**Chapter 3**

**Arbitrage and Financial Decision Making**

* 1. The benefit of the rebate is that Honda will sell more vehicles and earn a profit on each additional vehicle sold:

Benefit = profit of $6000 per vehicle × 15,000 additional vehicles sold = $90 million.

The cost of the rebate is that Honda will make less on the vehicles it would have sold:

Cost = loss of $2000 per vehicle × 40,000 vehicles that would have been sold without rebate = $80 million.

Thus, benefit – cost = $90 million – $80 million = $10 million, and offering the rebate looks attractive.

(Alternatively, we could view it in terms of total, rather than incremental, profits. The benefit is $6000/vehicle × 55,000 sold = $330 million, and the cost is $8000/vehicle × 40,000 sold = $320 million.)

* 1. Czech buyer’s offer = 2,000,000 CZK / (25.50 CZK/CAD) = 78,431.37 CAD

Thai supplier’s offer = 3,000,000 THB / (41.25 THB/CAD) = 72,727.27 CAD

The value of the deal is $78,431 – $72,727 = $5704 today.

* 1. The price at which ethanol becomes attractive is ($3.75 + $1.60 / bushel of corn) / (3 gallons of ethanol / bushel of corn) = $1.78 per gallon of ethanol.

1. Stock bonus = 100 × $63 = $6300

Cash bonus = $5000

Since you can sell (or buy) the stock for $6300 in cash today, its value is $6300, which is better than the cash bonus.

1. Because you could buy the stock today for $6300 if you wanted to, the value of the stock bonus cannot be more than $6300. But if you are not allowed to sell the company’s stock for the next year, its value to you could be less than $6300. Its value will depend on what you expect the stock to be worth in one year, as well as how you feel about the risk involved. You might decide that it is better to take the $5000 in cash than wait for the uncertain value of the stock in one year.
2. The price of the ticket is $359. Price if you purchase the miles is $0.03 × 5000 = $150. So you should purchase the miles.
3. In part (a), the existing miles are worthless if you don’t use them. Now, they are not worthless, so you must add in the cost of using them. Because there is no competitive market price for these miles (you can purchase at 3¢ but not sell for that price), the decision will depend on how much you value the existing miles (which will depend on your likelihood of using them in the future).
4. Having $200 today is equivalent to having 200 × 1.04 = $208 in one year.
5. Having $200 in one year is equivalent to having 200 / 1.04 = $192.31 today.
6. Because money today is worth more than money in the future, $200 today is preferred to $200 in one year. This answer is correct even if you don’t need the money today, because by investing the $200 you receive today at the current interest rate, you will have more than $200 in one year.
   1. Cost = $1 million today





The NPV is positive, so it is a good investment opportunity.

* 1. Let the required level of interest rate be r.

160,000 × (1 + r) = 170,000 implies r = 170,000 / 160,000 – 1 = 6.25%

1. 









1. The firm can borrow $18.18 million today, and pay it back with 10% interest, using the $20 million it will receive from the government (18.18 × 1.10 = 20). The firm can use $10 million of the $18.18 million to cover its costs today, and save $4.55 million in the bank, earning 10% interest to cover its cost of 4.55 × 1.10 = $5 million next year.

This leaves 18.18 – 10 – 4.55 = $3.63 million in cash for the firm today.

1. 





1. If only one of the projects can be chosen, project C is the best choice because it has the highest NPV.
2. If two of the projects can be chosen, projects B and C are the best choice because they offer a higher total NPV than any other combination.
3. 



Costs are lower under the first supplier’s offer, so it is the better choice.

1. The firm can borrow $100,000 at 6% from a bank for one year to make the initial payment to the first supplier. One year later, the firm will pay back the bank $106,000 (100,000 × 1.06) and the first supplier $100,000 (10 × 10,000), for a total of $206,000. This amount is less than the $210,000 (21 × 10,000) the second supplier demanded.
2. Take a loan from Royal Bank at 5.5% and save the money in Scotiabank at 6%.
3. Royal Bank would experience a surge in the demand for loans, while Scotiabank would receive a surge in deposits.
4. Royal Bank would increase the interest rate, and/or Scotiabank would decrease its rate.
   1. There is exchange rate risk. Engaging in such transactions may incur a loss if the value of the dollar falls relative to the yen. Because a profit is not guaranteed, this strategy is not an arbitrage opportunity.
   2. We can trade one share of CN Rail stock for 49.85 USD per share in the U.S. and for 50.40 CAD per share in Canada. By the Law of One Price, these two competitive prices must be the same at the current exchange rate. Therefore, the exchange rate must be

 today.

* 1. 





While the total cash flows paid by each security are the same ($1000), securities A and B are worth less than $1000 because some or all of the money is received in the future.

1. We can value the portfolio by summing the value of the securities in it:

Price per share of ETF = 2 × $50 + 1 × $69 + 3 × $17 = $220.

1. If the ETF currently trades for $200, an arbitrage opportunity is available. To take advantage of it, one should buy the ETF for $200, sell two shares of CNR, sell one share of CP, and sell three shares of WJA. Total profit for such a transaction is $20.
2. If the ETF trades for $250, an arbitrage opportunity is again available. It can be realized by buying two shares of CNR, one share of CP, and three shares of WJA, and selling one share of the ETF for $250. Total profit would be $30.
3. This security has the same cash flows as a portfolio of one share of B1 and one share of B2. Therefore, its no-arbitrage price is 94 + 85 = $179.
4. This security has the same cash flows as a portfolio of one share of B1 and five shares of B2. Therefore, its no-arbitrage price is 94 + 5 × 85 = $519.
5. There is an arbitrage opportunity because the no-arbitrage price should be $132 (i.e., 94 / 2 + 85). One should buy two shares of the security at $130/share and sell one share of B1 and two shares of B2. Total profit would be $4 (i.e., 94 + 85 × 2 – 130 × 2).
   1. The PV of the security’s cash flow is ($150 in one year) / (1 + *r*), where *r* is the one-year risk-free interest rate. If there are no arbitrage opportunities, this PV equals the security’s price of $140 today.

Therefore,

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Rearranging:

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1. 





All projects have positive NPV, and Xia has enough cash, so Xia should take all of them. It would retain $10,000 in cash.

1. Total value today = Cash + NPV(projects) = 100,000 + 7272.73 + 12,727.27 + 12,727,27 = $132,727.27

c. After taking the projects, Xia will have 100,000 – 20,000 – 10,000 – 60,000 = $10,000 in cash left to invest at 10%. Thus, Xia’s cash flows in one year = 30,000 + 25,000 + 80,000 + 10,000 × 1.1 = $146,000.



This is the same as calculated in (b).

d. Unused cash = 100,000 – 20,000 – 10,000 – 60,000 = $10,000

Cash flows today = $10,000

Cash flows in one year = 30,000 + 25,000 + 80,000 = $135,000



e. Results from (b), (c), and (d) are the same because all methods value Xia’s assets today. Whether Xia pays out cash now or invests it at the risk-free rate, investors get the same value today. The point is that a firm cannot increase its value by doing what investors can do by themselves (and this is the essence of the second separation principle).

a.  pays  in both cases (i.e., it is risk free).

b. Market price. Expected return is.

c. Since the combination of A and B gives a certain payoff of $600, this is a risk-free security. Thus, its expected return calculated in (b) is the risk-free interest rate, so the risk-free interest rate is 3.986%.

a. 

b. D = 3B + A

c. No-arbitrage price of 

d. No-arbitrage price of 

e. Expected payoff of C is. Expected return.

Risk premium .

f. Expected payoff of D is. Expected return.

Risk premium .

g. Return when strong, return when weak.

Difference .

h. Price of C given 10% risk premium = expected cash flow discounted using risk-adjusted rate .

Buy  for 1039, sell C for 1053, and earn a profit of .

i. Return when strong, return when weak.

Difference 

j. Price of D given 10% risk premium = expected cash flow discounted using risk-adjusted rate .

Buy D for 1053 and sell for 1269, and earn a profit of .

a. Whether the last digit in the Dow index is odd or even has no correlation with the Dow index itself or with anything else in the economy. Hence the payout of this security does not vary with anything else in the economy, so it will not have a risk premium. Given equal probability that the last digit of the Dow index will be even or odd, the price of the security will be



b. No.

c. The answers would remain the same; however, in this case, if the actual prices departed from $476.19,   
an arbitrage opportunity would result because, by purchasing both securities, you can create a riskless investment. The investment will have a 5% return only if the price of the basket of both securities is $476.19 × 2 = $952.38.

a. Half as variable half the risk premium of market  risk premium is 3%.

b. Market price .

a There is an arbitrage opportunity. One would buy from the NASDAQ dealer at $27.95 and sell to the NYSE dealer at $28.00, making a profit of $0.05 per share.

b. There is no arbitrage opportunity.

c. To eliminate any arbitrage opportunity, the highest bid price should be lower than or equal to the lowest ask price.

* 1. According to the Law of One Price, the price that a portfolio of securities is trading at is equal to the sum of the price of securities within the portfolio. If the portfolio, composed of a bond and JNJ stock, is currently trading with a bid price of $141.65 and an ask price of $142.25, and the bond is trading at a bid price of $91.75 and an ask price of $91.95, then the no-arbitrage price of the stock should be between $(141.65 – 91.95) and $(142.25 – 91.75) or between $49.70 and $50.50.

At any price below $49.70 or above $50.50, an arbitrage opportunity would exist. For example, if the stock were currently trading at $49, an investor could purchase the stock and the bond for $49 + $91.95 = $140.95 and then immediately sell the portfolio for $141.65 and have an arbitrage of $141.65 – 140.95 = $0.70. If the price of the stock was $50.60, then an investor could purchase the portfolio for $142.25 and sell the bond and stock individually for $91.75 and $50.60 respectively. The investor would gain an arbitrage of $91.75 + $50.60 – $142.25 = $0.10.

The following problems are from the Appendix

a. Security 1 is risk free as the cash flow of $1100 occurs regardless of the economy. Thus, the risk-free interest rate is 1100 / 1000 – 1 = 10%.

b. This is easy as the payoffs are just the sum of security 1 and 2 put together. Therefore, the price is 1000 + 875 = $1875.

1. Using the matrix operations described in the chapter, we have the following:



So



Since



the value of the replicating portfolio is



Note: upon viewing the solution, you can also see that this security is just three and one-third times security 2.

1. Using the matrix operations described in the chapter, we have the following:



So



Since



the value of the replicating portfolio is



1. Using the matrix operations described in the chapter, we have the following:



So



Since



the value of the replicating portfolio is



1. To replicate the security described in (b), we would need 23 of the security in (d) and 20 of the security in (e). The total value would be as follows:

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This is the same value as calculated in (b).

1. To replicate the security described in (c), we would need 40 of the security in (d) and 30 of the security in (e). The total value would be as follows:

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This is the same value as calculated in (c).

a. A risk-free security with payoff of $100 can be constructed by combining one unit of security 1 with one unit of security 2. The price is thus 35 + 55 = $90. Thus, the risk-free rate is 100 / 90 – 1 = 11.11111111%

b.

i. It would take 20 units of security 1 and 20 units of security 2 to replicate this risk-free security.

ii. The market price today of this security would be .

iii. The market price today of this security would be 2000 / 1.1111111111 = $1800.

c.

i. It would take 40 units of security 1 and 20 units of security 2 to replicate this risk-free security.

ii. The market price today of this security would be .

d.

i. It would take 20 units of security 1 and 40 units of security 2 to replicate this risk-free security.

ii. The market price today of this security would be .

e. The security in (c) has a high payoff when the economy is strong and a low payoff when the economy is weak; whereas the security in (d) has a high payoff when the economy is weak and a low payoff when the economy is strong. Risk-averse investors are averse to risks that are correlated with how well the economy is doing. Since the security in (d) has payoffs that are countercyclical to the economy, a risk-averse investor holding (d) would get a benefit similar to insurance on the state of the economy; this actually will reduce the investors’ overall risks related to the economy. Thus, investors will pay a premium for the security in (d) and it will have a negative risk premium.

* 1. We can replicate the payoffs of the assets with 140 units of security 1 and 80 units of security 2. Therefore, the value of the assets today is the sum of the units × price per unit  
     140 × $35 = $4900  
     80 × $55 = $4400  
     So the value of the assets today is 4900 + 4400 = $9300.   
     The expected payoff from the assets is $11,000.

The expected return of the asset is 18.2795699%.   
Using the risk-free rate we found before in 3A.2(a), the risk premium for the assets is 7.1684588%.

* 1. i. Since the assets always pay off more than the promised amount to the bond, the bond payoffs are risk free. Payoffs to equity = asset payoff minus bond payoff. Expected payoffs for each row are the sum of the product of the probability × payoff for each economy.

|  |  |  |  |
| --- | --- | --- | --- |
|  | Weak Economy | Strong Economy | Expected Payoff |
| Asset Payoffs in One Year | $8000 | $14,000 | $11,000 |
| Bond Payoffs in One Year | $5000 | $5000 | $5000 |
| Equity Payoff in One Year | $3000 | $9000 | $6000 |

ii. We can replicate the payoffs of the bond with 50 units of security 1 and 50 units of security 2. So the bond's value today is $4500.

iii. The bond's expected return is 11.111111111%

The bond's risk premium is 0.000000000%

Note that this is the risk-free rate we found before in 3A.2(a).

iv. We can replicate the payoffs of the equity with 90 units of security 1 and 30 units of security 2. So the equity's value today is $4800.

v. The equity's expected return is 25.0000%

The equity's risk premium is 13.88888889%

vi. The sum of the bond and equity values is $4500 + $4800 = $9300.

So the sum of the bond and equity values is simply the value of the company's assets.

vii.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Weight | Expected Return | | Weight × Expected Return |
| Bond | 0.483870968 | 11.111111111% |  | 5.37634409% |
| Equity | 0.516129032 | 25.0000% |  | 12.90322581% |
|  |  |  | **Sum** | **18.27956989%** |
|  |  |  |  |  |

The weighted average expected return of the bond and equity is the same as the asset's expected return in (a).

* 1. i. Since the assets sometimes pay less than the promised bond amount, the bondholders will receive the minimum of the asset payoff or the promised payment. Equity holders receive the asset payoff less the bond payoff. Payoffs are shown below:

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  | Weak Economy | Strong Economy |  | Expected Payoff |  |
| Asset Payoffs in One Year |  |  | $8000 | $14,000 |  | $11,000 |  |
| Bond Payoffs in One Year |  |  | $8000 | $10,000 |  | $9000 |  |
| Equity Payoff in One Year |  |  | $0 | $4000 |  | $2000 |  |
|  |  |  |  |  |  |  |  |

Note: in the weak economy, the company essentially goes bankrupt and cannot fully pay the bond, and equity is left with nothing.

ii. We can replicate the payoffs of the bond with 100 units of security 1 and 80 units of security 2. So the bond's value today is $7900.

iii. The bond's expected return is 13.9240506%.

The bond's risk premium is 2.81293952%. (Note: the positive risk premium indicates it is risky.)

iv. We can replicate the payoffs of the equity with 40 units of security 1 and 0 units of security 2. So the equity's value today is $1400.

v. The equity's expected return is 42.8571%

The equity's risk premium is 31.74603175%

vi. The sum of the bond and equity values is $7900 + $1400 = $9300

So the sum of the bond and equity values is simply the value of the company's assets.

vii.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Weight | Expected Return | | Weight × Expected Return | |
| Bond | 0.849462366 | 13.9240506% |  | 11.82795699% |  |
| Equity | 0.150537634 | 42.8571% |  | 6.45161290% |  |
|  |  |  | Sum | 18.27956989% |  |
|  |  |  |  |  |  |

The weighted average expected return of the bond and equity is the same as the asset's expected return in (a).