Part I - Dependent Variables

- **Stock Returns** (usually represented as a **ratio**):

Definition: The total stock return is the **appreciation in the price** plus any **dividends** paid, divided by the **original price** of the stock.

$$Total\ Stock\ Return = \frac{(P_1 - P_0) + D}{P_0}$$

$$P_0 = Initial\ Stock\ Price$$
$$P_1 = Ending\ Stock\ Price(Period\ 1)$$
$$D = Dividends$$

The income sources from a stock is dividends and its increase in stock price.
Video Link: https://www.investopedia.com/terms/r/return.asp

Different types of returns:

1. Holding Period Return (持有期收益率):

   Definition: the holding period return is the percentage change in the value of an investment over the period it is hold

$$HPR = \frac{P_1 - P_0 + CF_1}{P_0} \rightarrow 正负的 cash\ flow.$$
$$也就是\ income.$$

价差部份

P_0 : Initial Value

P_1 : End-of-Period Value

$$HPR = \frac{FV - PV}{PV} \searrow 持有期中, cash\ flow\ 为\ 0$$

PV: Present Value

FV: Future Value   Ex. T-bill, Stock w/o Dividend.

HPR 只有在 "Holding Period" 相同的时候才可以拿来比较

Annualized HPR = ((HPR + 1) ^ 1/t) - 1 t stands for the time period

2. Nominal Rate of Return vs. After Tax Real Rate of Return

Nominal Rate of Return: The nominal rate of return is the amount of money generated by an investment before factoring in expenses such as taxes, investment fees, and inflation. The nominal rate of return has its merits since it allows investors to **compare the performance of an investment irrespective of the different tax rates** that might be applied for each investment.

Formula: $\text{Nominal rate of return} = \frac{\text{Current market value} - \text{Original investment value}}{\text{Original investment value}}$

After Tax Real Rate of Return: The after-tax real rate of return is the actual financial benefit of an investment after accounting for the effects of inflation and taxes. It is a more accurate measure of an investor's net earnings after income taxes have been paid and the rate of inflation has been adjusted for.

Ex :

Step 1. The return is calculated by, first of all, determining the after-tax return before inflation, which is calculated as Nominal Return x (1 - tax rate). For example, consider an investor whose nominal return on his equity investment is 17% and his applicable tax rate is 15%. His after-tax return is, therefore:

0.17×(1−0.15)=0.1445=14.45%

Step 2. Let's assume that the inflation rate during this period is 2.5%. To calculate the real rate of return after tax, divide 1 plus the after-tax return by 1 plus the inflation rate. Following our example, the after-tax real rate of return is:

$$\frac{(1+0.1445)}{(1+0.025)} - 1 = 1.1166 - 1 = 0.1166 = 11.66\%$$

可能影响Stock Return的factor (从宏观经济学的角度) :

1. **Interest rate**
   U.S. Federal Reserve sets short-term interest rates → affect loans, credit cards and mortgages → Fed lowers rates to spur economic growth and raises rates to control inflation
   Rising rates → higher borrowing costs → lower disposable income (可支出的收入) for individuals and less investment flexibility for businesses → lead to lower revenues and profitability → reduce equity returns
   Lower interest rates → more consumer and business spending → improve profitability and equity returns

2. **Employment**
   Unemployment rates are high → disposable income goes down → consumption (比如车 旅行 一类的商品) goes down → 除consumer staples sector (日用消费品板块) 不受影响，其他板块的股票回报率会下降

3. **Commodity Prices**

   Rising prices for energy and raw materials → higher production and transportation costs for many businesses → reduce profitability

4. **Spending**

   Consumers spend when they have confidence in their jobs and in the economic outlook → benefits the stock returns of companies in most sectors
   Businesses invest in new capital equipment and expand facilities → benefit construction companies and equipment suppliers

5. **Global Economies**

   Global economic conditions affect equity returns because companies do business across borders.
   Ex. A weak U.S. economy could affect the revenues and profit margins of Asian and European suppliers of U.S. companies.

- **Risk-free Rate**:

Definition: The risk-free rate of return refers to the theoretical rate of return of an investment **with zero risk**.

In theory, the risk-free rate is the **minimum return an investor expects for any investment** because he will not accept additional risk unless the potential rate of return is greater than the risk-free rate.

In practice, however, a truly risk-free rate **does not exist** because even the safest investments carry a very small amount of risk. Thus, the interest rate on a **three-month U.S. Treasury bill** is often used as the risk-free rate for U.S.-based investors.

Video link: https://www.investopedia.com/terms/r/risk-freerate.asp

✓ Pros	× Cons
• Zero default risk since T-bills have a U.S. government guarantee.	• T-Bills offer low returns compared with other debt instruments as well as when compared to certificates of deposits (CDs).
• T-bills offer a low minimum investment requirement of $100.	• The T-Bill pays no coupon—interest payments—leading up to its maturity.
• Interest income is exempt from state and local income taxes but subject to federal income taxes.	• T-bills can inhibit cash flow for investors who require steady income.
• Investors can buy and sell T-bills with ease in the secondary bond market.	• T-bills have interest rate risk, so, their rate could become less attractive in a rising-rate environment.

因为T-bill 没有利息，所以它的发行方式是"折价发行" - "discount"：以低于面额的价格发行
Ex: 面额为$1,000的债券，发行商将发行价格定在$950

p.s. 在这篇paper里，由于缺乏1871 - 1919年的短期美国国债利率，作者用1920 - 1971年的"**商业票据利率**"做了一个regression：

Treasury-bill rate = −0.004 + 0.886 × Commercial Paper Rate

Commercial Paper: Commercial paper is a commonly used type of **unsecured**, **short-term** debt instrument issued by **corporations**, typically **used for the financing** of payroll, accounts payable and inventories, and meeting other short-term liabilities.

Video Link: https://www.investopedia.com/terms/c/commercialpaper.asp

Accounts payable (AP) is an account within the general ledger(总账) that represents a company's obligation to pay off a short-term debt to its creditors or suppliers.

Inventory is the term for the goods available for sale and raw materials used to produce goods available for sale.

对比：
https://www.quora.com/What-is-the-difference-between-corporate-bonds-and-commercial-papers-in-India#:~:text=Main%20difference%20between%20corporate%20bonds,requirements%20such%20as%20working%20capital.

Part IV - Macroeconomic Indicators

- **Inflation (infl)**:

  Definition: Inflation is a quantitative measure of the rate at which the average **price level** of a basket of selected goods and services in an economy increases over some period of time. It is the rise in the general level of prices where a unit of currency effectively buys less than it did in prior periods. Often expressed as a percentage, inflation thus indicates a decrease in the **purchasing power** of a nation's currency. 本文作者使用的是来自Bureau of Labor Statistics 的 CPI (Consumer Price index).

  Causes:

  There are two causes of inflation.[7] The most common is demand-pull inflation. That's when demand outpaces supply for goods or services. Buyers want the product so much that they're willing to pay higher prices.

  Cost-push inflation is the second, less common, cause. That's when supply is restricted but demand is not. That happened after Hurricane Katrina damaged gas supply lines. Demand for gasoline didn't change, but supply constraints raised prices to $5 a gallon.

  https://www.youtube.com/watch?v=UMAELCrJxt0

  How does the government reduce inflation?

- Governments can use wage and price controls to fight inflation, but that can cause recession and job losses.
- Governments can also employ a contractionary monetary policy to fight inflation by reducing the money supply within an economy via decreased bond prices and increased interest rates.

  Video Link:
  https://www.investopedia.com/ask/answers/111314/what-methods-can-government-use-control-inflation.asp

- **Investment to Capital Ratio (i/k):**

  Definition: The investment to capital ratio is the ratio of aggregate (private nonresidential fixed) **investment** to aggregate **capital** for the whole economy. 可以体现一个国家经济的投资情况（储蓄情况）

C. A Functional Form For Technology and Investment Returns

The empirical section of this paper uses the following parametric form of the technology.

Production: $$y_t = mp_t k_t + mpl_t l_t \qquad (13)$$

Resources: $$y_t = c_t + I_t$$

Capital accumulation: $$k_{t+1} = (1 - \delta)\left[k_t + \left(1 - \frac{\alpha}{2}\left(\frac{I_t}{k_t}\right)^2\right)I_t\right] \qquad (14)$$

where y_t denotes output, k_t capital, l_t labor, and I_t investment. Values mp_t and mpl_t are the marginal products of capital and labor, δ is the depreciation rate, and α is the adjustment cost parameter. As the investment/capital ratio increases, larger fractions of investment are lost, which is the adjustment cost.

The one-period investment return is, from its definition, equation (12):

$$R^I(t \to t + 1) = (1 - \delta)\left(mp_{t+1} + \frac{1 + \alpha(I_{t+1}/k_{t+1})^3}{1 - (3/2)\alpha(I_{t+1}/k_{t+1})^2} \right)$$
$$\cdot \left(1 - \frac{3}{2}\alpha\left(\frac{I_t}{k_t}\right)^2 \right). \tag{15}$$

The notation $R(t \to t + 1)$ distinguishes a quarterly return from an annual return, $R(t \to t + 4)$.

If the investment/capital ratio at time t is high, the investment return is low, because investment runs into a stiff adjustment cost. (If one thinks of this model as demand for investment, investment is high when returns are low, as expected.) When the investment/capital ratio at time $t + 1$ is high, however, the investment return from t to $t + 1$ is *high* (the squared term in the denominator outweighs the cubed term in the numerator for small investment/capital ratios). In creating a return from t to $t + 1$, the firm *dis*invests at time $t + 1$ to restore its original capital plan. A time when adjustment costs are *high* is a good time to *lower* investment, because the firm can sell a larger quantity of the consumption good for every unit by which it lowers the capital stock.

The investment return has roughly the same sensitivity (partial derivative) to investment/capital ratios at t and at $t + 1$, though with opposite sign. Hence, the investment return is roughly proportional to the change in the investment/capital ratio, or, since capital changes less than investment, to investment growth.