

# 15.415 Foundations of Modern Finance

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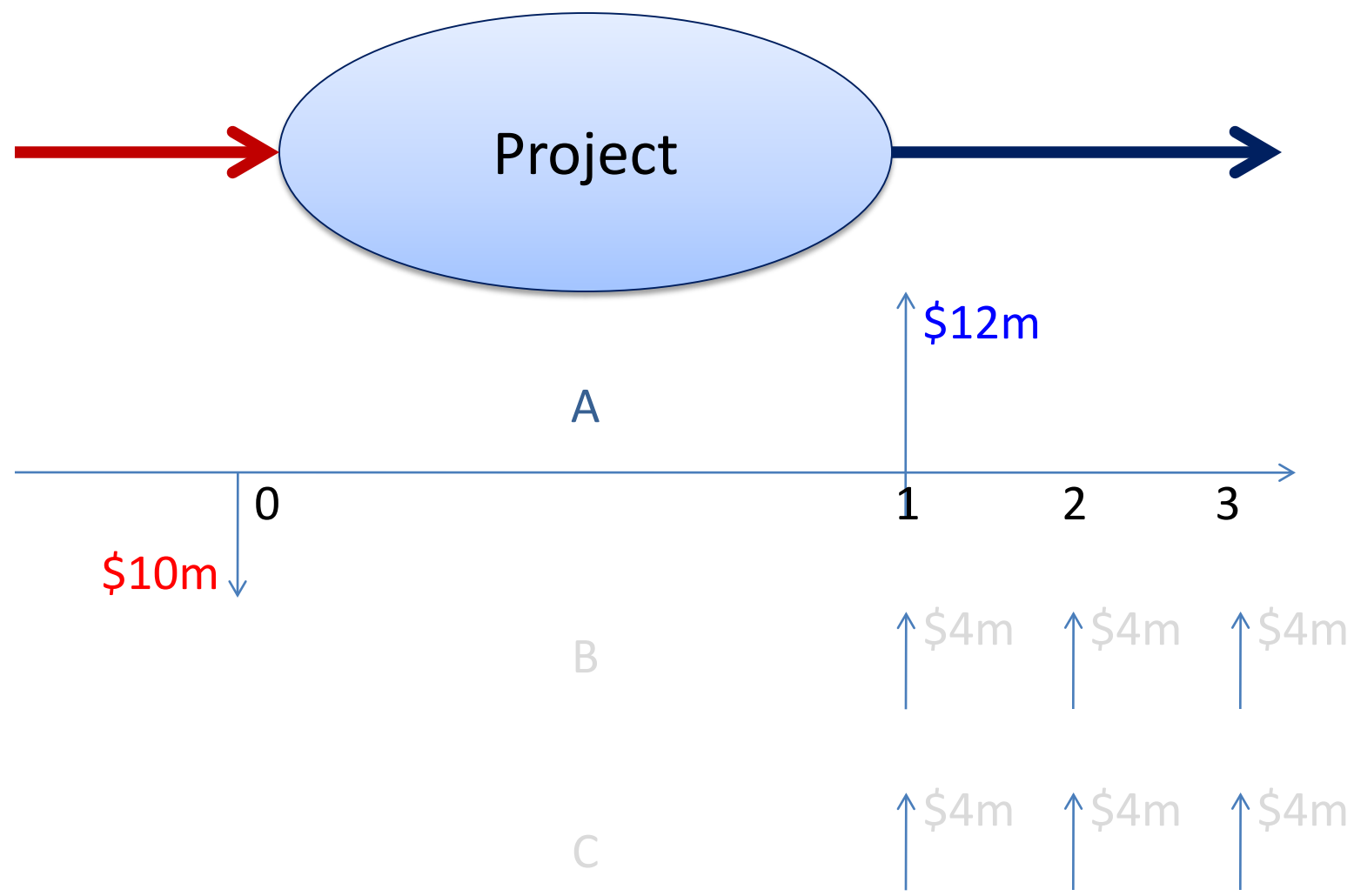
## Lecture 1: Introduction



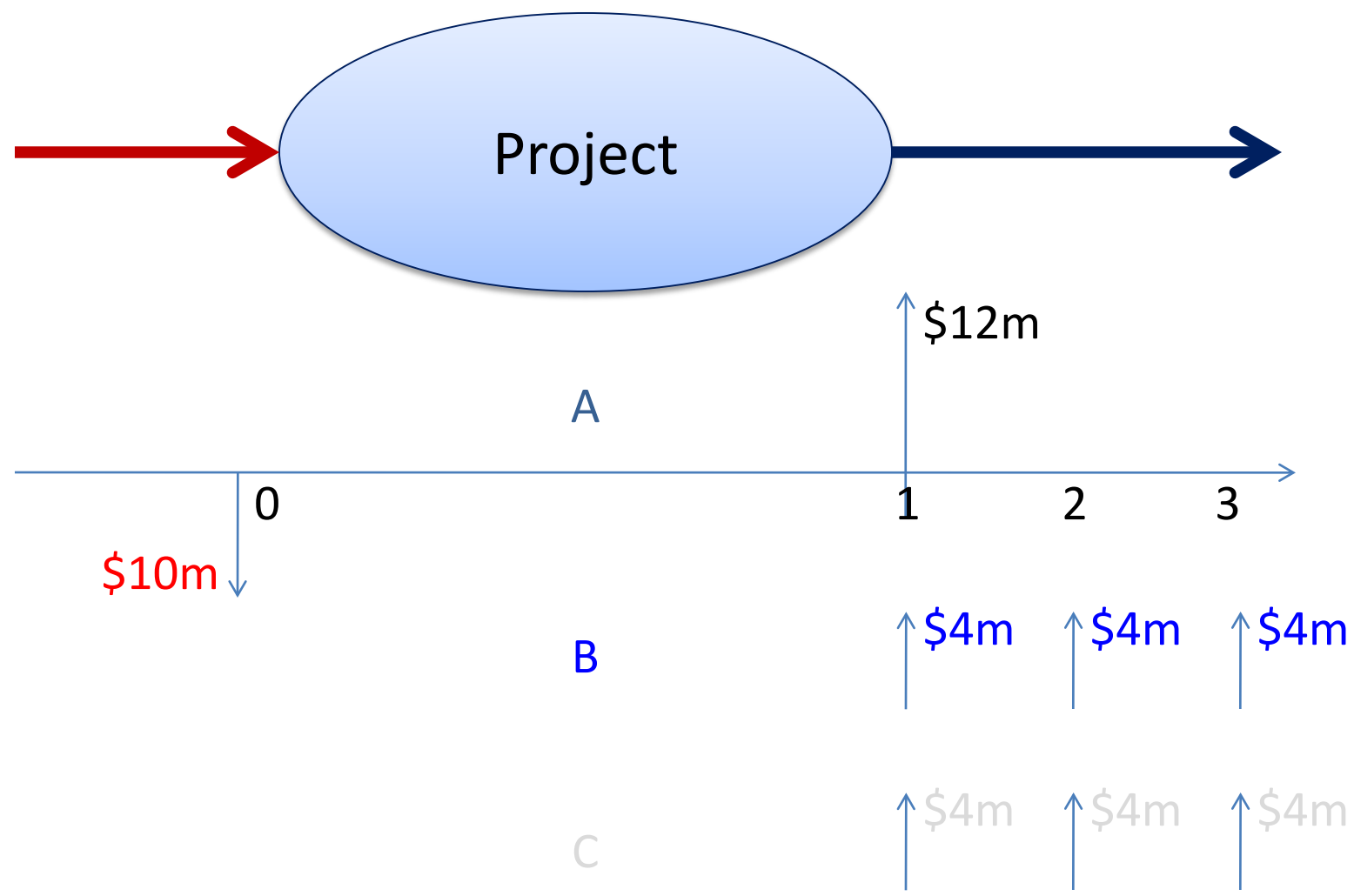
- What is finance
- A unified framework for financial analysis
- Basic approach to asset valuation
- Arbitrage and arbitrage pricing
- Overview of the financial market
- Key economic roles of the financial market
- Unifying principles of finance

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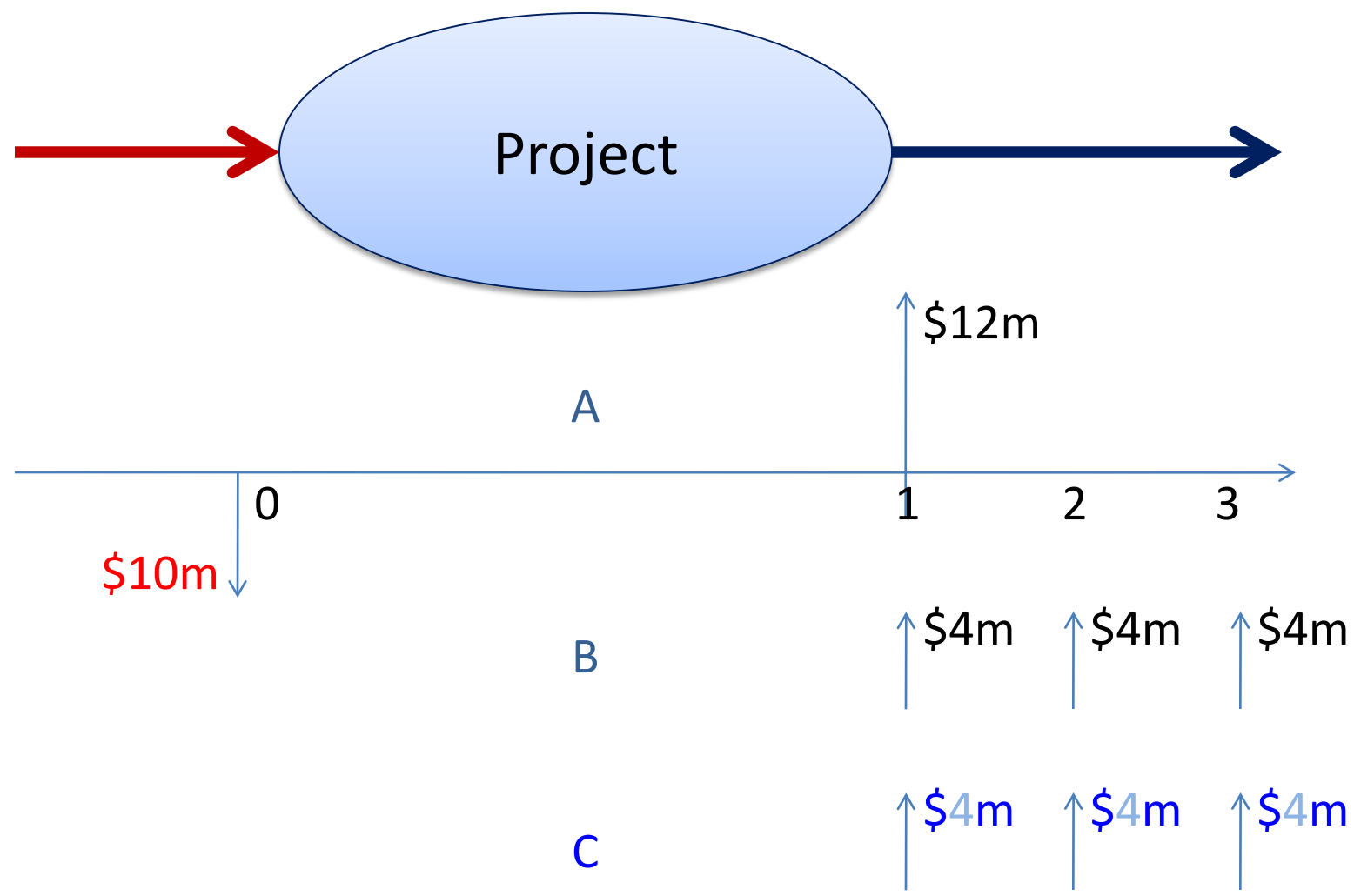
How to make a business decision? (To create value/wealth.)



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- Finance is about the bottom line of business activities.
- A business activity is a process of acquiring and disposing **assets**:
  - Real/financial,
  - Tangible/intangible.
- All business activities reduce to two functions:
  - Grow wealth (create value),
  - Manage wealth to best meet economic needs.
- Financially, a business decision starts with the **valuation** of assets.
  - “You can’t create and manage what you can’t measure.”
- Value is an objective measure --- determined by the financial market.
- **Valuation is the central issue of finance/business.**

Questions we would like to answer in this course:

1. How to value assets?
2. How corporations make financial decisions?
  - Capital budgeting/real investment: What projects to invest in?
  - Financing: How to finance a project?
    - Selling financial assets/securities/claims (debt, stock, ...)
  - Payout: What to pay back to shareholders?
    - Paying dividends, buy back shares, ...
  - Risk management: What risk to take or to avoid and how?
3. How households make financial decisions?
4. How governments make financial decisions?

We do so by developing and applying a unified analytical framework and a set of basic principles of modern finance.



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## Financial state of a corporation/household

### Balance sheet

Assets	Liabilities
Cash	Debt (D)
Capital	Equity (E)
Intangibles	
Value	Value

## Financial state of a corporation/household

### Income statement

Source of funds = Use of funds

$$NI + \Delta D + \Delta E = I + C + Div + T$$

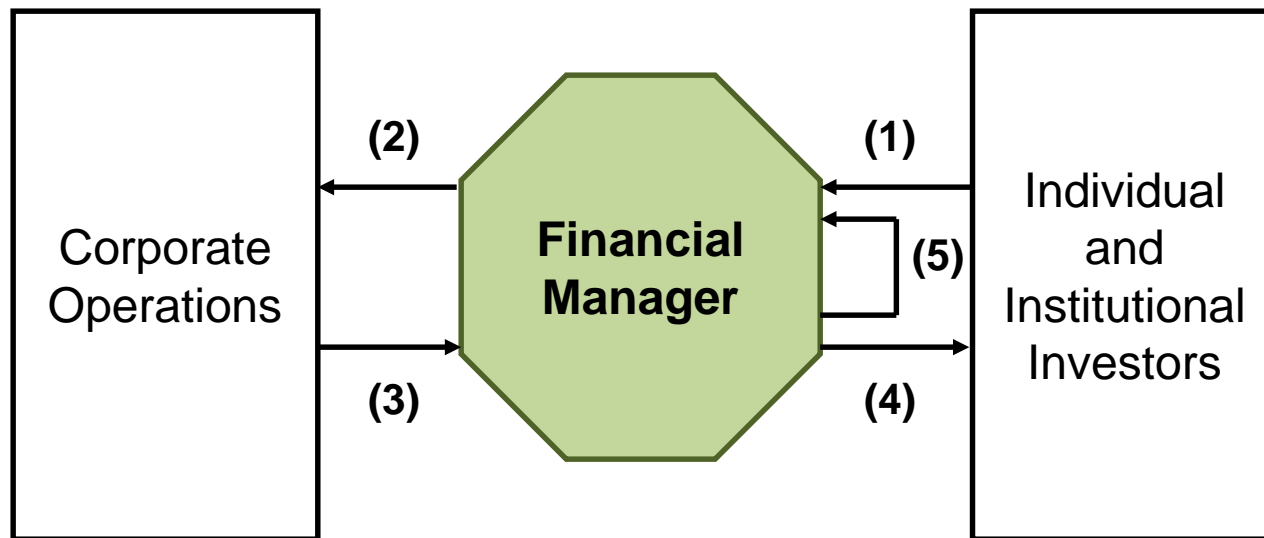
- ❖  $NI$  : net income
- ❖  $\Delta D$  : funds raised from new debt issue
- ❖  $\Delta E$  : funds raised from new equity issue
- ❖  $I$  : investment
- ❖  $C$  : coupon payment
- ❖  $Div$  : dividend payment
- ❖  $T$  : tax payment

Financial state of a corporation/household

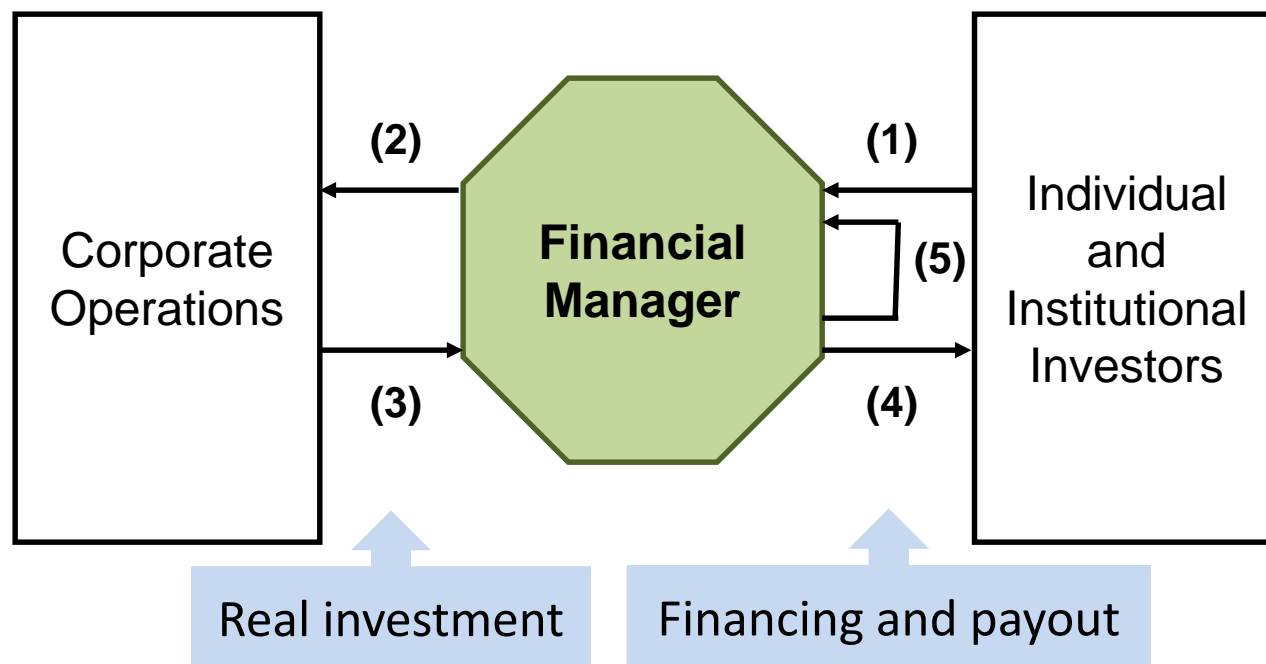
Balance sheet evolution:

Assets	Liabilities		Assets	Liabilities
Cash	Debt (D)		Cash	Debt (D + $\Delta D$ )
Capital	Equity (E)		Capital + I	Equity (E + $\Delta E$ )
Intangibles			Intangibles	
Value	Value		Value	Value

## Corporate financial decisions



- (1) Cash raised from investors by selling financial assets ( $\Delta D + \Delta E$ )
- (2) Cash invested in real assets (tangible and intangible) ( $I$ )
- (3) Cash generated by operations (after tax) ( $NI - T$ )
- (4) Cash returned to investors (debt payments, dividends, etc.) ( $C + Div$ )
- (5) Cash reinvested ( $NI - T - C - Div$ )



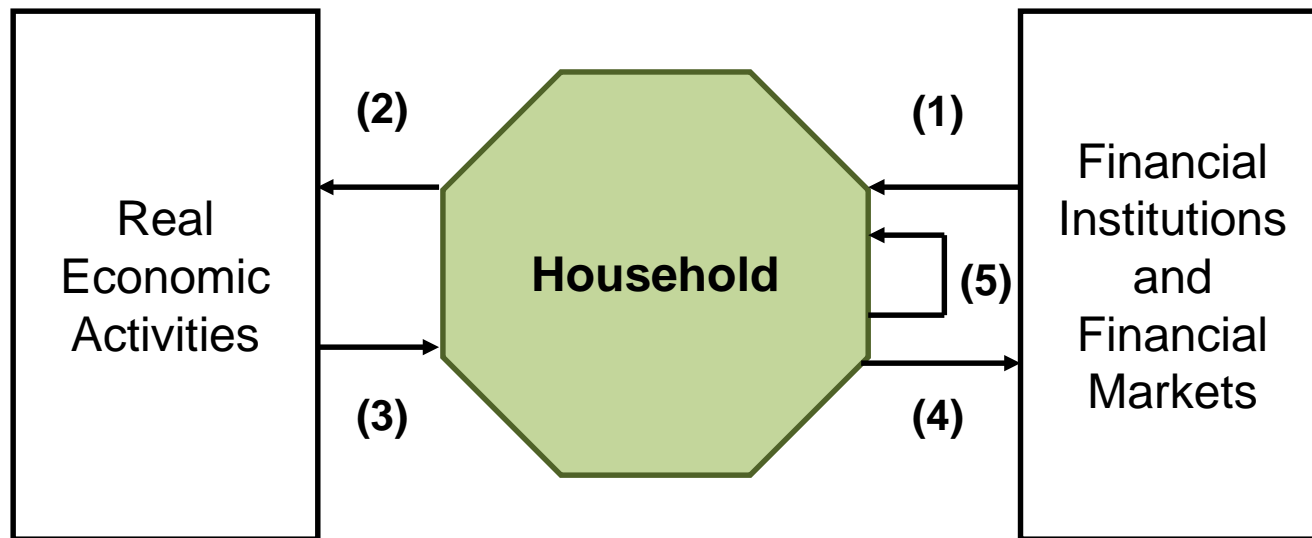
**Management decisions** --- manage cash flow (1), (2), (4), (5).

- **Real investment/capital budgeting**: (2), (3) -- valuing real assets
- **Financing and payout**: (1), (4), (5) -- valuing financial assets
- **Risk management**: (1) and (4) -- valuing financial contracts.

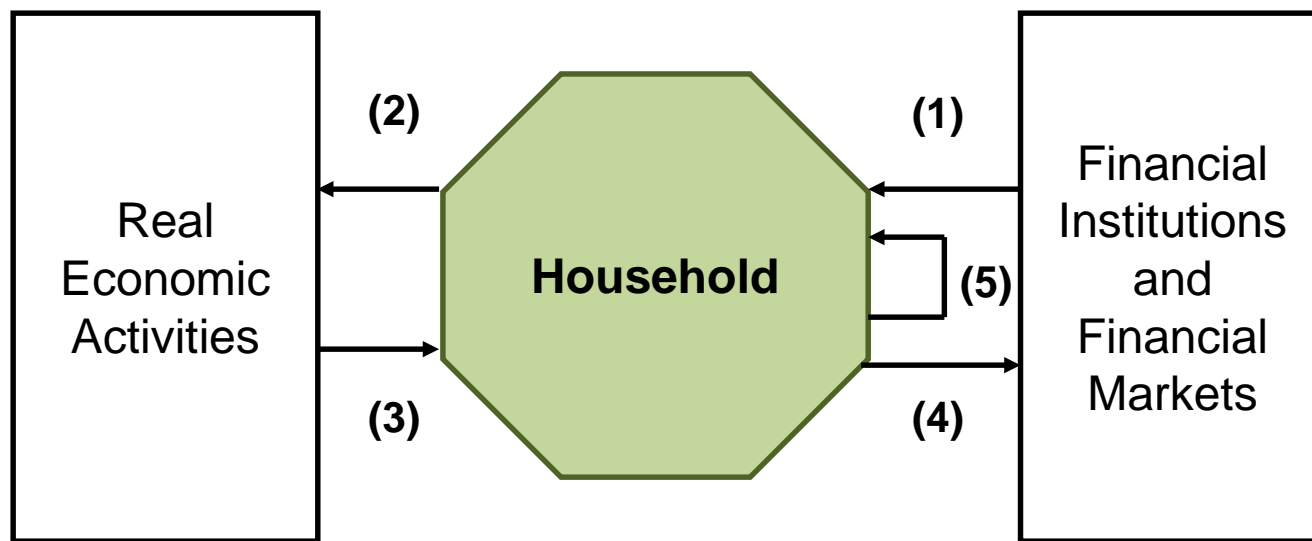
**Objective**: Create maximum value for **shareholders**.

Sound business decisions rely on how to value assets.

## Household financial decisions



- (1) Cash raised from financial institutions or from holdings of financial assets
- (2) Cash invested in real assets (tangible and intangible)
- (3) Cash generated by labor supply and real assets
- (4) Cash returned to financial institutions or invested in financial assets
- (5) Cash consumed and reinvested.



**Household financial decisions** --- manage cash flow (1), (2), (4), (5).

- Real investment: (2), (3) -- valuing real assets
- **Consumption/saving/investment**: (1), (4), (5) -- valuing financial assets
- Risk management: (1) and (4) -- valuing financial assets.

**Objective:** Maximize lifetime “happiness/welfare” or “**utility**”.



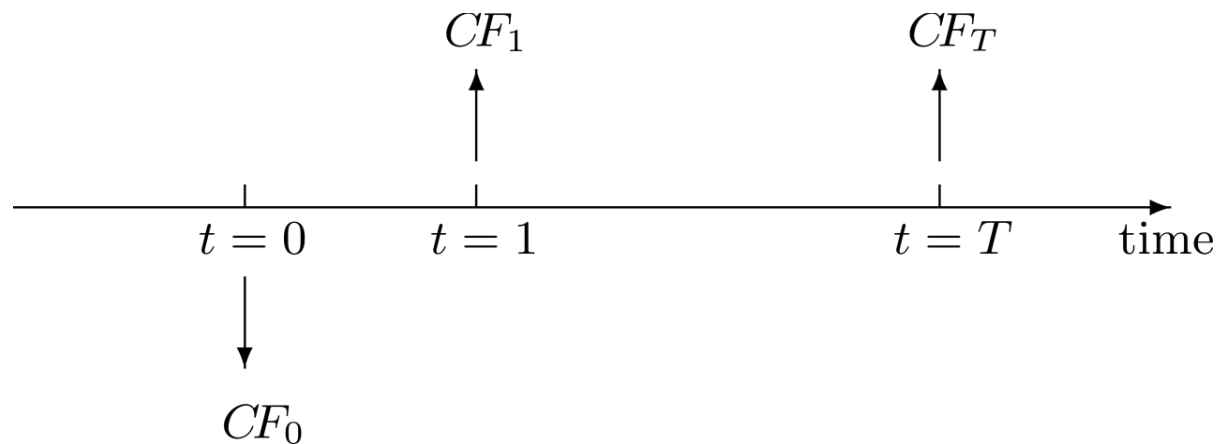
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Each asset is defined by its **cash flow** (CF):

Time:	0	1	2	...
Cash Out:	$(-)CF_0$	.	.	...
Cash In:	.	$CF_1$	$CF_2$	...
Net cash flow:	$CF_0$	$CF_1$	$CF_2$	...

Value of an asset = Value of its cash flow

“Visualizing” a cash flow (an asset):



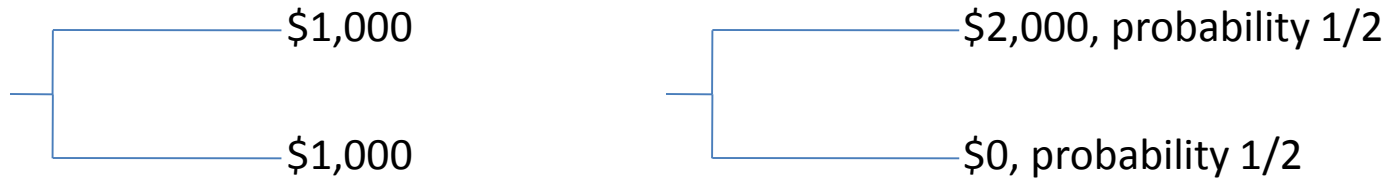
Two important characteristics of a cash flow (other than size):

### 1. Time



Which one do you prefer? --- **Time value of money.**

### 2. Risk



Which one do you prefer? --- **Risk premium.**

Time and risk are two key elements in finance.

How can we value/price a cash flow (an asset)?

**Example 1. (Safe asset)** An asset yields cash flow in one year with a sure value of \$1,000. How much is it worth today?

Suppose that assets/cash flows traded in the financial market with the same timing and risk offer a return of 5% (e.g., one-year US Treasury bonds, yielding a sure annual interest of 5%).

A potential buyer of the asset also expects a sure return of 5%. Let the price of the asset be  $X$ . Then,

$$X(1 + 0.05) = 1,000$$

or

$$X = \frac{1,000}{1 + 0.05} = 952$$

which gives the asset's **current market value**.

What if the asset can be traded at a higher price, say \$960?

Consider the following set of trades:

- 1) Buy \$952.38 worth of 1-year US Treasury bonds, which will pay \$1,000 in one year (at 5% interest rate), same as the asset;
- 2) Sell this sure cash flow of \$1,000 in one year for \$960 today.

These trades will net a positive cash flow or  $960 - 952 = \$8$  today. This is a **free lunch**.

If there are no **frictions** in the financial market (e.g., trading costs and constraints), there should be no free lunches.

- ☐ Thus, the price of the asset can't be higher than \$952.
- ☐ How about lower?

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Definition: An **arbitrage** (**free lunch**) is a set of trades in the financial market such that it

- ❑ requires non-positive initial cash flow/investment
- ❑ yields non-negative future payoffs
- ❑ at least one of the inequalities is strict.



**Example.** Citi's 12-month lending rate is 1% and Chase is selling 12-month certificate of deposit (CD) at an interest rate of 1.125%.

Arbitrage trades:

- 1) Borrow \$100 from Citi at interest rate of 1% per year,
- 2) Buy \$100 worth of 12-month CD from Chase at 1.125% per year.

Resulting cash flow:

Cash flow	Year 0	Year 1
Borrow \$100 at 1%	100	$-(100)(1+0.01) = -101.000$
Buy \$100 of CD at 1.125%	-100	$(100)(1+0.01125) = 101.125$
Net cash flow	0	\$0.125

This is a free lunch: zero initial investment, \$0.125 sure profit in year 1.

**Example.** IBM shares are trading on New York Stock Exchange (NYSE) at \$190 and London Stock Exchange (LSE) at £120 and the pound/dollar exchange rate is at \$1.50/£.

Arbitrage trades:

- 1) Sell 1 share of IBM at NYSE for \$190,
- 2) Convert \$190 into pounds at \$1.50/£, obtaining £130,
- 3) Buy 1 share of IBM at LSE at £120.

Cash flow	Year 0	Year 1
Sell 1 share of IBM at NYSE at \$190/share	\$190	−1 share of IBM
Convert \$190 into £ at \$1.50/£, yielding £130	−\$190 + £130	
Buy 1 share of IBM at LSE at £120/share	−£120	1 share of IBM
Net cash flow	£10	0

- ❑ This is a free lunch: initial cash flow of £10, zero cash flow in the future.
- ❑ Arbitrage trades will quickly shift prices to make the free lunch disappear.

**Example 2. (Risky asset)** An asset yields a risky cash flow in one year with an expected value of \$1,000. How much is it worth today?

Suppose that assets/cash flows traded in the financial market with the same timing and risk offer an expected return of 10% (e.g., stocks with similar risks, yielding an expected annual return of 10%).

A potential buyer of the asset also expects an annual return of 10%. Let the price of the asset be  $X$ . Then,

$$X (1 + 0.10) = 1,000$$

or

$$X = \frac{1,000}{1 + 0.10} = 909$$

which gives the asset's current market value.

In a **well functioning** (**frictionless**) financial market, there should be no arbitrage opportunities.

- Why?
- How about frictions (e.g., entry cost, trading costs, constraints, information asymmetry, ...)?
- Don't need all investors to face limited frictions.

In absence of arbitrage, assets with same payoffs should have the same prices. – **Law of One Price (LOP)**

With a **rich** and well functioning financial market, all assets are valued/priced by the market (the prices of traded assets).

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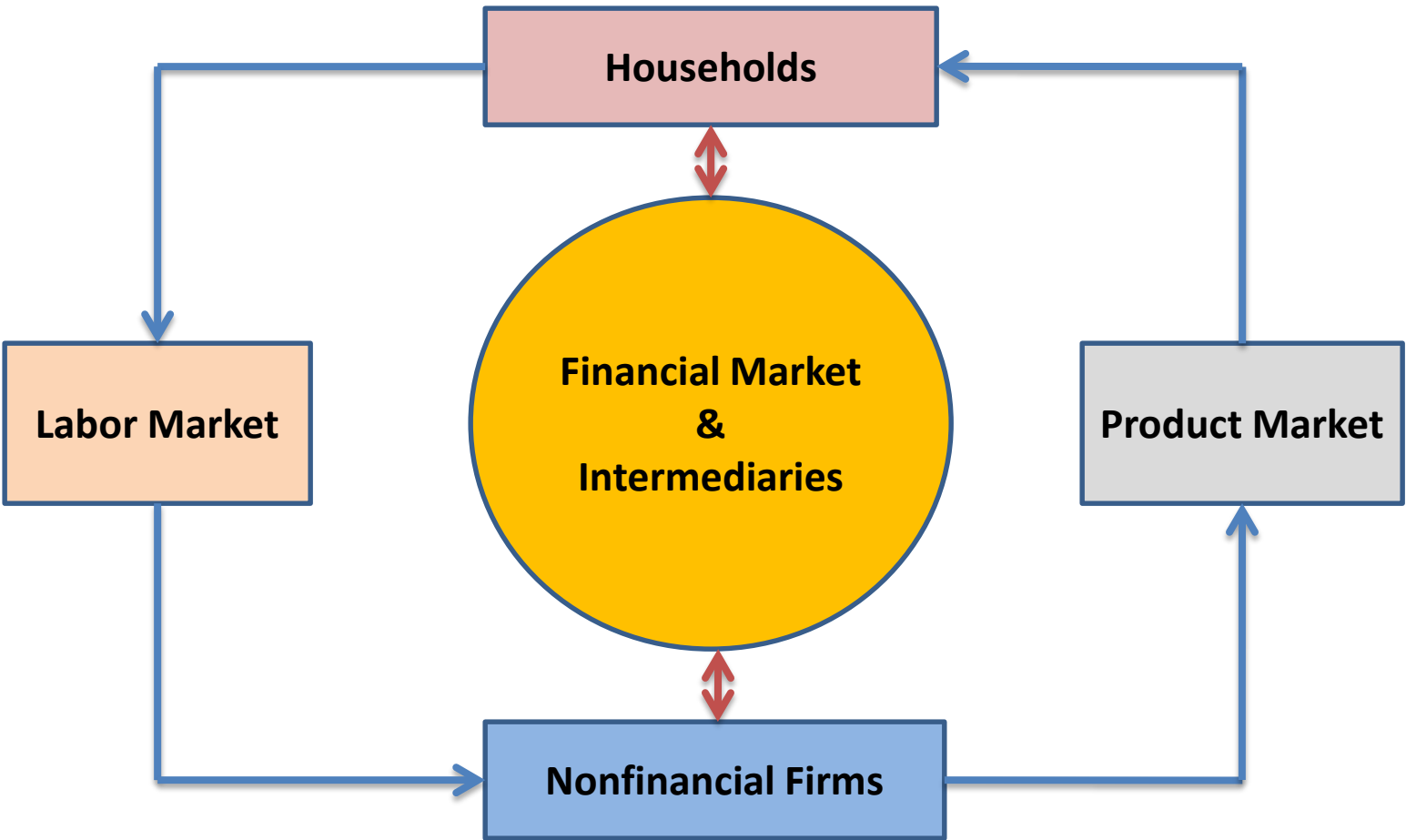
Two important lessons so far:

1. Sound economic decisions rely on how to value assets;
2. Asset valuation is determined by the financial market.

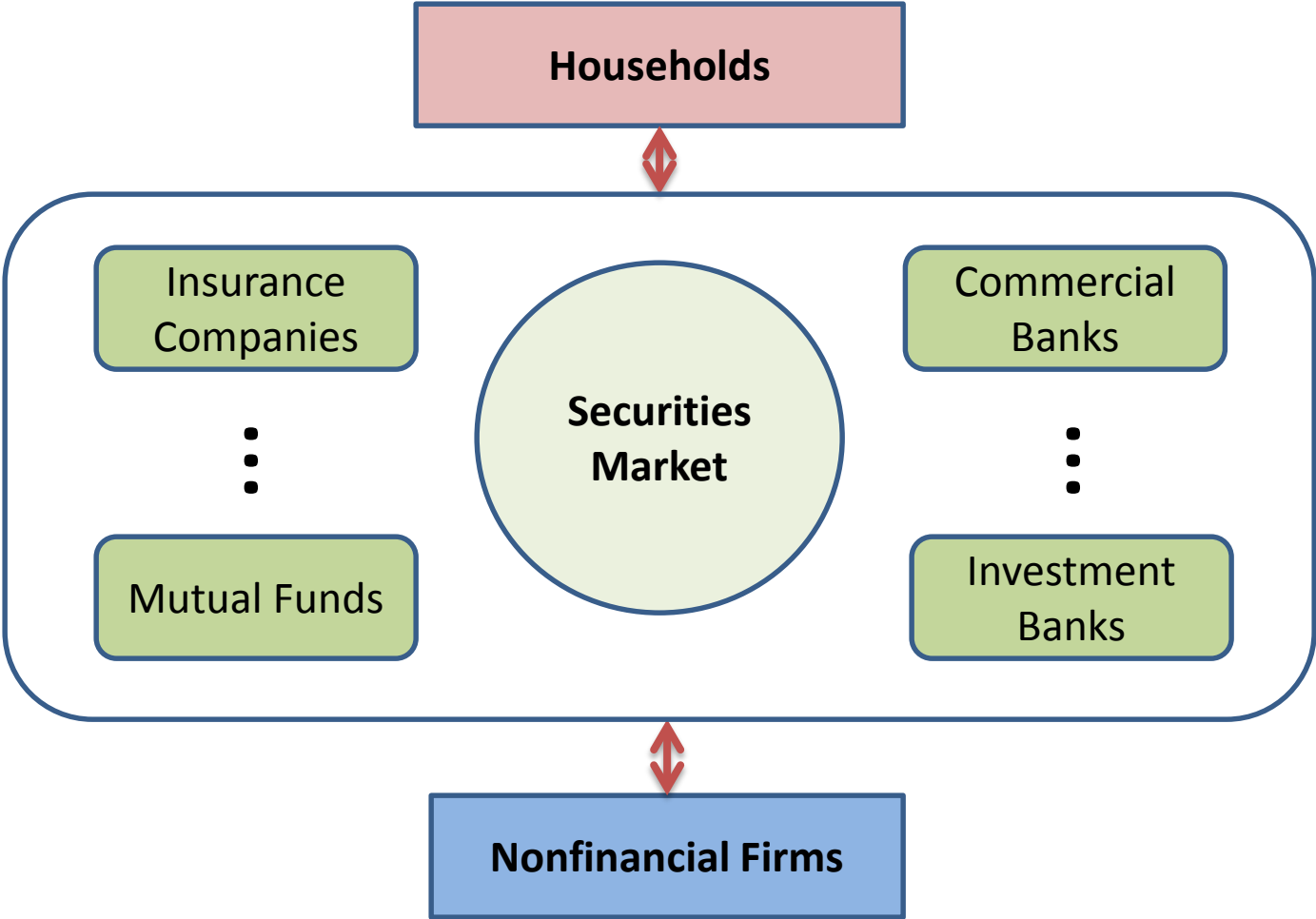
Central role of the financial market for the economy:

- Guiding economic decisions by firms/households at the micro level,
- Allocation resources across different economic activities at the macro level.

Financial market at the center of the economy:



Financial market & intermediaries





- **Securities market** - where financial assets/claims/contracts are traded
- **Money market**: Short-term debt securities
  - Short-term government, bank and corporate debt (Treasury Bills, CDs, Commercial Papers, ...)
- **Capital market**: Long-term securities
  - Government and corporate bonds, asset-backed securities, ...
  - Stocks, ...
- **Derivatives**: Securities with payoffs tied to other prices
  - Forwards and futures, swaps, options, ...
- **Financial Intermediaries** - Own mostly financial assets
- Banks, insurance companies, S&Ls, ...
- Mutual funds, hedge funds, private equity (PE) funds, ...
- **Nonfinancial firms** - Own mostly real assets
- **Households** - Own both real and financial assets
- **Governments** - Own both real and financial assets/liabilities

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## 1. Allocating resources

- ❑ Across time

**Example.** Borrow money to buy a home.

- ❑ Across different states of the economy

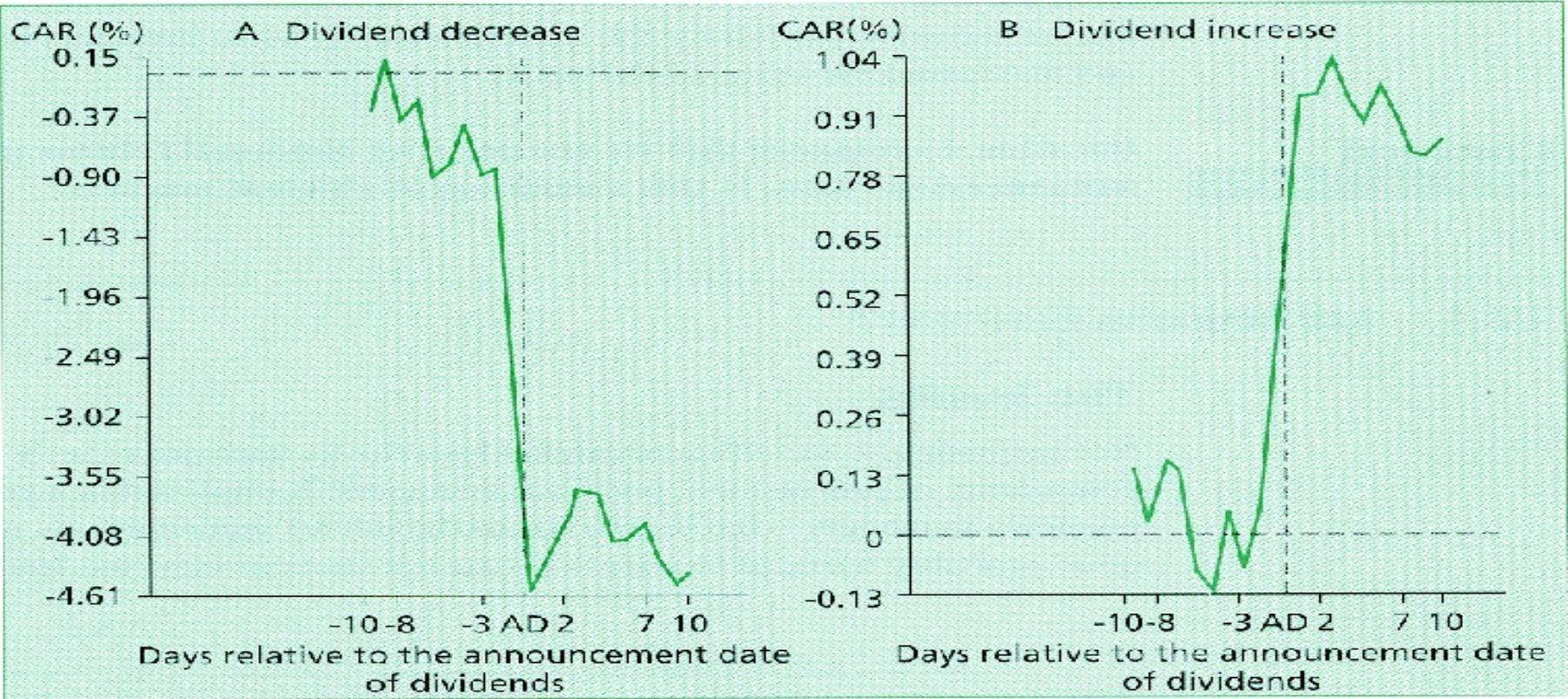
**Example.** Invest in stocks/bonds.

## 2. Price discovery

- ❑ Market prices reflect available **information**.

Price Change around Dividend Announcements

(Stock price change as measure by the cumulative abnormal return in the days around dividend announcement.)



- **Market imperfections/frictions:**
  - **Transaction costs** (TCs)
    - Missing markets
    - Access cost
    - Trading cost/liquidity
    - Position/trading constraints ...
  - **Information asymmetry**
    - Between a firm's different stakeholders
    - Between corporate managers and the financial market
    - Between different market participants
  - **Taxes**
    - Corporate taxes
    - Personal taxes
- Our analysis always starts with a frictionless market as the benchmark.
- Real markets have frictions, which will be considered when needed.

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**P1: There is no such thing as a free lunch in the financial market.**

**P2: Other things equal, individuals/agents:**

- **Prefer more money to less (non-satiation);**
- **Prefer to avoid risk (risk aversion);**
- **Prefer money now to later (impatience).**

**P3: Financial market prices shift to equalize supply and demand.**

**P4: Market imperfections are central to financial innovation.**