

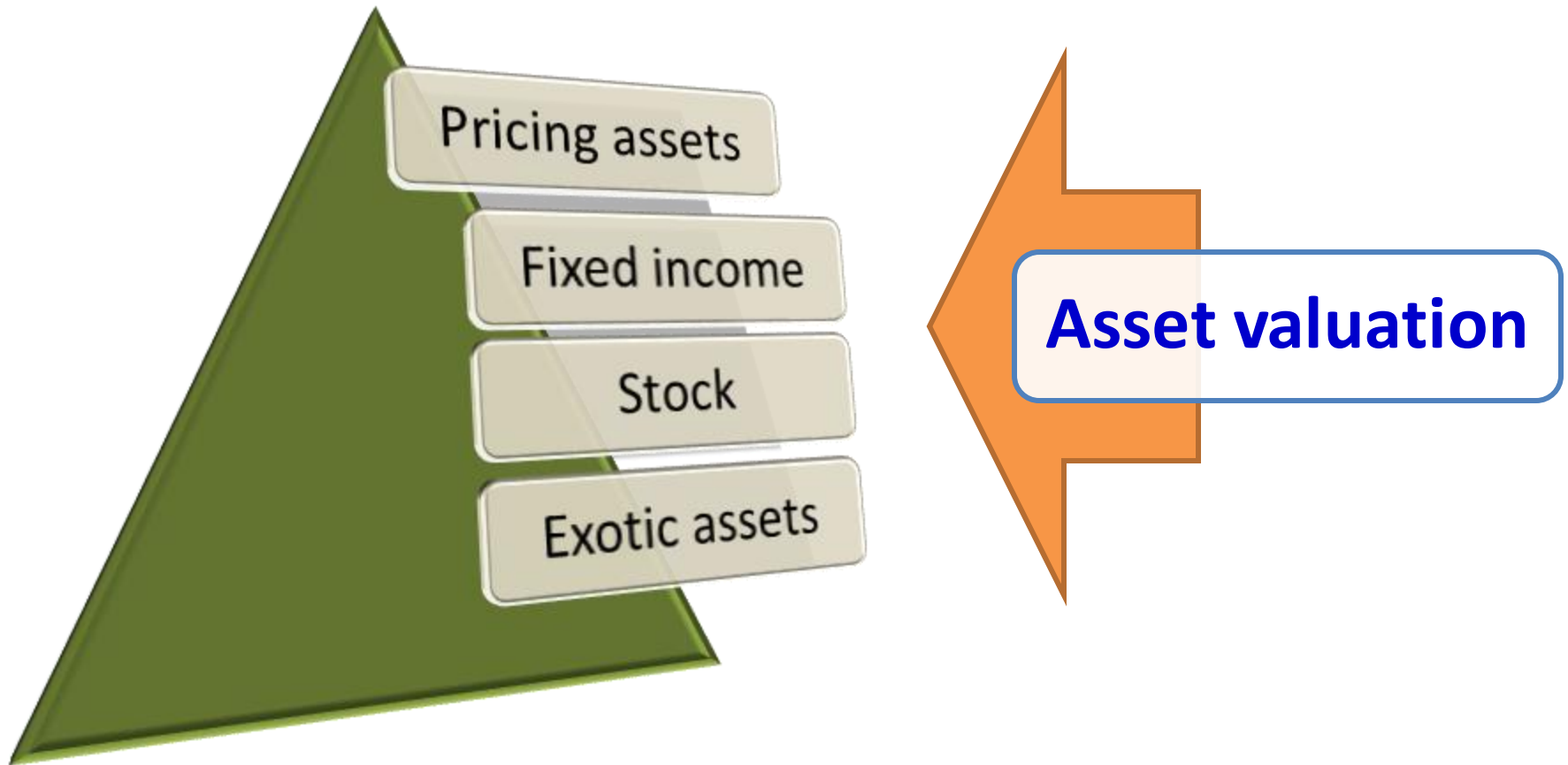
# **Principle of asset valuation**

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# Principle of asset valuation



# Financial asset as an apple tree.

- Apple tree
  - Giving apples over time
  - Amount of apples might be certain/uncertain
- Asset
  - payment of cash-flow/pay-off in the future.
  - Risky and riskless cash-flow.

**Valuation of an apple tree = Valuation of cash-flow/pay-off**

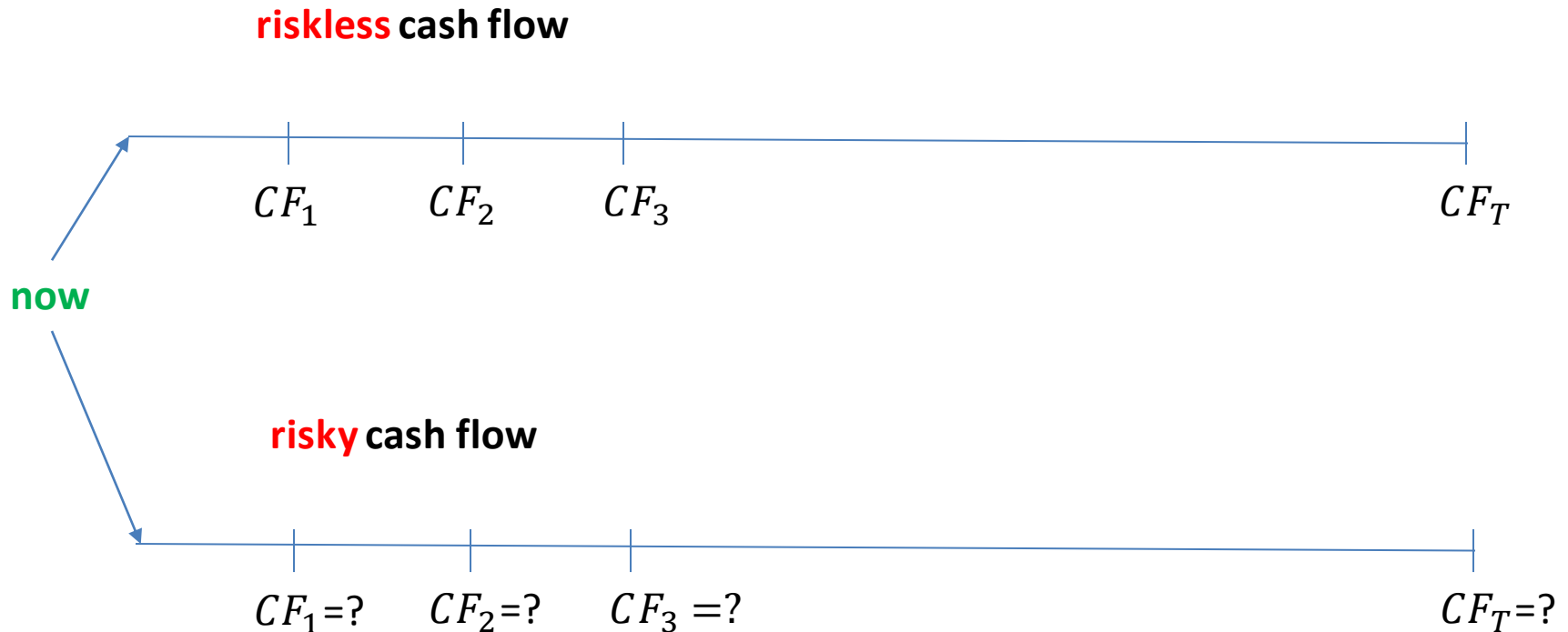
# Principle of asset valuation 1

Asset valuation = **sum** of the **present value** of the **future cash flow** delivered.

# Principle of asset valuation 1

- Present value of cash flow?
  - Cash flow delivered in the future.
  - Direct sum doesn't make sense because of the time value of money.
    - For infinite period of payment, direct sum does not produced a converged sum.
  - Future value must adjusted into the present value using a discount rate ( $r$ )

# Risky and Riskless cash-flow



Single discount rate?: No, discount rate must reflect the nature of cash-flow received. Discount rate must price-in risk of the asset

# Principle of asset valuation 1

- Valuation of asset with riskless cash flow

$r_f$  = discount rate for riskless asset

- T finite period of cash flow

$$V_t = \frac{CF_1}{1 + r_f} + \frac{CF_2}{(1 + r_f)^2} + \dots + \frac{CF_T}{(1 + r_f)^T}$$

- Infinite period of cash flow

$$V_t = \lim_{T \rightarrow \infty} \left( \frac{CF_1}{1 + r_f} + \frac{CF_2}{(1 + r_f)^2} + \dots + \frac{CF_T}{(1 + r_f)^T} \right)$$

# Principle of asset valuation 1

- Valuation of asset with risky cash flow

Approach 1: Risk-adjusted discount rate method

$$V_t^j = \frac{E(CF_1)}{1 + r_j} + \frac{E(CF_2)}{(1 + r_j)^2} + \dots + \frac{E(CF_T)}{(1 + r_j)^T}$$

# Principle of asset valuation 1

Approach 2: Cash-flow adjusted method

$$V_t^j = \frac{E(CF_1) - \varphi}{1 + r_f} + \frac{E(CF_2) - \varphi}{(1 + r_f)^2} + \dots + \frac{E(CF_T) - \varphi}{(1 + r_f)^T}$$

$\varphi$  = adjustment factor

# In practice: riskless/risky assets

- Riskless cash-flow = T-bill
  - Shot-term asset: T is very short!
  - Certain cash-flow asset, but longer “T”, could be subjected to inflation risk and liquidity risk.  
Discount rate must be priced in accordingly.
- Risky cash-flow = Stock

# Efficient market: pricing = “fair”/”fundamental” valuation

- Price of an asset reflects the fair value
  - Price < value → buy more, price goes up.
  - Price > value → sell out, price goes down.
- When price moves too far away from the fundamental value, we call “bubble”.
  - Tulip bubble
  - Jap90 bubble
  - Dot-com bubble v.s. US House price bubble

# Cautionary notes

- Asset pricing/valuation is NOT to explain how price is **determined**.
  - Asset pricing only tells us about the **method** that financial economists use to calculate the fair price of an asset.
  - This can be thought as a formula.

# Cautionary notes

- Asset price **determination** will be relying on demand and supply of assets.
- Mechanically,
  - **Each investor** evaluates the value of asset using **their own (subjective) discount rates** → demand for assets
  - Equilibrium price is determined by  $D = S$ .
    - Low valuation investors move out, only high-valuation investor stays. Price reflects the highest bid.
- **Asset pricing formula only tells us the relationship between market price and market discount rate.**

# Example: riskless cash flow

- An asset is assumed to repay \$100 to the holder one year from now. Current market price is assume to be \$90. Calculate the market discount rate of the asset.

# Example: risky cash flow

- Assuming one year from now, an asset is expected to repay \$100 with the chance of 75%, and nothing with the chance of 25%. Suppose that current trading price is \$50. Calculate the market discount rate of the asset. What about the spread?

# Principle of asset valuation 2

Equivalent assets should be priced the same.

# Equivalent assets

- Assets with the identical structure of cash-flow are called **equivalent assets**.
- Obvious, so why do we discuss about this?

# Equivalent assets: A and B

- Asset A: 1 year zero-coupon (discount rate = 10%)
  - Cash flow = 110
  - Pricing today = 100.
- Asset B : 2 year zero-coupon (discount rate = 15%)
  - Cash flow = 132.25
  - Pricing today = 100.

# Equivalent assets: A and B

- Asset C: Asset with pre-specified payment
  - Cash-flow in 1<sup>st</sup> year = 55
  - Cash-flow in 2<sup>nd</sup> year = 132.25
- C is equivalent to new asset comprised of  $\frac{1}{2}$  of A and one B.

$$\text{Price of C} = \frac{1}{2} * \text{Price of A} + 1 * \text{Price of B.}$$

- If not, someone can do the arbitrage.
  - The Law of one price in finance!!

# Equivalent asset as a foundation for financial engineering!

- Most structured product/exotic asset are designed to give complicate pattern of cash-flow.
- One way to calculate its fair price is to *“STRIP”* the asset into pieces of **basic assets** that constitute to be the constructed equivalent asset.
  - Replicating cash-flow the structured asset with multiple assets whose underlying price are known.