ***ETFs*** as a natural choice of a (usually) liquid asset providing diversification at low cost, even for small capitals.

Part I

Introduction

CHAPTER

ONE

SUMMARY

Introduction

Financial goals; money; inflation (BC and inflation target);

Asset classes

Asset allocation

CHAPTER

TWO

REFERENCES

Here some references to othere sources, in order to reasonably organize the contents of this book

Investment and Portfolio Management - RICE - coursera - A.Ozoguz, J.Foote

Global Financial Markets

- Intro and Review of Elementary Finance Tools
- Financial system and financial assets: fixed income, equity and derivatives
- Organization of financial markets and securities trading

Portfolio Selection and Risk Management

- Intro and R/R: R/R trade-off
- Ptf construction and diversification
- Investor choices: utility functions, mean-variance preferences
- Optimal capital allocation and portfolio choice: mean-variance optimization (Modern Portfolio Theory)
- Equilibrium asset princing models: CAPM, return-beta; multi-factor models (e.g. Fama-French)

Biases and Portfolio Selection

- Efficient Market Hypotesis (EMH), and anomalies
- Biases and realistic preferences
- Inefficient markets: equity premium, volatility puzzle (?), long-run reversal to the mean, value effect, momentum
- Investor behavior

Investment Strategies and Portfolio Analysis

- Performance measurement and benchmarking
- Active vs passive investing: R^* risk-adjusted return measurements: Sharpe, Sortino, Treynor'ratio, Jensens'alpha,…;comparing rhe R^*
- Performance evaluation: style analysis and performance attribution

Capstone: Build a Winning Investment Portfolio

Using software for building ptf and assess its properties

- …

Part II

Macroeconomic Context for Investing

CHAPTER

THREE

ACTORS

3.1 People

3.2 Private companies

3.3 Government - public

3.4 Banks

3.4.1 Central banks

3.4.2 Investment banks

3.5 Foreign regions

CHAPTER

FOUR

INFLATION

Inflation is the **rate** at which the general level of prices for goods and sevices changes.

Contents. Definition and *inflation indices*, with examples of indices used in Italy: NIC, FOI, IPCA; *components of inflation*, with details of IPCA in Italy; *correlation with other macroeconomic quantities*; *who controls inflation*; *origin of inflation*

4.1 Inflation Indices (e.g. in Italy)

Overall inflation is the the weighted average of inflation on different classes of goods and services, weighted for their share of expenses.

Everyone perceives its own inflation, depending on its expenses. Different indices are usually used within an economy to track inflation for some "average individual".

Different indices may differ on values of weights, and other "details" like the effect of discounts and public transfers.

As an example, three indices are used in Italy:

- **NIC** (Prezzi al Consumo per l'intera Collettività Nazionale), usually the general
- **FOI** (Prezzi al Consumo per Famiglie di Operai e Impiegati), usually used for contracts, pension and inflation-linked contracts, ex-tobacco and lotteries.
- **IPCA** (Indice Armonizzato dei Prezzi al Consumo, HIPC *Harmonized Index of Consumer Prices*), used for comparison and statistics in the EU

4.2 Weights and Price Indices of Classes of Goods and Services - Italy IPCA

National and International Institutions for Statistics (in Italy, ISTAT) provide open-access databases collecting statistics about society and economics, including data about price.

ISTAT. As an example, Italian ISTAT provides data at https://esploradati.istat.it/databrowser/#/it/dw

All the data we need here is available under the category "Prezzi" - *Prices*. In order to reach a reasonable stability of the notebook, data have been downloaded, cleaned and stored in a folder on the repository of the project.

4.2.1 Inspect Data

Before producing plots, price indices and weights of level-4 categories are visually inspected. Data are usually collected in tables.

Category Price Indices - Level-4 IPCA

Category Weights - Level-4 IPCA

4.2.2 Plots

Category weights - Level-2 IPCA

The weights assigned to IPCA (Harmonized Index of Consumer Prices) categories represent the average expenditure share of households on each category of goods and services. These weights reflect how important each category is in the consumption basket.

These weights are revised annually to account for changing consumer behavior, as one can easily realize acting on the slider of the picture below. They are the weights used in computing the overall inflation i index, as the weighted sum of inflation i_c of IPCA categories,

$$i = \sum_{c \in \text{Cat}} i_c \, w_c \, .$$

Category Prices - Level-2 IPCA

Some categories in IPCA are subject to strong seasonal effects, meaning prices follow recurring patterns during the year.

As an example:

- Clothing and Footwear: in July–August, retailers apply seasonal discounts (saldi) in Italy and prices in IPCA do include these discounts when they are actually applied in stores, as it's shown by seasonal July/August price drops
- Fresh fruits and vegetables: prone to seasonal availability, leading to fluctuating prices.
- Travel and tourism: prices rise in summer and holidays.

Seasonality can obscure underlying inflation trends: that's why **seasonally adjusted** inflation is evaluated, see below.

```
Index(['[00] Indice generale',
       '[01] -- prodotti alimentari e bevande analcoliche',
       '[02] -- bevande alcoliche e tabacchi',
       '[03] -- abbigliamento e calzature',
       '[04] -- abitazione, acqua, elettricità, gas e altri combustibili',
       '[05] -- mobili, articoli e servizi per la casa',
       '[06] -- servizi sanitari e spese per la salute', '[07] -- trasporti',
       '[08] -- comunicazioni', '[09] -- ricreazione, spettacoli e cultura',
       '[10] -- istruzione', '[11] -- servizi ricettivi e di ristorazione',
       '[12] -- altri beni e servizi'],
      dtype='object', name='Tempo')
```

Category Price Changes (Inflation) - Level-2 IPCA

The 12-month inflation rate (year-on-year or YoY) compares prices in a given month to the same month the year before. It's already less prone to seasonal effects than the month-to-month rate.

However, even YoY rates can exhibit seasonal patterns, especially in volatile components like food, energy, and clothing. In order to reduce volatility of inflation indices, it's possible to use:

- **Core inflation**, as a measure of inflation that excludes the most volatile items (e.g., unprocessed food, energy), in order to provide a smoothed measure of inflation trends.
- Statistical filtering, and moving averages

Energy post-2022

Since 2022, prices in the energy and utility sectors have shown exceptional volatility. Different causes may have contributed, like geopolitical tensions (notably, the war in Ukraine), "liberalized" electricity/gas markets in Italy where price caps were adjusted or removed. Inflation in energy and electricity was also influenced by a *base effect* (e.g., very low prices in 2020–2021 followed by spikes in 2022).

Policy interventions like tax reductions and bonuses - that are not "free" -, which may or may not be reflected in consumer prices, depending on implementation.

The use of *core inflation* in 2022–2023 was arguable, as energy prices didn't just spiked and reverted, but was/is quite a long-term shock (war, sanctions, market and supply restructuring,…); as energy price influences many other sectors, food price rose as well, due to input cost shocks /fretilizers, transports,…) not as a result of seasonality only. Using core inflation and excluding energy and food components masked the true **cost-of living** impact on households.

Category contributions to overall inflation - Level-2 IPCA

4.3 Correlations in macroeconomics with inflation

Some correlations exist[1] between inflation and other macroeconocmics quantitites.

- **Phillips Curve**: inverse relation between inflation and unemployment (in the short-run)
- **Money supply** in the long-run "*Inflation is a monetary phenomenon*", M.Friedman.

4.4 Control of Inflation

Control of inflation is one of the goals of **central banks**, like the FED and the ECB.

Central banks aims at controlling inflation, matching target inflation (usually set as 2%) by means of **monetary policy**:

- interest rates (cost of money)
- non-conventional actions, like quantitative easing (QE)/tightening (QT)

[1] …

A goverment may indirectly influence inflation with **fiscal policy**, as taxation and government spending can influence demand.

Credibility of targets, and actors through their actions and forward guidance may influence inflation as well: expectations influences inflation.

4.5 Origin of inflation

Origin of inflation?

- *short-run*, *medium-run*: cost-push, demand-pull, built-in (triangle model)
- *long-run*: "inflation is always and everywhere a monetary phenomenon" M.Friedman

CHAPTER

FIVE

CHARACTERISTIC TIMES IN ECONOMY

5.1 The short run

5.2 The medium run

5.3 The long run

CHAPTER

SIX

POLICY

	Monetary Policy	Fiscal Policy
Controlled by	CB	Government
Main tools	IR, Money supply	Taxes, Spending, Transfers
Speed	Usually faster	Politically slower, debated
Focus	Inflation, lliquidity, credit	Employment, Income distribution
Independence		

6.1 Monetary policy

6.2 Fiscal policy

Part III

Investing Principles

CHAPTER

SEVEN

INTRODUCTION TO PRINCIPLES OF INVESTING

Investing is a core part of personal financial management—it's how individuals navigate uncertainty to meet their financial goals under real-world constraints. The most basic objective is to preserve the real value of wealth, protecting it against *inflation*; more ambitious goals include growing capital to fund retirement, education, or other life plans.

Sound investing requires understanding *return* and *risk* of available assets, and the fundamental *R/R trade off*. It also demands attention to **constraints** such as *liquidity* needs, *time horizon*, *acceptable volatility*, and *risk tolerance*. One of the main principle is *diversification* - which can reduce risk and, in some cases, enhance returns.

This section introduces the core concepts needed to build a robust investment strategy: how *compound returns* shape long-term growth, how *volatility drag* reduces expected performance, and how a clear, principle-based approaches - like *rebalancing* - may improve performance under uncertainties.

Given its set of constraints, an informed and intelligent agent, see *Portfolio construction* would take actions that try to maximise return for a given accepted risk, or minimize risk for a given desired return: this behavior can be summarized in choosing actions on a *Pareto front*, i.e. within the set of all Pareto efficient solutions.

Sections

Section	Key Concepts
1. *Return*	
2. *Risk*	
3. *Risk-Return Trade-Off*	
4. *Diversification*	
5. *Portfolio Construction*	
6. *Time and Compounding*	Compounding and volatility drag
7. *Disciplined Investing*	PIC/PAC, rebalancing,…

7.1 Return

Return is the reward for investing. It can come from **capital gain** (price increase of assets bought), or **periodic cashflows**, like interest (from bonds), or dividends (from stocks). Some assets produce predictable return (either nominal, or real), other assets have less predictable returns. Any asset has some level of uncertainty, or *risk*[1].

Most returns are quoted on a **per-period** basis - usually annually - and expressed as the percentage of the reward over the initial amount of the investment.

For a many-year investment, single-period returns ***compound*** over time.

7.1.1 Costs

While return are uncertain, at least to a certain level, usually costs - fees, expenses, taxes - or part of them, are certain. With equal other conditions, the intelligent investor should reduce costs (known), as higher costs reduce returns w/o changing the level of risk.

7.2 Risk

Risk measures uncertainty and its effects, combining probability of events and consequences of specific events. *All the assets have some systematic and some specific risks* .

Key measures (*should give info about magnitude, frequency/probability, and duration*) include:

- standard deviation or **volatility**: how much returns may deviate from their expected value),
- max loss (usually 100% can't be neglected for catastrophic although rare events), value at risk (VaR, max loss with a given probability), drawdown (maximum peak-to-trough loss)
- time-to-recover (time to recover drawdowns, in a temporal perspective)

Usually, risk metrics measure uncertainty, without discerning from positive and negative events: these metrics perceive a higher-than-expected return as a risk as well. Some metrics instead, see *Sortino ratio* in *risk-return* section, aims at quantifying only negative events as risk.

7.3 Risk-Return Trade Off

"There's no free lunch"

Higher expected returns usually come with higher risk.

…but high risk doesn't imply high expected return

Very stupid actions usually implies poor return with high risk. Just as an example, playing Russian roulette for fun implies an expected return worse than an alternative "do-nothing and have an ice-cream instead" scenario (at least, if your goal is not to kill yourself, and your return function does not positively weight this outcome) with higher uncertainty on the final status of your health.

[1] Even the most safe assets could undergo some (really) **rare**, but usually (really) **catastrophic events**. Just as an example, it's hard to imagine what could happen even to bonds issued by the most (perceived and priced) safe government or institution, in case of its participation in a war.

Sometimes the same could happen if one plays doing trading with some random meme-stocks or shit-coins.

Risk-adjusted return provides an indication of the expected return per unit of risk. Common metrics are:

- **Sharpe ratio**, comparing excess return and volatility compared with a "risk-free" asset - or a benchmark

$$S := \frac{\mathbb{E}[R - R_b]}{\sqrt{\text{var}[R - R_b]}}$$

- **Sortino ratio**

$$So := \frac{\mathbb{E}[R] - T}{\text{DR}} \ ,$$

with T target return, and DR the downside deviation, i.e. the deviation w.r.t the target return evaluated only for returns r lower than the target return T

$$\text{DR}^2 = \int_{r=-\infty}^{T} (T - r)^2 \, f(r) \, dr \ ,$$

being $f(r)$ the probability density function of the (continuous) random variable R representing return

7.4 Diversification

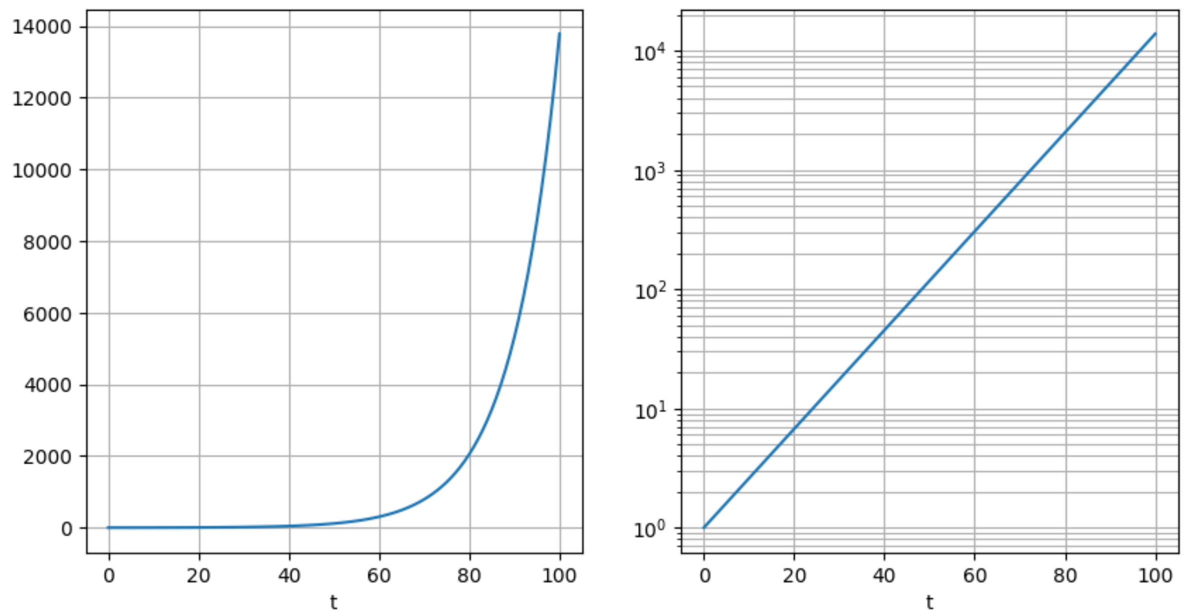
Diversification spreads risk across different investments so no single event can ruin your portfolio. Diversification works well with assets that are not - or at least they're loosely - correlated: in this case, diversification could increase return per unit of risk.

7.5 Portfolio Construction

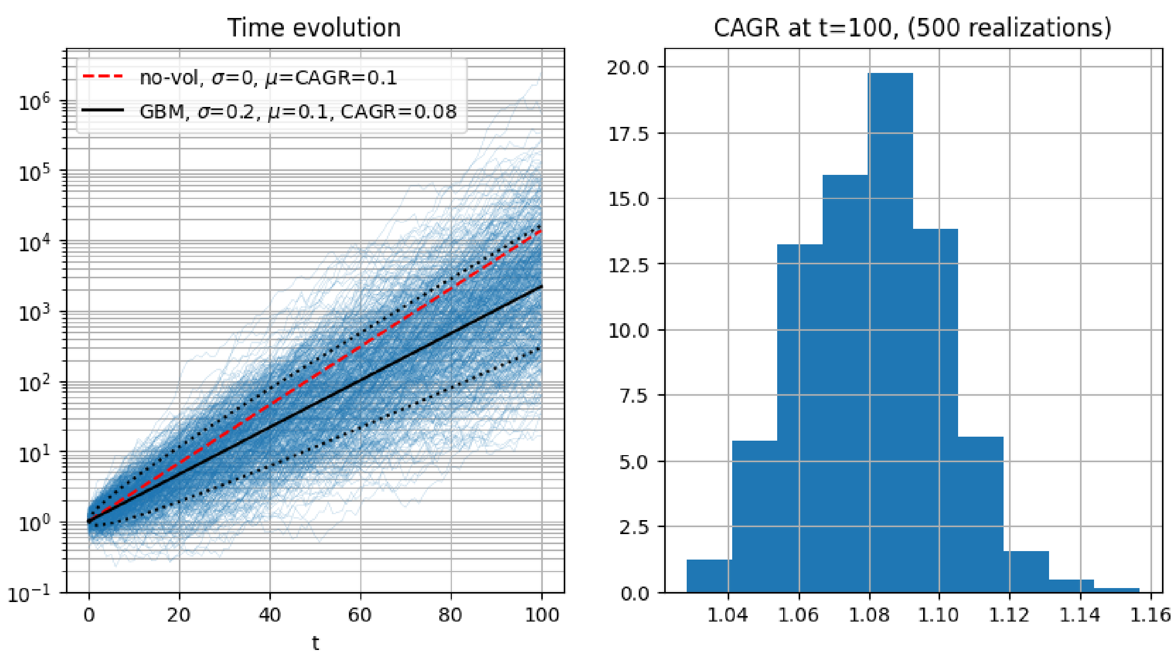
7.6 Time

7.6.1 Compound Return

```
(Text(0.5, 0, 't'), None)
```



Volatility Drag



todo

- *"Time and risk?" Listen to The Logic of Risk*

7.7 Disciplined Investing

7.7.1 Rebalancing

Colab Notebook, rebalancing.ipynb

Rebalancing premium

Part IV

Asset classes

CHAPTER

EIGHT

INTRODUCTION TO ASSET CLASSES

CHAPTER

NINE

BONDS

...

Here the most general expression for nominal and real **yield** are derived as a function of prices, face value of coupon, taxation and year to maturity, both in case of coupon reinvestment or not (reinvestment not always possible); a closed form solution is then derived under some assumptions, like constant (or average) rates; the effect on price and yield of credit rating and rating change, coupon, year to maturity are discussed on both examples and real-world cases.

Extra:

- definition of duration
- risks: inflation; reinvesment (at lower rates) for bonds with same maturity and different coupons
- inflation linked

9.1 Constant coupon bonds

9.1.1 W/o reinvestment

At time t_0 the unit price of a bond is p_0; investing Y_0 allows to buy $N_0 = \frac{Y_0}{p_0}$ titles; each title has the right of receiving net coupon $C(1-t)$, with t taxation rate, per period (here assumed 1-year coupon range).

$$N_0 = \frac{Y_0}{p_0} = \frac{Y_0}{p_{in}} \frac{p_{in}}{p_0}$$

W/o reinvestment, the number of titles hold is constant and equal to N_0. As capital Y_i can be written as the product of unit price and number of bond in portfolio, the DCF of a bond w/o coupon reinvestment reads

$$\begin{aligned}\widetilde{DCF} &= = -Y_0 + Y_N \prod_{k=1}^{N} (1+r_k)^{-1} + \sum_{k=1}^{N} N_0 C(1-t) \prod_{j=1}^{k} (1+r_j)^{-1} \\ &= N_0 \left[-p_0 + p_N \prod_{k=1}^{N} (1+r_k)^{-1} + C(1-t) \sum_{k=1}^{N} \prod_{j=1}^{k} (1+r_j)^{-1} \right] ,\end{aligned}$$

This DCF must be corrected a CF at time t_N corresponding to tax on capital gain if $p_n > p_0$, discounted as

$$-N_0(p_N - p_0)\, t \prod_{k=1}^{N} (1+r_k)^{-1} \qquad \text{(only if } p_N > p_0)$$

The cumulative real return (if the discount ratio is inflation) is the ratio between the DCF and the actual value of the investment Y_0,

$$\frac{\widetilde{DCF}}{Y_0} = -1 + \frac{p_N}{p_0} \prod_{k=1}^{N} (1+r_k)^{-1} + \frac{C}{p_0}(1-t) \sum_{k=1}^{N} \prod_{j=1}^{k} (1+r_j)^{-1}$$

If the discount rate is constant, or the average (which average) discount rate is used, the expression of the cumulative return reads

$$\frac{\widetilde{DCF}}{Y_0} = -1 + \frac{p_N}{p_0}(1+r)^{-N} + \frac{C}{p_0}(1-t)\sum_{k=1}^{N}(1+r)^{-k}$$

9.1.2 W/ reinvestment

Time	Cashflows	ΔQuantity	Quantity	DF
0	$-Y_0$	$N_0 = \frac{Y_0}{p_0}$	$N_0 = \frac{Y_0}{p_0}$	1
1	$+N_0 C(1-t)$			$(1+r_1)^{-1}$
1	$-N_0 C(1-t)$	$N_1 = \frac{N_0 C(1-t)}{p_1}$	$N_{0:1} = N_0 + N_1$	$(1+r_1)^{-1}$
2	$+N_{0:1} C(1-t)$			$(1+r_1)^{-1}(1+r_2)^{-1}$
2	$-N_{0:1} C(1-t)$	$N_2 = \frac{N_{0:1} C(1-t)}{p_2}$	$N_{0:2} = N_0 + N_1 + N_2$	$(1+r_1)^{-1}(1+r_2)^{-1}$
$\dots$				
$T-1$	$+N_{0:T-2} C(1-t)$			$\prod_{k=1}^{T-1}(1+r_k)^{-1}$
$T-1$	$-N_{0:T-2} C(1-t)$	$N_{T-1} = \frac{N_{0:T-2} C(1-t)}{p_{T-1}}$	$N_{0:T-1} = \sum_{k=0}^{T-1} N_k$	$\prod_{k=1}^{T-1}(1+r_k)^{-1}$
T	$+N_{0:T-1} C(1-t)$			$\prod_{k=1}^{T}(1+r_k)^{-1}$
T	$+N_{0:T-1} p_T$			$\prod_{k=1}^{T}(1+r_k)^{-1}$

All the cashflows from coupons are immediately reinvested so the DCF is

$$\begin{aligned} DCF & = -Y_0 + \underbrace{N_{0:T-1}\left(p_T + C(1-t)\right)}_{Y_T} \underbrace{\prod_{k=1}^{T}(1+r_k)^{-1}}_{DF_T} = \\ & = -Y_0 + Y_T\, DF_T \ , \end{aligned}$$

with

$$\begin{aligned} N_{0:T-1} & = N_{0:T-2} + N_{T-1} = N_{0:T-2} + N_{0:T-2}\frac{C(1-t)}{p_{T-1}} = N_{0:T-2}\left[1 + \frac{C(1-t)}{p_{T-1}}\right] = \\ & = N_{0:T-3}\left[1 + \frac{C(1-t)}{p_{T-2}}\right]\left[1 + \frac{C(1-t)}{p_{T-1}}\right] = \\ & = \dots = \\ & = N_{0:1}\prod_{k=2}^{T-1}\left[1 + \frac{C(1-t)}{p_k}\right] = \\ & = N_0\prod_{k=1}^{T-1}\left[1 + \frac{C(1-t)}{p_k}\right] . \end{aligned}$$

Cumulative discounted return reads

$$\begin{aligned}\frac{DCF}{Y_0} &= -1 + \frac{Y_T}{Y_0} DF_T = \\ &= -1 + \frac{N_0}{N_0\, p_0} \prod_{k=1}^{T-1} \left(1 + \frac{C(1-t)}{p_k}\right) (p_T + C(t-1))\, DF_T \\ &= -1 + \frac{p_T}{p_0} \prod_{k=1}^{T} \left(1 + \frac{C(1-t)}{p_k}\right) DF_T \\ &= -1 + \frac{p_T}{p_0} \prod_{k=1}^{T} \left(\frac{1 + \frac{C(1-t)}{p_k}}{1 + r_k}\right) .\end{aligned}$$

Composite discounted return is obtained, after writing the diiscounted cashflow as the difference between discounted cashflow at time t_T and t_0, $DCF = Y_T\, DF_T - T_0$,

$$(1 + DCAGR)^T = \frac{Y_T\, DF_T}{Y_0} = \frac{DCF}{Y_0} + 1 = \frac{p_T}{p_0} \prod_{k=1}^{T} \left(\frac{1 + \frac{C(1-t)}{p_k}}{1 + r_k}\right)$$

$$DCAGR = \left(\frac{p_T}{p_0} \prod_{k=1}^{T} \frac{1 + \frac{C(1-t)}{p_k}}{1 + r_k}\right)^{\frac{1}{T}} - 1$$

If[1] price of the bond is constant throughout its whole life, $p_k = 1$, $\forall k = 0 : T$, and discount rate r is constant, the number of held bonds at time $T-1$ is

$$N_{0:T-1} = N_0 \left(1 + C(1-t)\right)^{T-1} ,$$

the discounted cashflow is

$$\begin{aligned}DCF &= -N_0 + N_0 \left(1 + C(1-t)\right)^{T-1} (1 + C(1-t))\, (1+r)^{-T} = \\ &= N_0 \left[-1 + \left(\frac{1 + C(1-t)}{1+r}\right)^T\right] ,\end{aligned}$$

cumulative discounted return

$$\frac{DCF}{Y_0} = -1 + \left(\frac{1 + C(1-t)}{1+r}\right)^T$$

and the composite discounted return reads

$$DCAGR = \frac{1 + C(1-t)}{1+r} - 1 .$$

---

[1] It's a big if. Even if credit rating and inflation are constant throughout the life of the bond, years to maturity decreases and thus - usually - the required rate decreases as well.

CHAPTER TEN

EQUITY

What's equity?

Contents

Valuation methods. Comparison and intrinsic value methods.

Financial statements. Introduction to financial statements of a company.

Correlations, plots and fun-facts.

10.1 Equity Valuation

Detailed introduction

Equity valuation blends common sense, mathematics, expectations, estimation—and a bit of art. Buying shares in a company, whether directly or through a fund, means owning a (tiny) stake in a real business that produces goods and/or services and has the potential to generate earnings or free cash flows. As a shareholder, you are not just investing in market prices—you're becoming a part-owner of the enterprise. This ownership entitles you to a share of the company's profits through dividends or capital appreciation. It also comes with certain rights and responsibilities, especially during difficult periods.

When companies face financial stress or pursue growth opportunities, they may issue new shares to raise capital. This can lead to dilution, reducing the percentage ownership of existing shareholders. However, shareholders often have preemptive rights, allowing them to participate in new issuances to maintain their ownership stake. Moreover, owning equity means having a claim on the residual value of the company—what's left after all debts are paid—in both prosperous and challenging times. Understanding these dynamics is crucial to valuing equity: you're not just buying into today's performance, but into a stream of future cash flows and the complex, evolving structure of ownership.

Sensitivity analysis could provide an estimate of the effects of different parameters/assumptions on the final result.

Different valuation methods exist, and can be broadly classified in

- **comparison** approach: P/E, EV/EBITDA, or other indices used to compare companies of the same sector, marked, dimension,…[1]
- **intrinsic value** approach, based on **DCF**
- …other methods for general firms (cost approach,…); valuation of financials;…

[1] It's not always possible to find "equivalent" companies for the comparison…; P/E, EV/EBITDA,… whould be projected into the future to keep into account future in the value of a firm.

10.1.1 Comparison

10.1.2 Intrinsic value

- Future cash flows are estimated,
- CFs are discounted, usually for the $WACC$ (Weighted Average Cost of Capital) to find the NPV (net present value) of the **enterprise value** EV
- Cash and equivalents are added to the NPV to find the **equity value**

$WACC$

$$WACC = \frac{E}{V} R_e + \frac{D}{V} R_d (1 - t)$$

being R_e the **cost of equity** and R_d the **cost of debt** (maybe the easiest part to estimated accurately, since the debt structure is usually known/programmed). The factor $(1 - t)$ usually appears as interest payments are tax-deductible.

Equity Risk Premium R_e - Sharpe

Following W.Sharpe, equity risk premium can be estimated as

$$R_e = R_f + (R_m + R_f)\beta \ ,$$

being R_f the risk-free rate (usually 10Y US Treasuries), and R_m the annual return of the market/sector of the investment, β is a measure of risk or stock volatility of returns of the investment relative to that of the market/sector.

CHAPTER ELEVEN

ETFS