Lecture 1. Introduction to Finance & Present Values

Thummim Cho
London School of Economics

LSE Summer School

Outline of Lectures 1-6

Part 1: Financial Markets and Securities

- The basics: discounting and present values
  - lecture 1
- Financial securities
  - bonds (lecture 2)
  - stocks (lecture 3)
  - derivatives (lecture 6)
- Portfolio theory and expected returns
  - mean-variance portfolio choice (lecture 4)
  - CAPM (lecture 5)

Part 2: Corporate Finance

Topics Today

- Introduction to finance
  - What is a financial market?
  - Why are financial markets useful?

- Present values
  - Present value (PV) and discount rates
  - Net present value (NPV)
  - NPV rule vs. rate of return rule
  - A shortcut for perpetuity

Topics Today

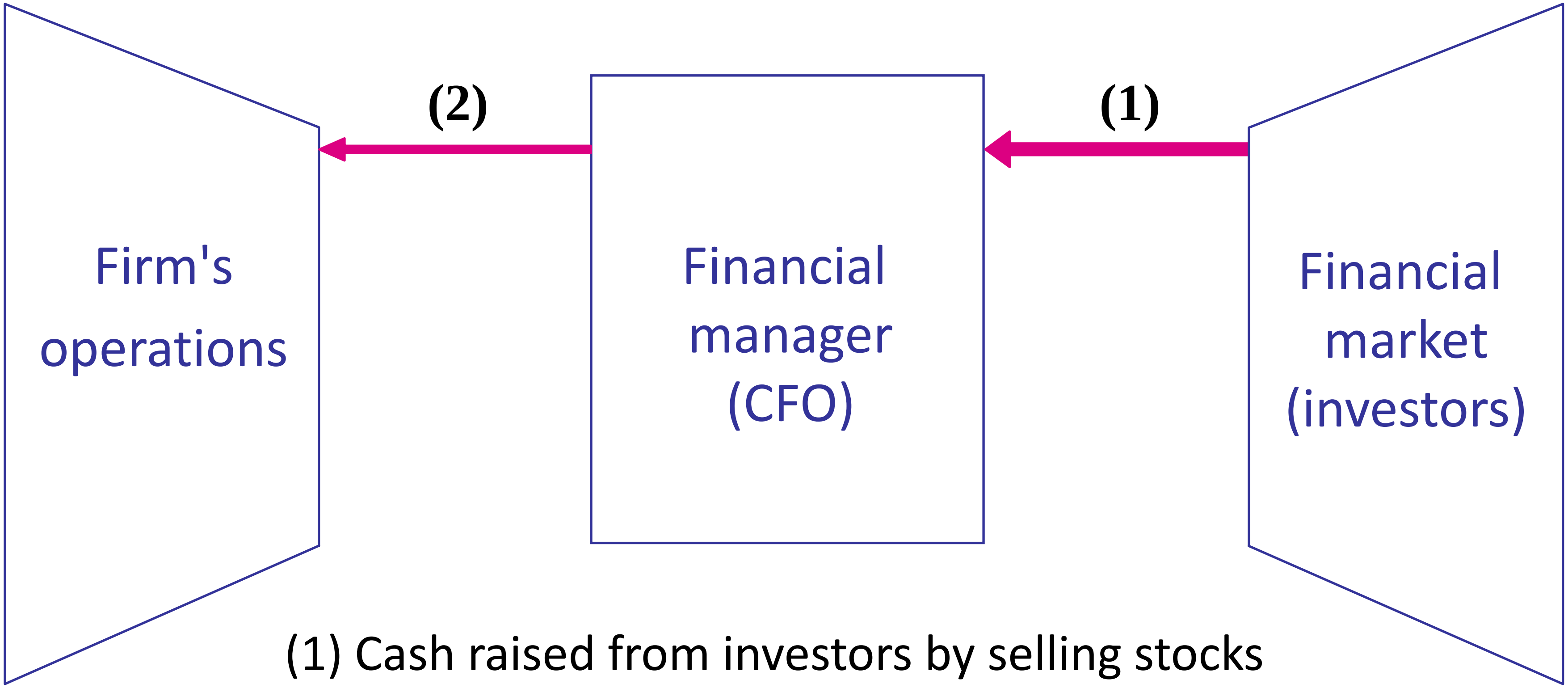
- **Introduction to finance**
  - What is a financial market?
  - Why are financial markets useful?

- Present values
  - Present value (PV) and discount rates
  - Net present value (NPV)
  - NPV rule vs. rate of return rule
  - A shortcut for perpetuity

Topics Covered

What is a financial market?

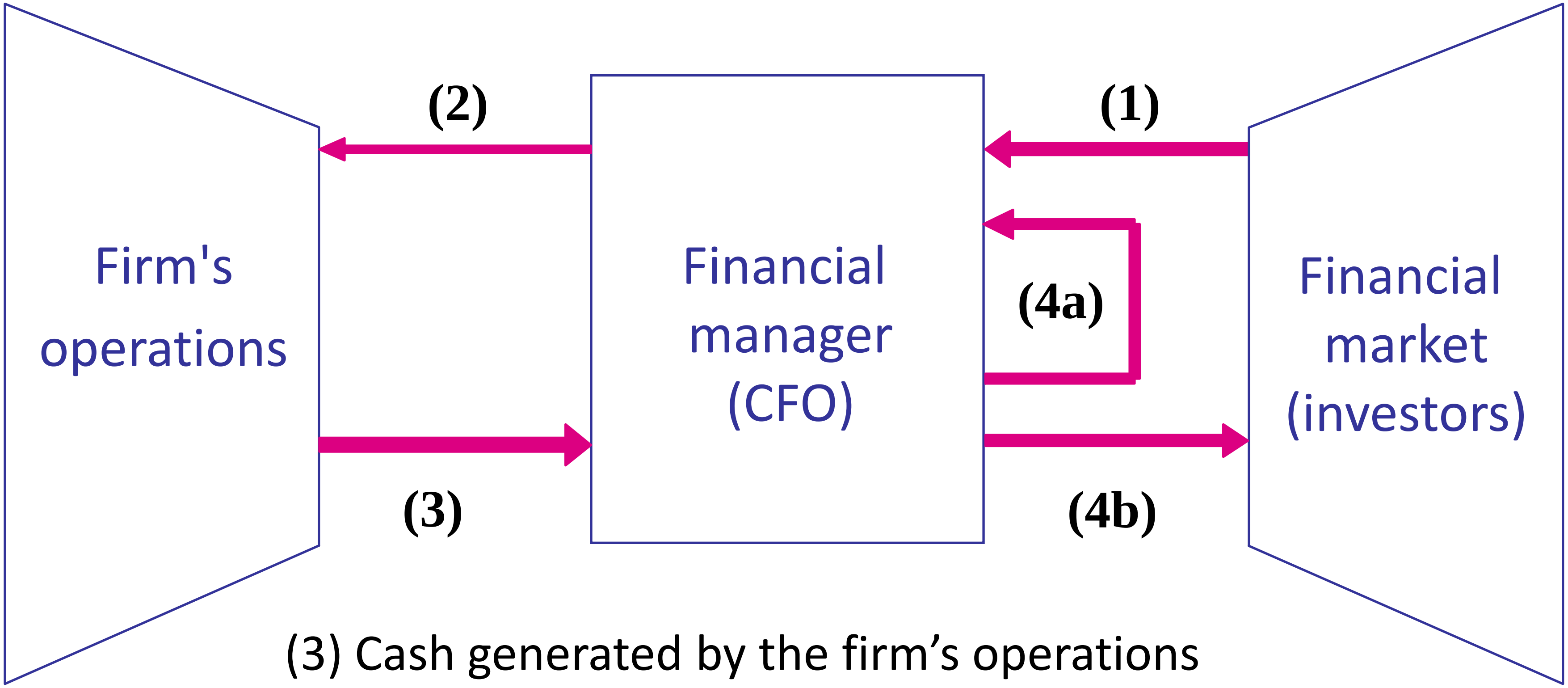
What is a Financial Market?



(1) Cash raised from investors by selling stocks and bonds to investors in the **primary market** ("initial public offering" or IPO)

(2) Cash invested in the firm's operations and used to purchase real assets.

What is a Financial Market?

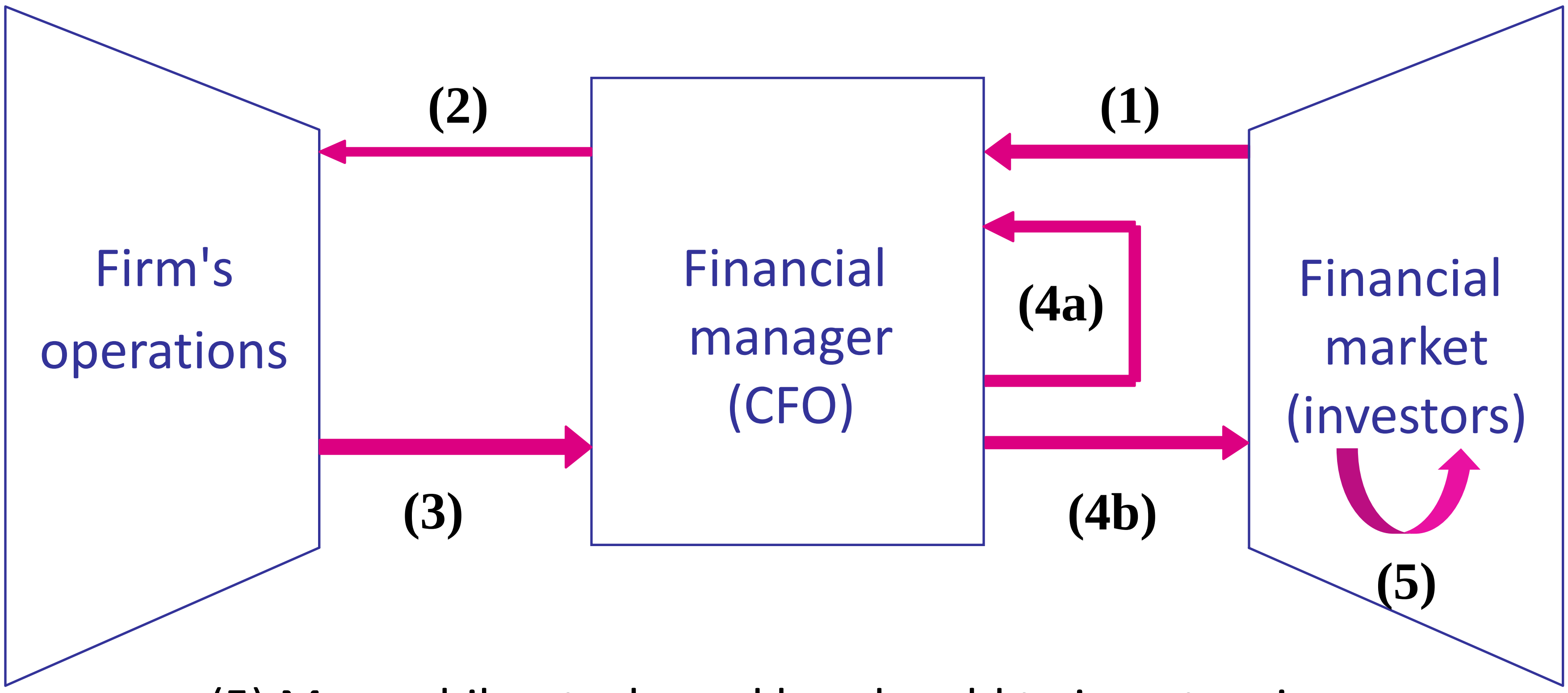


(3) Cash generated by the firm’s operations

(4a) Cash **reinvested**

(4b) Cash **distributed** to investors in the form of dividends, coupons, principal, and repurchases

What is a Financial Market?

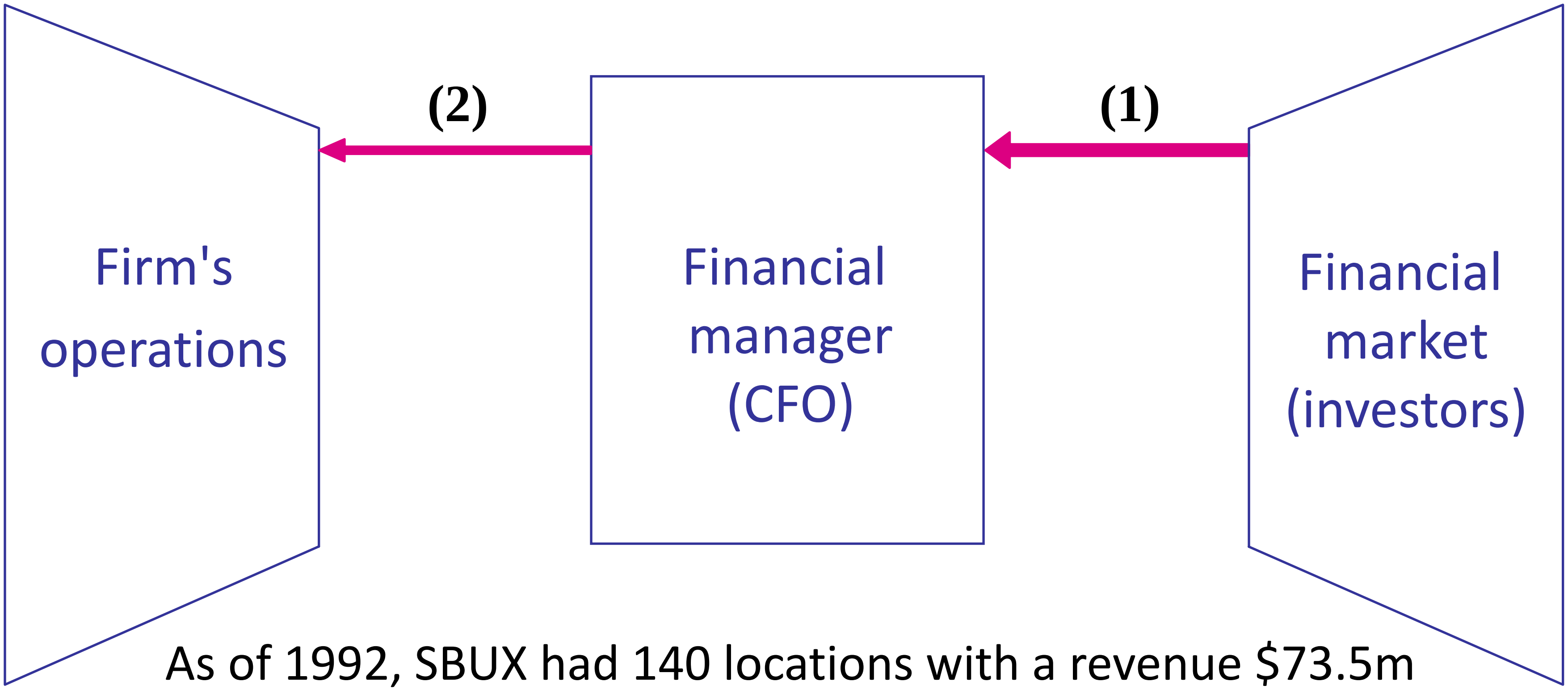


(5) Meanwhile, stocks and bonds sold to investors in the **primary market** are being constantly traded amongst the investors in the **secondary market**

Example: SBUX

Let’s go through steps (1)-(5) again in the context of Starbucks (SBUX) in 1992.

Example: SBUX

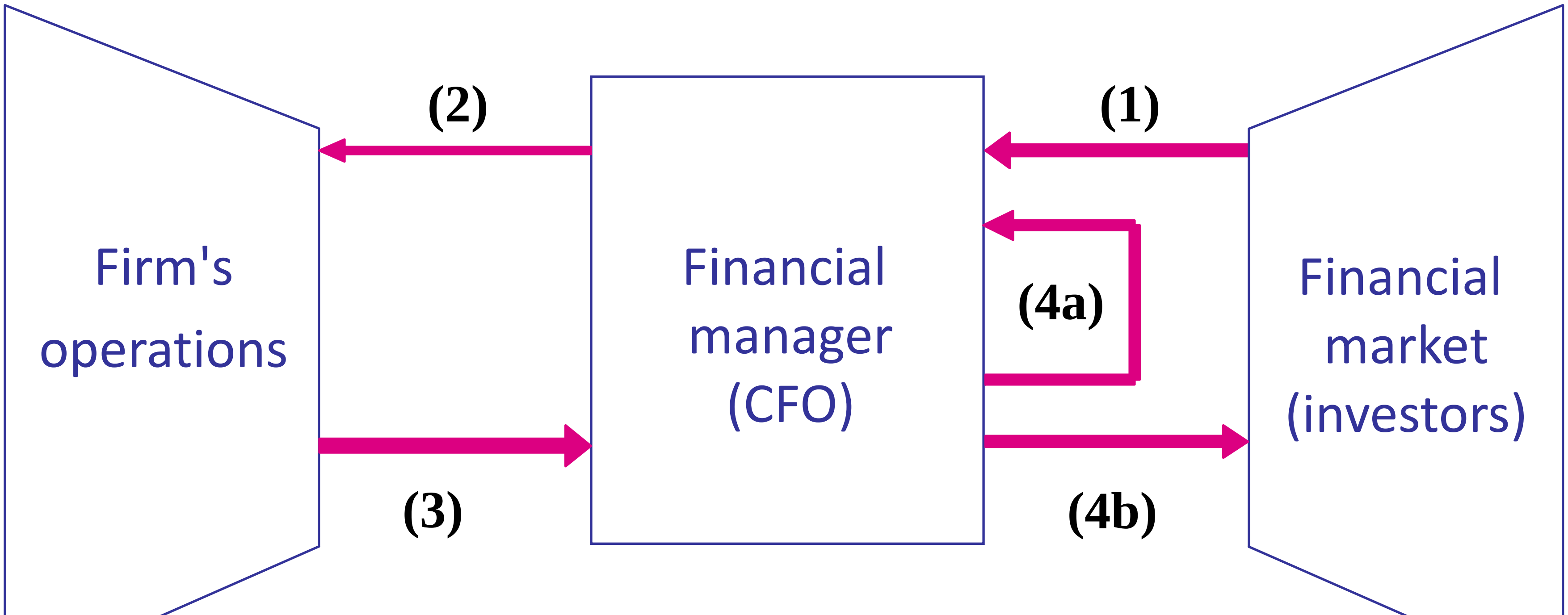


As of 1992, SBUX had 140 locations with a revenue $73.5m

(1) In 1992, SBUX goes “public” to raise $25 million.

(2) Over the following 2 years, SBUX used this money to double the number of stores and buy the right to sell Frappuccino

Example: SBUX

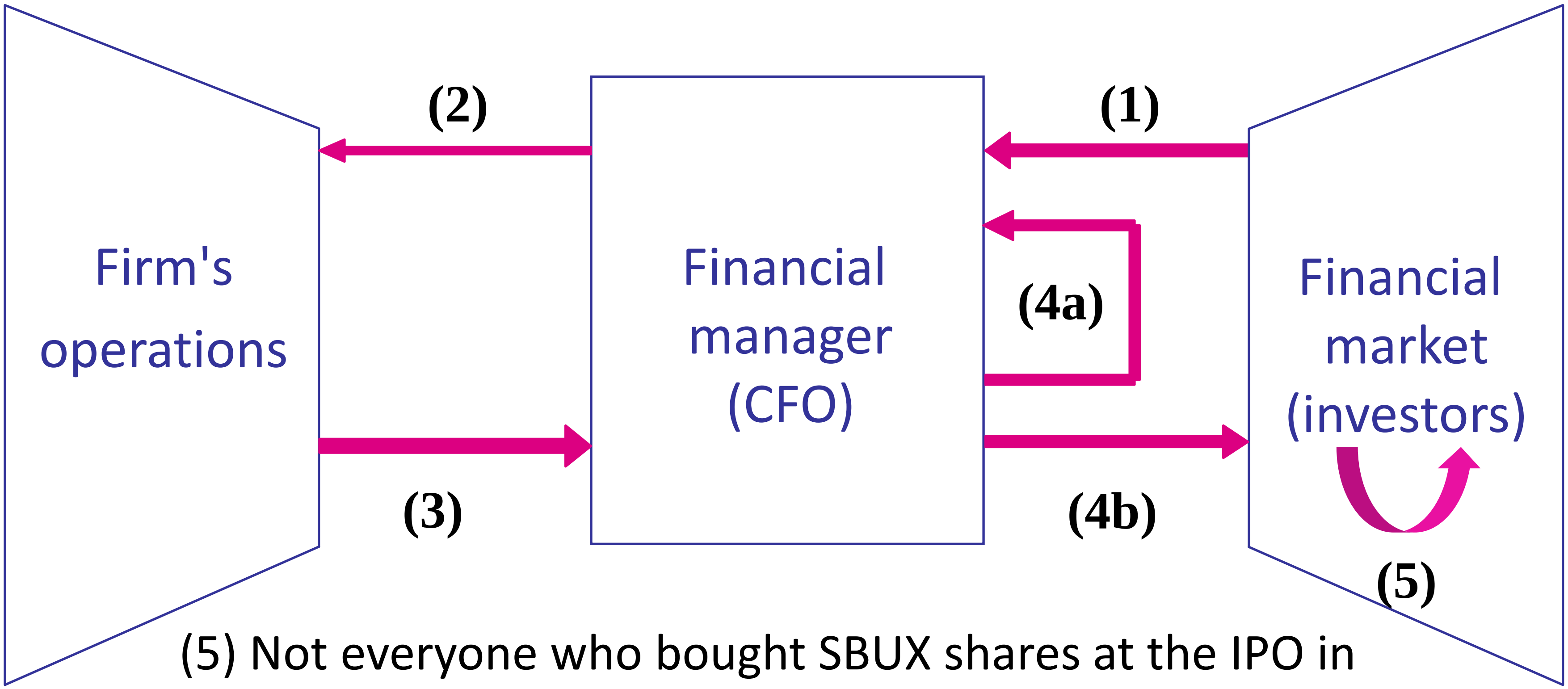


(3) These increased the overall revenue and earnings.

(4a) For the following 18 yrs, SBUX reinvested these earnings.

(4b) SBUX paid its first dividend on Mar 24, 2010.

Example: SBUX

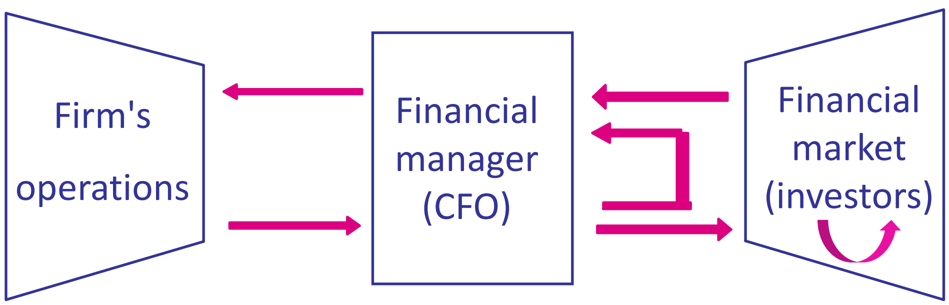


(5) Not everyone who bought SBUX shares at the IPO in 1992 held on to them; stocks have exchanged hands in the secondary market.

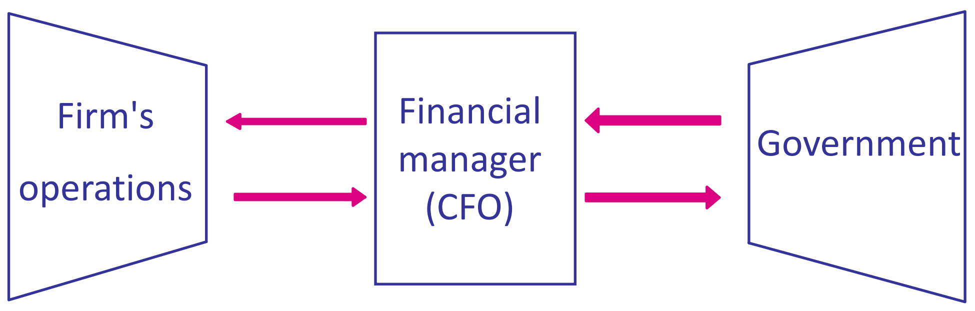
If you did hold on to it, you would've transformed a $1,000 investment into a small flat in London ($400,000).

Why Are Financial Markets Useful?

Financial market

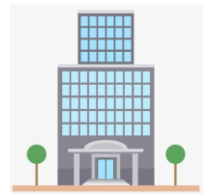


VS. **Central planning**



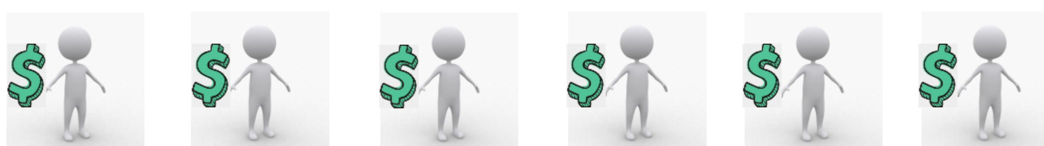
Why Are Financial Markets Useful?

Suppose we need to figure out the value of a firm’s business model. (Investors give that money to the firm at the IPO or SEO.)



- **Central panning →** the government has to figure this out.

- **Financial market →** leaves this to the investing public, who trades stocks to **determine the firm’s market value**.



These market values get **constantly updated** as new information about the economy and the firm flows in.

Why Are Financial Markets Useful?

Let's see how the financial market can determine the value of an asset through trading.

We'll simulate a market that trades a stock of a hypothetical company, which pays single dividend equal to **Dr. Cho's age** today (in £).

- There is an **initial public offering** (IPO) for one share.
- Then there is a **secondary market** and more information about the dividend (my age) gets revealed as well.
- The cash will be paid at 11am today to whoever is holding the stock then.

Topics Today

- Introduction to finance
  - What is a financial market?
  - Why are financial markets useful?

- **Present values**
  - Present value (PV) and discount rates
  - Net present value (NPV)
  - Shortcuts for perpetuity and annuity

Financial Decisions

Should you choose to receive $100 today or $105 today?

- Hint: it's not a trick question.

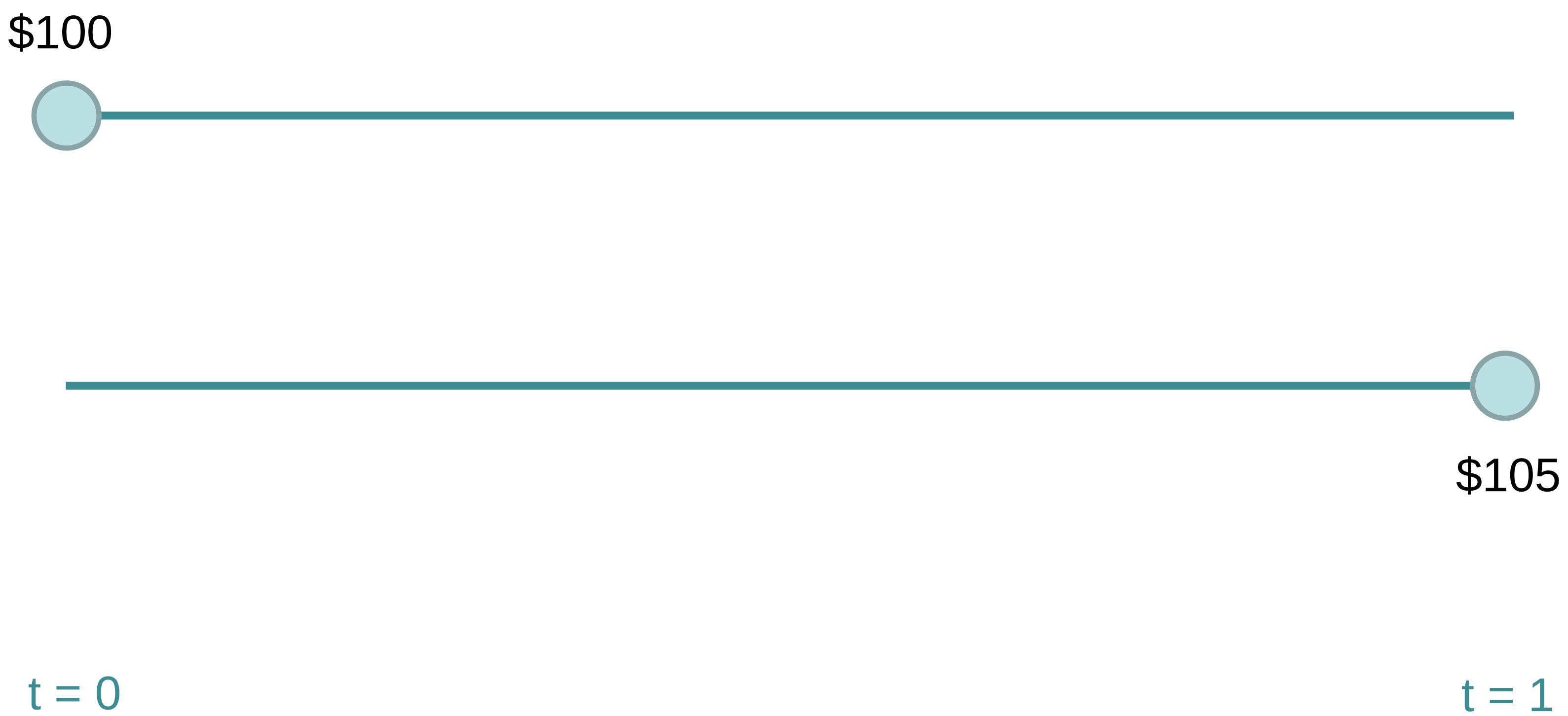
- This decision is easy to make because the cash flows arise **today** with **certainty**.

- In contrast, a **financial decision** compares cash flows that differ across **time** and **state**

Financial Decisions

Should you choose \$100 today or \$105 a year from now?

- Cash flows arising in **different time periods**.



Financial Decisions

Should you choose a certain payoff of $105 or an expected payoff of $105 with the actual realizations as below depending on if the state of the economy? (all payoffs a year from now)

- Cash flows in **different states of the world** leading to **uncertainty**.

Present Value and Discount Rate

Between \$100 today and \$100 a year from now, you would probably prefer \$100 today.

Why?

1. Money today allows you to buy something over the next one year if needed; money next year doesn't
2. Even if you didn't plan to buy before next year, Inflation means \$100 buys you less next year

Present Value and Discount Rate

- Let C_t be the cash flow at date t. For us, $t = 0$ means today.

- Let $PV(C_1)$ denote today's value of $C_1 = \$100$ in one year.

- We call $PV(C_1)$ the **present value** of C_1.

- What is $PV(C_1)$?

Present Value and Discount Rate

- At the least we do know that $PV(C_1) < \$100$.
- Hence, we can write

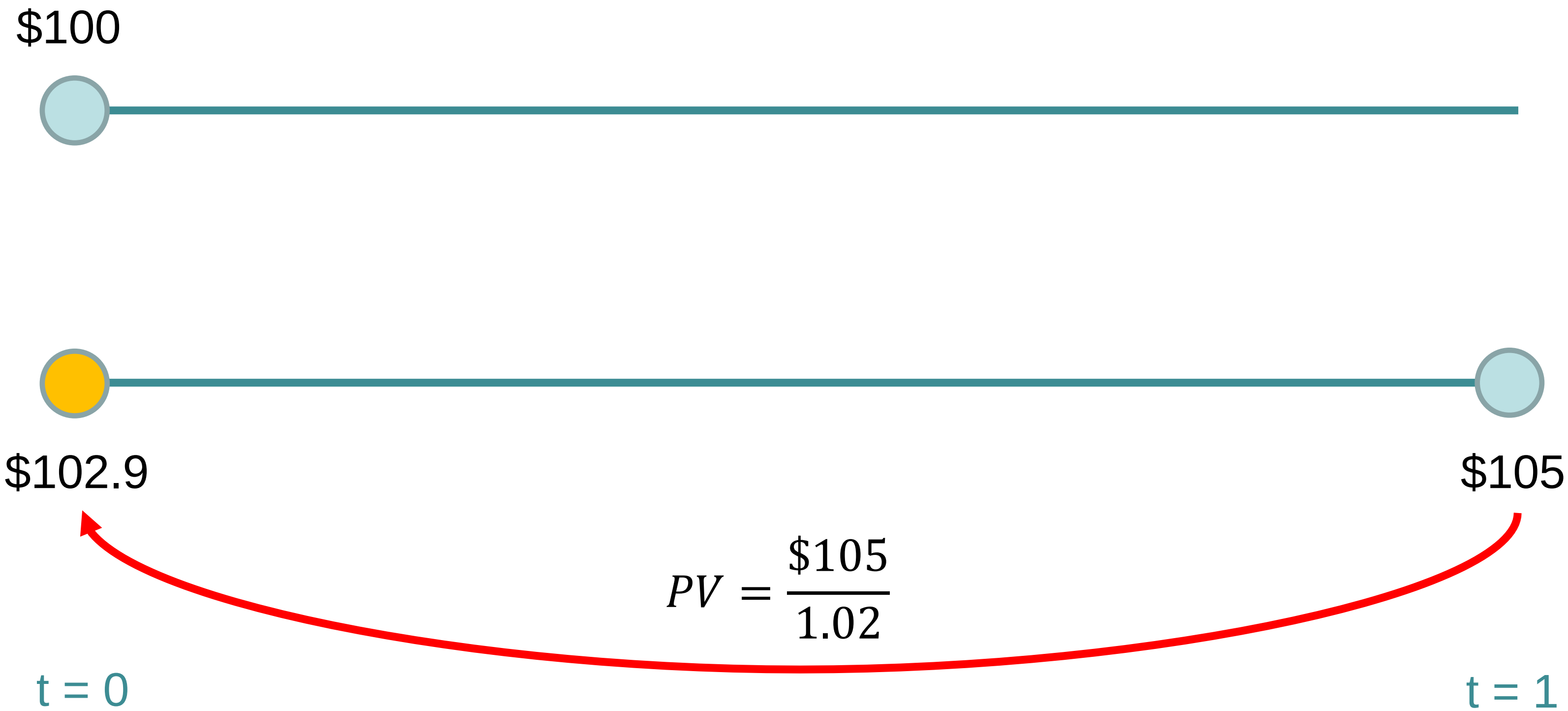
$$PV(C_1) = \frac{C_1}{1+r}$$

where $r > 0$.

- We call r the **discount rate**.
- We can find r as the **expected return on an investment with a similar risk profile** as the cash flow C_1.
  - Why?
  - We want to find an investment of $\$PV(C_1)$ in an asset that replicates the exact same cash flows across time and state.
  - The **riskier** the payoffs, the **higher the discount rate**. The precise definition of risk in lecture 5.

Present Value and Discount Rate

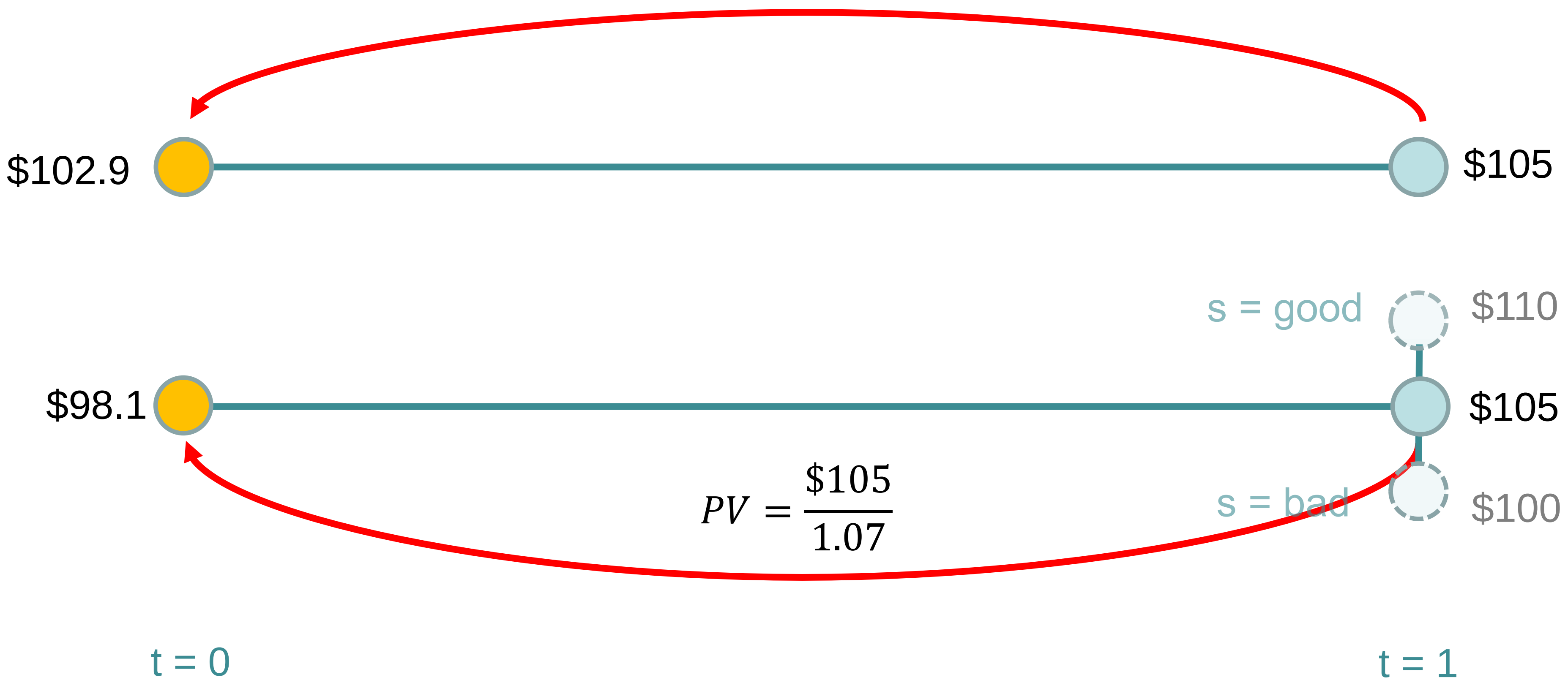
Should you choose \$100 today or \$105 a year from now? The 1-year US Treasury bill currently offers a 2% annual interest.



You would prefer the \$105 a year from now, since it has a PV of \$102.9 > \$100.

Present Value and Discount Rate

Should you choose a certain payoff of \$105 or an expected payoff of \$105 with the actual realizations as below depending on the economy? (all payoffs a year from now) A stock with the same risk as the uncertain payoff has an expected return 7%.



$$PV = \frac{\$105}{1.07}$$

Two Years

What is the present value of C_2 in two years?

- First, discount C_2 from year 2 to year 1 to get $\frac{C_2}{1+r}$ as the "present value" as of year 1.
- Next, discount $\frac{C_2}{1+r}$ from year 1 to year 0 to get $\frac{C_2}{(1+r)^2}$ as the present value as of year 0 (today).

Present Value of Cash Flow in Year t

The present value, as of today (year 0), of a cash flow that occurs in year t is

$$\frac{C_t}{(1+r)^t}$$

The PV of a Stream of Cash Flows

Suppose a project, denoted *S*, generates the following **stream of cash flows**:

Year 1	Year 2	Year 3
£20	£25	£45

What is the present value of project S if the discount rate is 3%?

The PV of a Stream of Cash Flows

Notice that owning this project is equivalent to owning a set of three simple projects:

Project A	Earn £20 in year 1
Project B	Earn £25 in year 2
Project C	Earn £45 in year 3

Then,

$$PV(S) = PV(A) + PV(B) + PV(C)$$

$$= \frac{20}{1.03} + \frac{25}{(1.03)^2} + \frac{45}{(1.03)^3} = £84.16$$

The PV of a Stream of Cash Flows

The present value of a stream of cash flows $\{C_1, C_2, C_3, \ldots, C_T\}$ is given by

$$PV = \sum_{t=1}^{T} \frac{C_t}{(1+r)^t}$$

where T is the date at which the cash flows become zero forever (if there is no such a date, then we set $T = \infty$).

Net Present Value

When a stream of cash flows includes a **contemporaneous cash flow** (C_0), the present value of such a stream is often called the **net present value** (NPV).

In most applications, the first cash flow is negative ($C_0 < 0$), reflecting the initial cost of an investment.

Example: Suppose you buy a London flat today for £1M, and you expect to sell it in one year for £1.2M. If the discount rate is 10%, $NPV = -1M + \frac{1.2}{1.1} = £90{,}909.09$

Net Present Value: Formula

Note that the PV formula also works for a contemporaneous cash flow C_0:

$$PV_0(C_0) = \frac{C_0}{(1+k)^0} = C_0$$

So, we have the more general formula:

$$NPV = C_0 + \sum_{t=1}^{\infty} \frac{C_t}{(1+k)^t} = \sum_{t=0}^{\infty} \frac{C_t}{(1+k)^t}$$

The NPV Rule

The NPV gives us a criterion for making financial investments:
Invest if and only if NPV>0.

Suppose the London flat costs instead 1.1M today. You may think it's still a good idea to buy it and sell it later for 1.2M. What does the NPV say?

$$NPV = -1.1M + \frac{1.2}{1.1} = -£9{,}090.91$$

So you're actually losing money with such an investment!

NPV: Example

Example

- *You want to buy a house and sell it next year at the forecasted price of $40,000.*

- *You think that the housing market is risky, so you apply a relatively high discount rate of 12%.*

- *If the sale price is $35,000, what is the net present value of your investment in the house?*

$$NPV = -\$35{,}000 + \frac{\$40{,}000}{1.12} = \$700$$

- Hence buying the house is a good deal.

(Internal) Rate of Return: Definition

Rate of return (RR) of a project is implicitly defined by

$$P_0 = \frac{C_1}{1+RR} + \frac{C_2}{(1+RR)^2} + \frac{C_3}{(1+RR)^3} + \dots$$

where P_0 is the price or the initial cost of investment.

The rule is to

1. Accept a project with the rate of return (RR) greater than discount rate (*r*). This is called the **rate of return rule**.
2. Prefer a project with a higher RR between two projects with the same discount rate.

Rate of Return: Example

Example

- *You want to buy a house and sell it next year at the forecasted price of $40,000.*
- *You think that the housing market is risky, so you apply a relatively high discount rate of 12%.*
- *If the sale price is $35,000, what is the rate of return on the investment? Compare it to the discount rate.*

$$P_0 = \frac{C_1}{1 + RR} \Rightarrow RR = \frac{C_1}{P_0} - 1 = 14.3\%$$

- Hence, RR = 14.3% > r = 12%

Pitfalls of the Rate of Return Rule

- But the rate of return rule can be tricky to use (chapter 5.3).

$$P_0 = \frac{C_1}{1+RR} + \frac{C_2}{(1+RR)^2} + \frac{C_3}{(1+RR)^3} + \ldots$$

1. Lending or borrowing? RR may be the same for two projects with negative and positive NPVs

	Cash Flows ($)			
Project	C_0	C_1	IRR	NPV at 10%
A	−1,000	+1,500	+50%	+364
B	+1,000	−1,500	+50%	−364

Pitfalls of the Rate of Return Rule

2. Multiple rates of return when there is more than one negative cash flow. For example:

Cash Flows (billions of Australian dollars)				
C_0	C_1	. . .	C_9	C_{10}
−3	1		1	−6.5

There are two IRRs in this case.

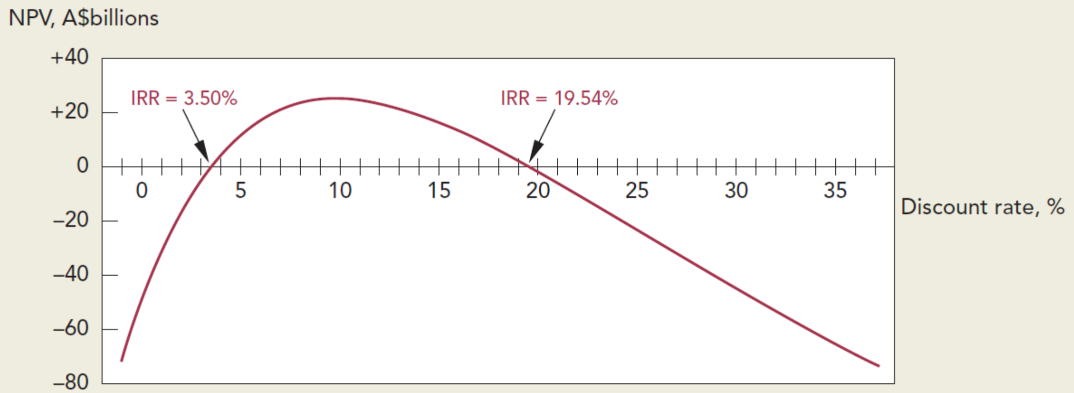


FIGURE 5.4

Helmsley Iron's mine has two internal rates of return. NPV = 0 when the discount rate is +3.50% *and* when it is +19.54%.

Pitfalls of the Rate of Return Rule

- What’s the verdict? **Just use the NPV rule**, especially when the IRR calculation is not straightforward.

Perpetuity

What is the present value of a project that pays annual cash flow C forever, starting in one year from now?

Let's call this project a **perpetuity**, and its present value by $PV_0(P)$.

Denote the present value of the perpetuity at time 1 by $PV_1(P)$.

Deriving the Perpetuity Formula

By construction, we have

$$PV_0(P) = \frac{C + PV_1(P)}{1 + k}$$

But notice that $PV_0(P) = PV_1(P)$. Why? In both cases, you receive the same amount C until infinity.

$$PV_0(P) = \frac{C + PV_0(P)}{1 + k}$$

Deriving the Perpetuity Formula

$$PV_0(P) = \frac{C + PV_0(P)}{1 + k}$$

$$\Leftrightarrow PV_0(P) + kPV_0(P) = C + PV_0(P)$$

$$PV_0(P) = \frac{C}{k}$$

Notice that the value of a perpetuity is not infinite!

There's also a shortcut for the present value of an "annuity," but that's somewhat less useful for security valuation.

Consols

- Perpetuities do exist in the real world.

- Over the years, the UK Government has issued some bonds– usually called **consols**–that pay a fixed interest forever.
  - Ex: Winston Churchill issued “4% consols” in 1927, to refinance national war bonds originating from the first World War.

- What is the value of a 4% consol with a **face value** of £1,000, if the discount rate is 0.75%? Answer: $(1000 \times 0.04)/0.0075 = £5{,}333.33$