

Corporate Finance, Module 19: Adjusted Present Value

Homework Assignment

(The attached PDF file has better formatting.)

Financial executives decide how to obtain the money needed to operate the firm:

- Whether to raise the money by issuing stock, issuing debt, or other methods, and what percentage of capital should come from each source.
- How to raise the money most efficiently: when to issue debt vs stock, what covenants to put in the bond indenture, when to pay stockholder dividends vs buying back shares.

Some successful actuaries become financial executives: Chief Financial Officers (CFO's), Chief Investment Officers (CIO's), and Risk Management Officers. Almost all actuaries in high corporate positions are expected to know financial theory and recommend optimal financing of the firm.

The textbook examines these issues. Financial economists disagree on several topics in these chapters, and the textbook explains the major viewpoints.

- Before Miller and Modigliani wrote their papers on capital structure, financial analysts believed that increasing the debt-to-equity ratio lowered the average cost of capital and raised the value of the firm.
- Module 17 discusses the Miller and Modigliani proposition that increasing the debt-to-equity ratio in perfect capital markets doesn't affect the value of the firm. The perfect capital markets is a strong condition.
- Module 19 says that increasing the debt-to-equity ratio may raise the value of the firm. Financial economists argue about the effects of taxes, principal agent problems, the costs of bankruptcy, financial slack, and the value of financial signals.

The homework assignment reviews the major capital structure issues. The homework assures that you read the textbook chapter; it is not testing you.

- The final exam problems test the formulas in the module and your ability to apply the proper formula to a scenario.
- The homework assignment guides you through the reasoning in this module.

During past semesters, many candidates posted questions on the discussion forum relating to the homework assignments for this module. These questions have been synthesized and re-written into dialogues between Jacob and Rachel.

- If you understand the concepts in this module, you can write a one or two line answer to each part of the homework assignment, even without reading the dialogue.
- Some concepts are confusing at first. Jacob's questions and Rachel's answers help you understand what the homework assignment wants. Sometimes Rachel's answers contain the answer to the homework question. Your answer need not be more comprehensive than Rachel's. You can re-state Rachel's answer in your own words.
- Rachel's comments discuss many issues. The dialogue does not say which line is the answer to the homework assignment. Once you understand the concepts, you can pick out the proper line. This homework assignment helps you master the concepts.

Homework assignment *Part A*:

A. Explain the view of financial analysts before Miller and Modigliani. Use the following logic:

- Suppose the firm needs \$100 million of capital to conduct its operations, and it returns \$10 million of net earnings (after-tax) each year. If it costs 10% a year to obtain this capital, how much should one pay for

the firm? (Treat the firm as a perpetuity. What is the net present value of this firm at a 10% capitalization rate?)

- If one can obtain the \$100 million of capital for 8% a year, how much should one pay for the firm? (What is the net present value at an 8% capitalization rate?)

Jacob: How do we answer this part of the homework assignment?

Rachel: Part A is straight-forward. An entrepreneur has a business plan for a firm. We need \$100 million of capital, which produces income of \$10 million a year. This is the expected return for firms in this industry, so the cost of capital is 10% per annum. Investors expect a return of 10% per annum for firms with this risk level, so cost to obtain the capital is 10% per annum. The net (income – cost of capital) is zero each year.

Before Modigliani and Miller, investment analysts did not properly associate each set of cash flows with its capitalization rate. Suppose the entrepreneur can raise the \$100 million of capital at a cost of 8% per annum. The dollar cost each year is $8\% \times \$100 \text{ million} = \8 million . The investment analysts assumed the *net* cash flow is \$2 million per annum.

The opportunity cost of capital is the return on the next best use of this capital for a project of similar risk. This project is like other projects in the industry, so the cost of capital is 10% per annum. The value of the project is a perpetuity of \$2 million per annum at a capitalization rate of 10% per annum.

Jacob: You state this logic as though it is incorrect. But this is what firms try to do. If it costs 8% per annum to raise capital, they develop projects that return more than 8% per annum. If the firm has a business plan that returns 10% per annum, it makes a net \$2 million per annum.

Rachel: What you ask is what Brealey and Myers emphasize. If the expected return on capital is 8% per annum, and other firms are earning \$8 million per annum on their investment of \$100 million, each firm works to improve its operations to earn more than \$10 million per annum.

- The firm may develop a better product (Apple with its i-products; Norwegian cell phones).
- The firm may reduce operating expenses (Japan with just-in-time inventory; South Korea and now China with lower cost but highly trained labor; India with low cost professional labor; Walmart with low costs from production through sales).
- The firm may develop more efficient marketing systems (State Farm and Allstate with low cost distribution of auto insurance; Charles Schwab with low cost brokerage services; Amazon with low cost distribution of books and now thousands of other products).

Jacob: Isn't the expected return for a firm equal to the cost of capital for the firm?

Rachel: In a *perfectly competitive market*, the expected return for a firm equals the cost of capital for the firm. No market is perfectly competitive all the time for all firms. A market is perfectly competitive because firms compete by continuously striving to improve their products. If one firm develops a better product or distribution system or lower costs, it gains a competitive advantage for a short while. It makes positive economic income, since its return is greater than the cost of its capital. Other firms in the industry have negative economic income, since they lose business to the innovating firm. Some of these firms exit the industry; others catch up by improving their own products. Eventually the industry returns to a perfectly competitive market.

If these innovations occur sporadically, with long lags, the description above would be fair. In most industries, the innovations occur so rapidly that it is hard to even keep track which firms are heading up and which are heading down. In cellular phones, Motorola was a star innovator one year and a laggard a few years later.

Jacob: What is the relation of this logic to the bond vs stock issue?

Suppose a firm has a 10% cost of equity capital and an 8% cost of debt capital. The shareholders paid in \$100 million to start the firm. They can issue debt at 8%. If they re-finance half the firm with debt, what the increase in their wealth?

Use the following steps:

- The firm earns \$10 million a year. Its opportunity cost of capital is 10% per annum. The present value of the future cash flows is $\$10 \text{ million} / 10\% = \100 million .
- If the firm issues debt for \$50 million, it pays coupons of $8\% \times \$50 \text{ million} = \4 million each year. Its net cash flow is $\$10 \text{ million} - \$4 \text{ million} = \$6 \text{ million}$. Its present value is $\$6 \text{ million} / 10\% = \60 million . The firm also has \$50 million in the bank from its debt issue, so the total value to the shareholders is $\$60 \text{ million} + \$50 \text{ million} = \$110 \text{ million}$.

The firm created \$10 million for its shareholders by re-financing with \$50 million of debt.

Jacob: This reasoning sounds good. What's wrong with it? Can you explain the Modigliani and Miller thesis with a simple illustration?

Rachel: Looking back (50 years after Modigliani and Miller wrote their papers), it is easy to see what is wrong. Miller uses a pizza illustration, which many authors have adopted. You have read the pizza illustration, the arbitrage argument, and the explanation in the textbook. Let's use another example, which is simpler to grasp.

Joseph buys \$1,000 of stocks which yield 15% per annum. The expected return is \$150 a year.

Joseph is not satisfied with \$150 a year. He goes to a bank and borrows another \$1,000, using the \$1,000 of stock that he just bought as collateral. He invests the second \$1,000 in the same stocks. The total expected return is \$300 a year. Joseph pays \$80 a year to the bank and receives (net) \$220 a year, for a 22% return on the original \$1,000 of capital.

Joseph is pleased with this financial arrangement. He returns to the bank to borrow another \$1,000, using the second set of stocks as collateral. He goes back and forth from the bank to the stock broker, using each set of stocks he buys as collateral for a new loan.

After 100 loans, Joseph has

- $\$1,000 + 100 \times \$1,000 = \$101,000$ invested in stocks, with an expected return of $15\% \times \$101,000 = \$15,150$ each year.
- Interest payments of $8\% \times 100 \times \$1,000 = \$8,000$ to the bank each year.
- Net income of $\$15,150 - \$8,000 = \$7,150$ each year.
- An annual return of 715%.

Jacob: This is not realistic. The bank wouldn't lend \$100,000 to Joseph.

Rachel: The bank realizes that Joseph has assumed enormous risk. If the stocks decline 20%, Joseph's collateral is worth \$80,000 for a total loan of \$100,000.

We analyze Joseph's risk and expected return. We don't want the bank to assume Joseph's risk, so suppose Joseph has a \$200,000 home, which he uses as collateral for the loans.

Jacob: If the bank gives Joseph the loan, Joseph has a wonderful return. This seems like an excellent investment opportunity. Take \$1,000 of cash, borrow another \$100,000 from a bank (with your house as collateral), and make a 715% net annual return in the stock market.

Rachel: Joseph's risk is commensurate with the return. Suppose the risk-free interest rate is 8%, the market risk premium is 7%, and the stocks have a CAPM beta of 1.00.

- A 1% decline in the stock price causes a loss to Joseph of $1\% \times \$101,000 = \$1,010$.
- Joseph has invested \$1,000 of his own money, so this is a 101% loss.
- The CAPM beta of Joseph's project is $101 \times 1.00 = 101.00$.

Jacob: What is the relation of this illustration to the Modigliani and Miller theorem?

Rachel: The illustration shows the leverage of loans.

- Financing half the project by a loan doubles the beta for the half financed by equity.
- Financing 99% of the project by loans multiplies by 100 the beta for the 1% financed by equity.

Jacob: Your answer is about CAPM betas; my question is about shareholders' wealth.

Rachel: The required return for shareholders is 10% if the firm has no debt. The risk-free interest rate is 8% in this illustration (the return on the debt). If the shareholders finance half the project with debt, the beta for the stock doubles, and their required return is 12%.

In this illustration, the shareholders get a net \$6 million expected return each year. The value of this perpetuity at a 12% opportunity cost of capital is $\$6 \text{ million} / 12\% = \50 million . The shareholders wealth remains $\$50 \text{ million} + \$50 \text{ million} = \$100 \text{ million}$ after receiving the \$50 million from the issue of debt.

Jacob: Does the Modigliani and Miller theorem depend on the CAPM? If the CAPM is not correct, what happens to the Modigliani and Miller theorem?

Rachel: We use the CAPM to clarify the mathematics of risk. Miller's pizza illustration and the arbitrage arguments for the Modigliani and Miller theorem do not depend on the CAPM.

{*Note to candidates:* The homework assignment for Part A is two lines explaining the pre-Modigliani and Miller view. The Jacob - Rachel dialogue explains the concepts for the other parts of this homework assignment and the rest of the module.)

Homework assignment *Part B*:

- B. Suppose the firm could hire a team of MBA's for \$1.8 million a year, including all wages, benefits, and other costs. The MBA's offer to do one of two things:
- They can implement changes in production operations to increase the net earnings by \$1.5 million a year.
 - They can devise a method to reduce the cost of capital from 10% to 8% by optimizing the percentages of debt and equity in the firm capital structure and using financial derivatives to leverage the lower costs of debt financing.

The MBA team must work anew each year to obtain these benefits, so the \$1.8 million cost is an annual cost. Which use of the MBA team is worthwhile according to the pre-Miller and Modigliani financial analysts? How does this change in the Miller and Modigliani perspective, if capital markets are perfect? For this part of the homework assignment, ignore taxes.

Jacob: The homework assignment doesn't mention how the MBA's accomplish their magic.

Rachel: How they propose to accomplish their work is not the issue. Miller and Modigliani say: It can't be done. Brealey and Myers provide a general rule: in perfect capital markets, we can't improve the firm's wealth by financial legerdemain.

Jacob: Suppose the MBS's find a way to reduce the cost of capital for half the firm's financing from 10% to 6%, giving an 8% average cost of capital.

Rachel: If they reduce the cost for half the financing from 10% to 6%, the cost for the other half rises to 14%. The overall cost of capital remains 10%.

Jacob: Capital markets are not perfect. Corporate income taxes, principal agent problems, signaling, costs of bankruptcy, and the desire for inflation slack are imperfections in capital markets. Does the Modigliani and Miller proposition affect real world financial theory?

Rachel: If we know the size of the imperfections, we can quantify the potential benefits of optimizing the capital structure. We know the personal and corporate income tax rates on stockholder dividends vs interest income. We can't easily measure principal agent problems or the benefits of financial slack, but we can estimate their relative sizes in different industries or scenarios. We can form hypotheses like:

- Hotels should use more debt financing than pharmaceutical firms.
- The reductions in the personal income tax rates on stockholder dividends and capital gains in the early 2000's should reduce the percentage of debt in firms' capital structures.

Some of these hypotheses are supported by empirical data; some are not. The work by Modigliani and Miller helps us test hypotheses about optimizing the wealth of firms.

(*Note to candidates*: Write two sentences for the pre-Modigliani and Miller view and the post-Modigliani and Miller view for this part of the homework assignment.)

Homework assignment *Part C*:

- C. The Miller and Modigliani Proposition applies in perfect financial markets, meaning that the corporate tax rate is zero, the costs of bankruptcy are zero, and there are no principal agent problems. The other friction costs of capital markets are smaller. The corporate tax rate is clear. Explain what is meant by the other two aspects of perfect financial markets listed above: the costs of bankruptcy and principal agent problems. A zero cost of bankruptcy does not mean that bankruptcy does not occur. Some persons lose money when a firm becomes bankrupt, since bankruptcy is defined as the inability to pay one's debts. Explain what Brealey and Myers mean by the costs of bankruptcy. Principal agent problems are complex, and Brealey and Myers gives several illustrations of potential conflicts. Give an example where managers and shareholders have conflicting interests.

Jacob: Is the cost of bankruptcy high or low for insurers?

Rachel: Most assets held by insurers are bonds, mortgages, real estate, and common stock. These assets lose none of their value in bankruptcy.

Jacob: If insurers have low costs of bankruptcy, they should favor debt financing. But insurers are financed by equity, not by debt. Does this imply that the trade-off theory is wrong?

Rachel: Debt does not raise an insurer's statutory surplus. Surplus notes held by mutual insurers and capital notes held by both mutual and stock insurers are exceptions, but these forms of debt are subject to regulatory approval.

But your question contains the germ of its answer. Debt financing is appropriate for insurers, so they have developed several ways of issuing debt: through holding companies, affiliates, and subsidiaries.

(*Note to candidates*: Write two sentences for this part of the homework assignment.)

Homework assignment Part D:

- D. Explain intuitively why Miller and Modigliani are correct. Miller used a pizza analogy: slicing a pizza a different way doesn't change the size of the pizza. We illustrate the theorem by assuming the same providers of capital provide the equity capital and the debt capital. The rigorous explanation uses an arbitrage argument. If you can restate the arbitrage argument that is fine; otherwise, give a non-rigorous intuitive explanation.

Jacob: What is the pizza in the pizza analogy?

Rachel: The pizza is the firm. The stockholders and bondholders who own the firm are the people who eat the pizza

Jacob: The stockholders own the firm; the bondholders are just lenders. Brealey and Myers often imply that both stockholders and bondholders are owners of the firm; why is this?

Rachel: In lay terms, the stockholders own the firm and the bondholders are lenders. For financial economists, both stockholders and bondholders have claims upon the resources of the firm. The law regulates whose claims take precedence (the bondholders) and who (the stockholders) get the left-over pieces after others have received their claims. The pizza analogy says: We can change who picks the first slice or how many slices each person gets, but these rules don't change the size of the pizza.

(Note to candidates: Write one or two sentences for this part of the homework assignment.)

Homework assignment Part E:

- E. If the value of the firm does not change but the providers of equity capital get a higher return on their investment, it must be that their risk has changed. Some readers assume this means that the probability of bankruptcy increases; since the probability of bankruptcy is higher, the shareholders need a higher return. This is not the meaning of higher risk, since only systematic risk warrants a higher return. Explain what Miller and Modigliani mean by higher risk. Use the following logic:
- If bankruptcy is correlated with market returns, bankruptcy might seem like a systematic risk. If this were the intention, the higher risk and higher return would occur only when the risk of bankruptcy is material. Brealey and Myers argue that the increase in the return on equity occurs even if the probability of bankruptcy does not change noticeably.
 - If the firm's income were constant each year, it would have no risk. But firms are risky, meaning that the income is not constant each year.
 - Higher debt means greater volatility in the return to shareholders. If the return to shareholders ranges from 5% to 15% for an all equity financed firm (unlevered firm), it may range from -5% to +25% for a firm that has much debt financing.
 - If the return to shareholders were negatively correlated with market returns, the variability in the firm's return is a hedge against market returns, and the systematic risk is negative. In CAPM terms, the beta of equity would be negative.
 - Explain why we expect the variability in the return to shareholders to be positively correlated with market returns. (Do firms do better in prosperous years or during recessions?) This positive correlation is the increased risk of the firm with debt financing.

Jacob: You imply that a higher probability of bankruptcy doesn't decrease the value of a firm. That is counter-intuitive. The textbook says that if a firm assumes debt, its probability of bankruptcy increases. This reduces the value of the firm, so its share price decreases.

Rachel: Suppose a firm is financed by \$100 million of equity. In good years, the firm earns \$50 million;

- F. Explain why increasing the debt-to-equity ratio increases the value of the firm when the corporate tax rate is positive. Give an intuitive explanation. Three parties have claims on the firm's earnings: creditors, shareholders, and the taxing authorities. If the taxing authorities get less, there is more remaining for the other two parties.

Jacob: This homework assignment emphasizes intuitive explanations. But corporate finance is a mathematical subject; shouldn't we emphasize more rigorous proofs?

Rachel: Miller and Modigliani prove their propositions rigorously, and all the inferences about corporate tax rates and costs of bankruptcy can be explained mathematically. Unless you understand intuitively what these propositions say, the mathematical proofs are not persuasive.

In your business career, you must explain these concepts to other company personnel. Rigorous mathematical theorems are not persuasive to lay persons. To have much effect on other company persons, you must explain these concepts intuitively.

(Note to candidates: Write one or two sentences for this part of the homework assignment.)