Chapter 3: Arbitrage and Financial Decision Making

Big picture:

1) If the price of an asset is less than its value, we should buy it.
2) If the price of an asset is greater than its value, we should sell it.
3) If we find two assets that always pay the same exact cash flows but which sell at two different prices, we should sell the high priced asset and buy the low priced assets.
4) Since it is so easy to trade financial assets, we should not be able to find any of these three opportunities with market-traded securities. We might find such opportunities with real assets (land, factories, private companies, etc.)

I. Financial Decision Making

A. Steps

1. Identify costs and benefits
   Note: work with accountants, managers, economists, lawyers, etc. to determine costs and benefits
2. Convert costs and benefits to equivalent dollars today
3. Proceed if the value of the benefits exceed the value of the costs

B. Equivalent Dollars (Value) Today

1. When competitive markets exist

   a. Definitions and example

   Competitive market:

   Q: Do such markets exist?

   =>$ 

   Bid price:
   Ask price:

   Notes:

   1) anyone can submit their own bid or ask price
      =>$ called a limit order
2) anyone submitting a market order takes whatever price exists in the market now

=> if buying, they’ll pay whatever the ask price is (the lowest price that anyone is willing to sell for)
=> if selling, they’ll get whatever the bid price is (the highest price that anyone is willing to pay).

b. Equivalent value today if competitive market:

Note:

Ex. Assume your uncle gives your 100 shares of Ford. What is the gift worth?
Ex. Would you trade your shares for $1000?
Ex. Would you trade your shares for 100 shares of Honda?

2. When a competitive market does not exist

Note: This is when finance gets more interesting

Ex. Ford dealership on Hwy 84 in Waco (Bird Kultgen)

a. Equivalent value today:

Notes:

1) =>

2) interest rate:
=>

3) interpretation:

C. Making Decisions

1) Accept all positive NPV projects or the highest NPV project if must chose
2) NPV = present value of all cash flows (inflows and outflows)
3) Interpretation of NPV:
4) Another way to think about it:
5) Decision doesn’t depend on preference for cash today vs. cash in the future
Ex. Assume you have an opportunity to buy land for $110,000 that you will be able to sell for $120,000 a year from today. Further assume that all cash flows are known for sure and that you can borrow or lend at a risk-free interest rate of 4%.

a. Should you buy the land if you have $110,000?

Q: How much would you have to invest at 4% to end up with $120,000 a year from today?

=>

Q: How much better off are you if you buy the land?

b. Should you buy the land if you have no money?

=> yes

II. Arbitrage and the Law of One Price

A. Introduction and Definitions

1. Arbitrage:

Note:

Ex. Assume that the price for GE stock is $15 on the New York Stock Exchange and $12 on the Boston Stock Exchange.

Arbitrage:

Arbitrage profit:
2. Normal market:
   
   Reason should be “normal”:

3. Equivalent assets:

4. Law of one price:

5. Short sales:

   1) today:
   2) later:

   Notes:

   1)
   2)
   3)
   4)

Ex. Assume you want to short-sell 100 shares of GE today for the market price of $12.50 per share

1) 

=> 

=>

2) assume price falls from $12.50 to $10

3) Q: How close out short position?

=>

4) assume that while you were short GE paid a dividend of $0.10 per share

=>

5) Profit =
B. No Arbitrage Prices for Securities

Key:

Ex. Assume you can borrow or lend at the risk-free rate of 7% and that a risk-free bond pays $1000 a year from today

\[ PV = \]

a) Assume price of bond is $920 (rather than its present value)

Goal in arbitrage: positive cash flow today, no possible net cash flow after today

Basic questions to ask when setting up an arbitrage:

1) What transaction (or set of transactions) is equivalent to the security?
2) Do you want to buy or sell the security?
3) What cash flows does this create?
4) What transaction today offsets the security’s cash flows in the future?

<table>
<thead>
<tr>
<th>Transaction</th>
<th>$ in one year</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transaction(t=0)</td>
<td>$ today</td>
<td>$ in one year</td>
</tr>
</tbody>
</table>

Total

Arbitrage profit =
b) Assume price of bond is $950 (rather than its present value)

<table>
<thead>
<tr>
<th>Transaction (t=0)</th>
<th>$ today</th>
<th>$ in one year</th>
<th>Transaction (t=1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Arbitrage profit =

=> only way there is no arbitrage:

Notes:

1) investors rushing to take advantage of the arbitrage opportunity will quickly drive the price to $934.58

2) interest rates are usually extracted from security prices rather than the other way around

Ex. What is usually known: CF$_1$ = $1000, Price = $934.58

\[ => 934.58 = \frac{1000}{1 + r} \Rightarrow r = .07 = 7\% \]

3) In a normal market, buying and selling securities has zero NPV

Keys:

a) NPV(buying security) =

=> in normal market, price = PV(CF)

b) NPV(selling security) =

=> in normal market, price = PV(CF)

=> otherwise arbitrage possible

C. No Arbitrage Prices of Portfolios

Key:

=> otherwise arbitrage is possible
1. ETF: exchange traded fund

2. Value Additivity: the price of a portfolio must equal the combined values of the securities in the portfolio

\[ \text{Price}(A+B) = \text{Price}(A) + \text{Price}(B) \]  \hspace{1cm} (3.5)

Ex. Assume the following:

ETF1 has one share of security A and one share of security B.
ETF2 has one share of security C and one share of security D.
Security A pays $100 a year from today and has a market price of $95.24.
Security B pays $150 a year from today and has a market price of $142.86.
Security C pays $200 a year from today and Security D pays $50 a year from today.

Q: What portfolio is equivalent to ETF1?

<table>
<thead>
<tr>
<th>Transaction</th>
<th>$ in one year</th>
</tr>
</thead>
</table>

=>

Q: What is the no-arbitrage price be for ETF1?

=>

Reason:

Key to arbitrage with equivalent portfolios with different prices:

Assume price of ETF1 is $220

| Transaction (t=0) | $ today | $ in one year | Transaction (t=1) |
Assume price of ETF1 is $245

\[
\begin{array}{c|c|c|c}
\text{Transaction (t=0)} & \text{today} & \text{$ in one year } & \text{Transaction (t=1)} \\
\hline
\end{array}
\]

=> only way no arbitrage: price of ETF1 = 238.10
=> arbitrage will quickly drive the price of ETF1 to $238.10

Q: What does the market price for ETF2 have to be?

Note: payoff on ETF2 next year: 200 + 50 = 250

Q: What portfolio is equivalent to ETF2?

=>

=>

Reason:

D. No-Arbitrage Pricing in an Uncertain World

1. Key ideas

1) Reason: for most people a $1 loss is a bigger deal than a $1 gain

2) Risk premium: extra return demanded by investors for holding risky assets instead of Treasuries

=> compensates investors for taking any risk

2. Risk premium on the market

=>

Note: the market risk premium will increase if:
3. Risk premium on a security

Key => Depends on two things:

1)  
2)  

=>

Ex. Assume the following:

– risk-free interest rate = 2%
– a strong or weak economy is equally likely
– price of the market index: $100
– payoff on stock market index depends on the economy as follows:
  weak economy = $75
  strong economy = $139

– payoff on Orange Inc. depends on the economy as follows:
  weak economy = $95
  strong economy = $159

Q: What are the expected cash flow next year, the possible returns, the expected return, and the risk premium on the market?

=> expected cash flow for the market index =
=> return on the market depends on the economy as follows:

   Strong:

   Weak:

=> expected return on the market index:
=> risk premium on the market index =

Q: What is the no-arbitrage price of Orange Inc.?

=>
<table>
<thead>
<tr>
<th>Transaction</th>
<th>Weak</th>
<th>Strong</th>
</tr>
</thead>
<tbody>
<tr>
<td>$ in one year</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Cost to build portfolio that is equivalent to Orange:

=> Cost of equivalent portfolio

=>

Q: What is arbitrage profit if the price of Orange is $125?

<table>
<thead>
<tr>
<th>Transaction</th>
<th>$ today</th>
<th>Weak</th>
<th>Strong</th>
<th>Transaction</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$ in one year</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Q: What is the arbitrage profit if the price of Orange is $110?

<table>
<thead>
<tr>
<th>Transaction</th>
<th>$ today</th>
<th>Weak</th>
<th>Strong</th>
<th>Transaction</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$ in one year</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Q: What are the possible returns, expected return, and risk premium on Orange if it is correctly priced at $119.61?

Return on Orange if strong economy =

Return on Orange if weak economy =

Note:
Q: How should the risk premium on Orange compare to the market (5%)?

\[ \Rightarrow \]

Expected cash flow for Orange =

Expected return on Orange =

Risk premium on Orange =

E. Transaction cost: cost to trade securities

Note: transaction costs include:
1. commission to broker
2. bid-ask spread: difference between bid price and ask price

Key: Transaction costs lead to the following modifications of earlier definitions:

- Normal market \( \Rightarrow \) no arbitrage after transaction costs covered
- Law of one price \( \Rightarrow \) difference in prices for equivalent securities must be less than transaction costs
- No arbitrage price \( \Rightarrow \) differences between price and the PV(CF) must be less than transaction costs
- Portfolio prices \( \Rightarrow \) Difference between the price of a portfolio and the sum of the prices of assets in the portfolio must be less than the transaction costs to build or break apart the portfolio