

Asset Markets

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Overview

1 Asset

2 Arbitrage

Asset

- An **asset** is a commodity that provides a flow of services over time
 - a house, or a computer
- A financial asset provides a flow of money over time—a **security**
- Typically, asset values are **uncertain**
 - we assume uncertainty away in this lecture for simplicity
 - incorporate uncertainty in the next lecture

Selling an Asset

- When should an asset be sold? At the maximum value?

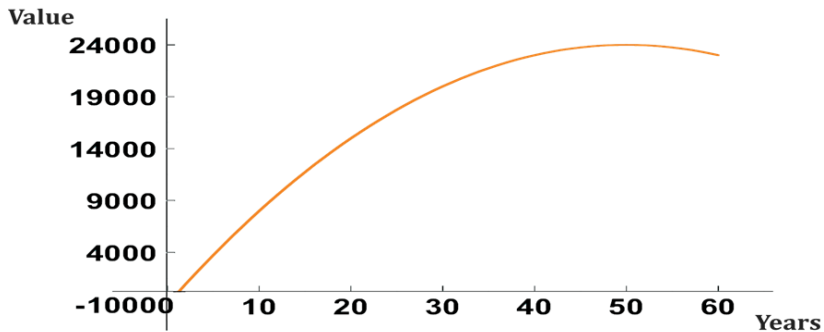
$$V(t) = -1000 + 1000t - 10t^2$$

- no

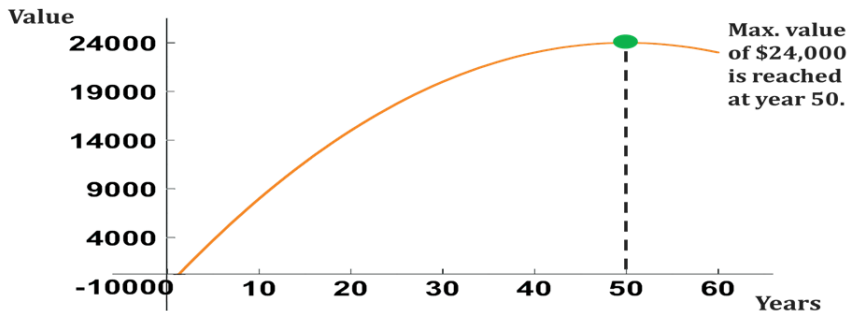
- Its value is maximized when

$$V'(t) = 1000 - 20t = 0 \quad \Rightarrow \quad t = 50$$

Selling an Asset



Selling an Asset



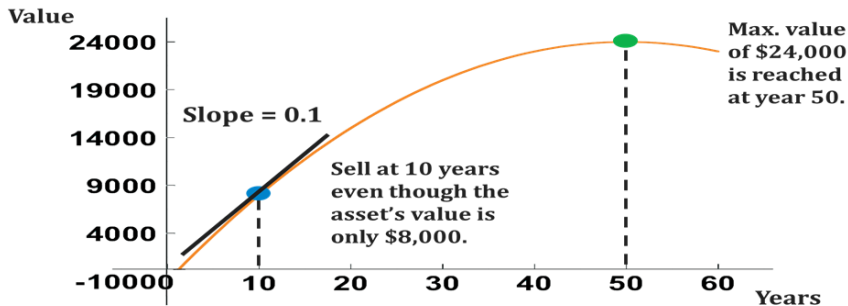
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Rate of Return

- The **rate of return** in year t is the income earned by the asset in year t as a fraction of its value in year t
 - if an asset valued at \$1,000 earns \$100 then its rate of return is 10%
- Suppose the interest rate is 10%. When should the asset be sold?
 - when the rate of return to holding the asset falls to 10%
 - it is better to sell the asset and put the proceeds in the bank to earn a 10% rate of return from interest
- The asset should be sold when

$$\frac{V'(t)}{V(t)} = \frac{1000 - 20t}{-1000 + 1000t - 10t^2} = 0.1 \quad \Rightarrow \quad t = 10$$

Rate of Return



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Rate of Return

- The payoff at year 50 from selling at year 10 and then investing the \$8,000 at 10% per year for the remaining 40 years is

$$\$8,000(1 + 0.1)^{40} = \$362,074 > \$24,000$$

- So the time at which an asset should be sold is determined by
 - rate of return = r (interest rate)

Assets with Consumption Returns



- Some assets pay off in terms of both money and consumption
 - housing provide both living and investment
 - the **implicit rental rate** on your house is the rate at which you could rent a similar house
- Let A be expected appreciation of a house over a year; T be the rental return. The total return is

$$h = \frac{T + A}{P}$$

1 Asset

2 Arbitrage

Arbitrage

- **Arbitrage** is trading for profit in commodities which are not used for consumption
 - buying and selling stocks, bonds, or stamps
- Without uncertainty, all profit opportunities will be found. What does this imply for prices over time?
 - return rate will be the same for all investments and the same as the interest rate
 - or the **no arbitrage condition**

Arbitrage

- The price today of an asset is p_0 . Its price tomorrow will be p_1 . Should it be sold now?
 - the rate of return from holding the asset is $R = \frac{p_1 - p_0}{p_0}$ or $(1 + R)p_0 = p_1$
- Sell the asset now for $\$p_0$, put the money in the bank to earn interest at rate r , and tomorrow you have $(1 + r)p_0$

Arbitrage



- When is not selling best?
 - $(1 + R)p_0 > (1 + r)p_0$ or $R > r$
 - sell now for $\$p_0$ if $R < r$ as $(1 + R)p_0 < (1 + r)p_0$
- If all asset markets are in **equilibrium** then $R = r$ for every asset. For all assets

$$p_1 = (1 + r)p_0 \quad \text{and} \quad p_0 = \frac{p_1}{1 + r}$$

Arbitrage in Bonds

- Bonds “pay interest.” Yet, when the interest rate paid by banks rises, the market prices of bonds fall. Why?
 - a bond pays a **fixed** stream of payments of \$ x per year, no matter the interest rate paid by banks
 - at an initial equilibrium the rate of return to holding a bond must be:

$$R = r' \quad (\text{the initial bank interest rate})$$

- if the bank interest rate rises to $r'' > r'$ then $r'' > R$ and the bond should be sold
- sales of bonds lower their market prices

Taxation of Asset Returns

- Let r_b be the before-tax rate of return of a taxable asset; r_e be the rate of return of a tax exempt asset; t be the tax rate. The no-arbitrage rule

$$(1 - t)r_b = r_e$$

- The after-tax rates of return are equal