

# Notes 5

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CHAPTER 5: APY AND APR, ARBITRAGE, AND THE  
LAW OF ONE PRICE

# Interest Rates

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- The interest rate represents the cost of money over time. It is attached to:
  1. Savings (such as a saving account)
  2. Loans (such as a mortgage).
- But are all interest rates the same?
- Lets see two examples from the same financial intermediary--CitiBank.

**i** Beginning April 19, 2021, Citi is lifting the six-per-statement limit on transfers from your savings and money

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# Earn 0.50% APY High-Yield Interest

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# Current Mortgage Rates

Purchase rates

Refinance rates

Home Equity rates

Rates based on a mortgage in Los Angeles, California. Rates effective as of 3/23/2021 9:26 AM ET and are subject to change without notice.

Mortgage Type	Rate	<a href="#">APR</a>	<a href="#">Points</a>	<a href="#">Sa</a>
30 Year Fixed	3.25%	3.457%	1.125	\$6 <a href="#">Ra</a>
15 Year Fixed	2.5%	2.83%	0.875	\$1 <a href="#">Ra</a>

# Effective Interest Rate

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## ***Definition*** - Effective Interest Rate - EAR

Indicates the total amount of interest that will be earned at the end of one year

- EAR considers the effect of **compounding**.
- Also referred to as the *effective annual yield (EAY)* or *annual percentage yield (APY)*.

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## **Definition** – Annual Percentage Rate - APR

Interest rate that is annualized using simple interest

# Formulas

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- $1 + \text{per} - \text{period } r = (1 + APY)^{\frac{1}{\# \text{period per year}}}$
- $1 + APY = (1 + \text{per} - \text{period } r)^{\# \text{periods per year}}$
- $APR = \text{per} - \text{period } r \times \# \text{periods per year}$

# Example 1

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- If the bank offers you a monthly interest rate of 1%, find the APR and the APY.
- There are 12 months in a year. We know that per-period  $r=1\%$ .
- $APR = 1\% \times 12 = 12\%$
- $1 + APY = (1 + 1\%)^{12} = 1.1268$

$$APY = 12.68\%$$



## Example 2

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- If a saving account pays 5% APY with semiannually compounding. Calculate per-period  $r$  and APR.
- There are two periods per year, and the formula for per period (six months in our example) interest rate is

$$\text{per - period } r = (1 + APY)^{\frac{1}{\# \text{ period per year}}}$$

$$\text{per - period } r = (1 + 5\%)^{\frac{1}{2}} = 0.0247 = 2.47\%$$

$$APR = 2.47\% * 2 = 4.94\%$$

## Example 3

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- Would a depositor prefer an APR of 8% with monthly compounding or an APR of 8.5% with semiannual compounding?
- The EAR of APR=8% with monthly compounding is

$$APY = \left(1 + \frac{8\%}{12}\right)^{12} - 1 = 8.3\%$$

- The EAR of APR=8.5% with semiannual compounding is

$$APY = \left(1 + \frac{8.5\%}{2}\right)^2 - 1 = 8.68\%$$

- The depositor will prefer the option with the higher EAR (effective annual rate).

# Arbitrage and the Law of One Price

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## ***Definition*** - Arbitrage

The practice of buying and selling equivalent goods in different markets to take advantage of a price difference. An arbitrage opportunity occurs when it is possible to make a profit without taking any risk or making any investment.

- Examples: Exchange rates, high-frequency trading.

## ***Definition*** – Normal Market

A competitive market in which there are no arbitrage opportunities.

# Arbitrage and the Law of One Price

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## **Definition** – Law of One Price

If equivalent investment opportunities trade simultaneously in different competitive markets, then they must trade for the same price in both markets.

- **Examples:** Assume a security promises a risk-free payment of \$1,000 in one year. If the risk-free interest rate is 5%, what can we conclude about the price of this security in a normal market?
- $PV = \frac{1,000}{1.05} = \$952.38 \text{ today.}$

# Arbitrage and the Law of One Price

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- What if the price of the security is not \$952.38? For example, the price is \$940.
- The opportunity for arbitrage will force the price of the security to rise until it is equal to \$952.38.
- Why is there an opportunity for arbitrage?