Capital Structure

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Introduction

My name is Raghavendra Rau and I'm a professor at the University of Cambridge. This is the third in a series of Gresham lectures this year on the big ideas of finance. The lectures this year are drawn from my textbook A short introduction to corporate finance, published by Cambridge University Press.

As I said before, there are only six major ideas in finance, five of which have won their originators Nobel prizes in economics. What are these ideas?

1. **Net Present Value (NPV):** NPV is the key principle in investment decision-making, where the objective is to maximize the present value of future payoffs. It involves three steps: computing cash flows, discounting those flows to a single present value using a discount rate, and deciding the financing method, which affects taxes.

2. **Portfolio Theory and the Capital Asset Pricing Model (CAPM)**

- The interest rate or discount rate in NPV is determined by investors, based on available investment opportunities. Markowitz and Sharpe, Nobel laureates, proposed that individual investments are parts of portfolios. They combined portfolios with risk-free assets to determine the market portfolio. The discount rate is determined using the CAPM formula.

3. **Capital Structure Theory:**

- This is the idea we are discussing in this lecture. It draws on Chapter 4 of my book. It explains how the discount rate changes based on the firm's financing decision – whether to go with debt or equity. Modigliani and Miller, Nobel winners, posited that in a perfect world, financing form doesn't affect firm value. But with real-world imperfections (like taxes), it does matter. We will cover this in lecture 3.

4. **Option Pricing Theory:**

- Lecture 4 discusses how to price options, which are contracts that give rights to buy or sell assets. Black, Scholes, and Merton, with the latter two winning a Nobel, provided a solution based on the no-free lunch principle. They matched the cost of a portfolio replicating an option's payoff to the option's cost.

5. **Asymmetric Information:**

- Lecture 5 deals with information imbalances in transactions, where one party has more information than the other. Akerlof, Spence, and Stiglitz, Nobel laureates, developed key concepts in this area, illustrating how information imbalances affect markets from used cars to financial policies.

6. **Market Efficiency:**

- The last lecture discusses how markets reflect all available information. The debate lies in the relationship between market prices and NPV. Three Nobel winners, Kahneman, Fama, and Shiller, contributed pioneering ideas on this topic, discussing market behavior and efficiency.

In essence, corporate finance revolves around six central ideas, with five of them recognized by Nobel Prizes.

Why do we need capital structure?

In the first two lectures in this series, we discussed the major inputs into the NPV formula. There were two obvious inputs - the cash flows and the discount rate. There is another non-obvious input – the capital structure of the firm and we will discuss this in this lecture. Why is leverage important? One reason of course is that it increases bankruptcy costs. If a firm has a higher amount of debt, it's seen as having a higher risk of defaulting on its obligations. As a result, investors demand higher returns for taking on this additional risk, leading to a higher discount rate for firms with more leverage. But that is not the whole answer.

Leverage increases risk for equity holders even in the absence of bankruptcy risk. Specifically, the risk to equity goes up with the presence of leverage. But this increase in risk is not due to the possibility of bankruptcy, but rather because the equity base of shareholders becomes a smaller proportion of the total asset base of the firm when leverage is used. This change in proportion magnifies the returns earned by the firm, both positively and negatively. When a firm uses more debt (leverage), the returns on equity can be much higher in good times because the returns are being generated from a smaller equity base. However, this also means that in bad times, the losses are magnified for the same reason. The smaller equity base has to absorb larger proportional swings in returns, making the investment riskier for equity holders.

But how much additional return is being generated by this additional risk? To answer that question, we need to turn to the third big idea in corporate finance – capital structure theory. Franco Modigliani and Merton Miller won the Nobel Prize in Economics in 1985 and 1990 respectively for coming up with this idea. Like all the ideas so far, the intuition is deceptively simple.

Capital structure in perfect and efficient markets.

Modigliani and Miller's fundamental insight was the separation or decoupling of a firm's investment decisions from its financing decisions. Before their work, there was no clear understanding of whether issuing debt was beneficial for firms, as empirical data showed mixed results: some firms benefitted from issuing debt, while others did not.

The key understanding they brought forward was that the effects of issuing debt should not be confused with the outcomes of what the firm does with the money obtained from the debt. In other words, the return on a debt issue depends not just on the act of borrowing but also on how the borrowed funds are invested. If the investment made with the borrowed money has a negative Net Present Value (NPV), then the market will react negatively, not because the firm issued debt, but because of the poor investment decision.

Modigliani and Miller's insight essentially established that the value of a firm is determined by its real assets (investments) and not by the specific mix of how those assets are financed (debt or equity). This concept is fundamental in understanding corporate finance, as it separates investment decisions (what assets to buy) from financing decisions (how to pay for those assets).

Modigliani and Miller made several simplifying assumptions for their model of perfect and efficient capital markets:

1. **Market Efficiency**: They assumed that financial markets were perfectly efficient, meaning that all available information was fully and immediately reflected in asset prices.
2. **Symmetric Information**: All market participants (buyers and sellers) had the same information, eliminating any information asymmetry.
3. **Perfect Competition**: Buyers and sellers could not influence the price of an asset through their individual trading actions, indicating a market where many participants were buying and selling.
4. **No Transaction Costs**: There were no costs associated with buying or selling securities, such as brokerage fees or other expenses.
5. **No Taxes**: The model did not consider any form of taxation, either personal or corporate.
6. **No Bankruptcy Costs**: There were no costs associated with a firm going bankrupt, such as legal fees.

In this idealized setting, Modigliani and Miller's thought experiment focused on firms that either issued debt to buy back shares or issued equity to retire debt. In these cases, the assets of the firm remained unchanged, allowing any changes in the firm's value to be attributed solely to the effects of issuing or retiring debt. The value of an all-equity financed firm in their model is denoted as V_U. This value, V_U, was equal to E_U, the value of its equity. Here, U stands for 'unlevered,' meaning a firm with no debt. This definition was crucial for their analysis as it represented a baseline case of a firm without any leverage (debt). They then decided to examine what happened to this value, call it V_L, when the firm added debt to its capital structure. Here L stands for 'levered'.

Modigliani and Miller sought to answer three key questions in this first set-up of perfect and efficient capital markets:

1. **How does the value of the firm change when it increases its leverage?** This question explores whether the levered value of the firm (V_L) is different from its unlevered value (V_U). Since the assets of the firm remain identical in both scenarios, any difference in value would imply that debt itself has some intrinsic value.
2. **How does the expected rate of return on equity (r_E) change when the debt-to-equity ratio changes?** In a scenario where there is no debt, the expected rate of return on equity is denoted as r_0. This question investigates whether this rate of return changes when the firm increases its leverage.
3. **What happens to the firm's overall cost of capital, its Weighted Average Cost of Capital (WACC), as the firm increases its leverage?** This question is concerned with understanding whether the firm's cost of capital is affected by an increase in debt, given that the WACC is a combination of the cost of debt and the cost of equity.

Their answers were simple and quite unexpected. They came up with three propositions:

1. **Change in Firm Value with Leverage**: Their first proposition stated that in a perfect and efficient capital market (where there are no taxes and no bankruptcy costs), the value of a levered firm (V_L) is the same as that of an unlevered firm (V_U). This means that debt is irrelevant in determining a firm's value under these conditions.
2. **Change in Expected Rate of Return on Equity with Leverage**: Their second proposition acknowledged that shareholders bear more risk when debt is introduced, as debt must be paid off before equity holders are compensated. As a result, the rate of return demanded by shareholders increases with the presence of debt ($r_E > r_0$).
3. **Change in the Firm's Overall Cost of Capital with Leverage**: The final proposition stated that while shareholders demand higher expected returns due to increased risk from leverage, this is offset by the lower returns demanded by bondholders. Consequently, the firm's overall cost of capital (WACC) remains the same as before leveraging ($WACC = r_0$). This reflects the principle of no arbitrage or the idea that there's no free lunch in financial markets.

To explain proposition I intuitively, let's consider an example. Suppose there are two firms that each generate £100 in earnings before interest and taxes (EBIT) annually. One firm is financed entirely with equity (unlevered), and the other has some level of debt (levered).

1. **For the Unlevered Firm**: If you own 10% of this firm, your share of the equity costs 10% of V_U (the value of the firm) and returns £10 as dividends (10% of the EBIT), since there are no taxes.
2. **For the Levered Firm**: Owning 10% of the equity and 10% of the debt of this firm costs 10% of V_L (the value of the levered firm). If the firm has issued £100 of perpetual debt at a 5% interest rate, it must pay £5 in interest (5% of $100). This leaves £95 in EBIT for equity holders. As a 10% shareholder, you would receive £9.5 as dividends (10% of $95) and £0.5 as interest (10% of £5).

The overall value to shareholders remains the same whether the firm is levered or unlevered. The interest rate or the amount of debt issued is irrelevant in this context. The total returns to the shareholders (from dividends in the unlevered firm or a combination of dividends and debt payments in the levered firm) are the same in both cases, thus making the firm's value unaffected by its capital structure under these ideal market conditions.

Modigliani and Miller's second proposition addresses how the risk to equity holders changes with the presence of leverage, even in perfect and efficient capital markets where bankruptcy is not a concern. The proposition asserts that the risk to equity increases when a firm uses leverage (debt).

The core idea is that when a firm takes on debt, the equity base of the shareholders becomes a smaller proportion of the firm's total asset base. This change in proportion means that equity holders are exposed to a magnified impact of the firm's returns. If the firm performs well, the returns on equity are amplified because they're generated from a smaller equity base. Conversely, if the firm performs poorly, the losses are also magnified for the same reason.

The proposition is represented by the formula:

$$r_E = r_0 + (r_0 - r_D)\frac{D}{E}$$

where:

- r_E is the expected rate of return on equity.
- r_0 is the expected rate of return on assets (or the firm's unlevered cost of equity).
- r_D is the cost of debt.
- D/E is the debt-to-equity ratio.

This formula captures the idea that as a firm increases its leverage, the expected return on equity also increases because equity holders demand a higher return for the increased risk they are taking on. The increase in risk is not due to bankruptcy, but because of the leveraged amplification of returns (either positive or negative) due to the reduced equity base relative to the firm's total assets.

Modigliani and Miller's third proposition states that in a perfect and efficient capital market, the firm's overall cost of capital, known as the Weighted Average Cost of Capital (WACC), remains constant even as the firm increases its leverage (uses more debt).

Here is an intuitive explanation of this proposition:

1. **Increasing Debt Increases Equity Risk**: When a firm increases its debt, the risk borne by shareholders increases because debt has to be paid off before equity. Therefore, shareholders demand a higher rate of return ($r_E > r_0$) to compensate for this increased risk (see proposition II).
2. **Bondholders Demand Lower Returns**: On the other hand, bondholders (the lenders) demand lower returns than equity holders. This is because debt is generally less risky than equity; it has a higher claim on the firm's assets and income.
3. **Balancing Effect**: The increased return demanded by shareholders is offset by the lower returns demanded by bondholders. As a result, the overall cost of capital for the firm remains the same, even when it uses more debt. In mathematical terms, this means that WACC= r_0, where r_0 is the cost of capital for an unlevered firm.

The essence of Modigliani and Miller's proof lies in the principle of no arbitrage, or the concept that there is no free lunch in financial markets. This principle implies that the value of a levered firm should be the same as an unlevered firm because investors can replicate the effects of leverage on their own if it were to offer any advantage. Thus, the overall cost of capital remains unchanged regardless of how much debt the firm takes on.

Capital structure with corporate taxes.

In the presence of corporate taxes, Modigliani and Miller developed three propositions that modify their earlier conclusions for perfect and efficient capital markets. Here they are, simplified:

1. **Tax Advantage of Debt**: In a world with corporate taxes, their first proposition states that there is a tax advantage to using debt over equity. This is because interest payments on debt are tax-

deductible, effectively reducing the firm's taxable income and thus its tax burden. The more debt a firm has, the less tax it pays, making debt a more attractive financing option compared to equity.

2. **Change in Expected Rate of Return on Equity**: Similar to the scenario without taxes, they looked at how the expected rate of return on equity (r_E) changes when the firm leverages up. The general idea in the presence of taxes is that the rate of return on equity still increases with leverage due to the increased risk; however, the tax shield provided by debt issuance partly offsets this increase.
3. **Impact on Firm's Overall Cost of Capital (WACC)**: The final question concerns the firm's overall cost of capital, or WACC, as it increases its leverage. In a corporate tax environment, the WACC is affected by the tax deductibility of interest payments. This means that as a firm takes on more debt, its WACC may decrease because the tax shield provided by the debt reduces the effective cost of borrowing. This differs from the no-tax scenario, where WACC remained constant irrespective of leverage.

These propositions collectively indicate that, in a corporate tax environment, debt financing can be more beneficial for a firm compared to a perfect market without taxes, primarily due to the tax advantages associated with debt.

More specifically, Modigliani and Miller's Proposition I in the presence of corporate taxes essentially states that the value of a firm increases with the amount of debt it takes on. This can be represented by the formula:

$$V_L = V_U + \tau_C \quad D$$

where

- $\mathbf{V_L}$ represents the value of a levered firm (a firm with debt).
- $\mathbf{V_U}$ represents the value of an unlevered firm (a firm without debt).
- $\boldsymbol{\tau_C}$ is the corporate tax rate.
- **D** is the amount of debt.

The reason behind this increase in value is the tax-deductible nature of interest on debt. When a firm pays interest on its debt, this amount is deducted before taxes are calculated on its profits. Therefore, by having debt, a firm reduces its taxable income, leading to lower tax payments. This tax saving, known as a tax shield, effectively increases the value of the firm because less of its income is taken away as taxes.

In other words, when a firm borrows money, not only does it get the money from the loan, but it also pays less in taxes because the interest it pays on the loan reduces its taxable income. This tax benefit increases the firm's overall value compared to a situation where it had no debt. Therefore, according to Modigliani and Miller, in a world with corporate taxes, debt financing has a clear advantage over equity financing due to this tax shield effect.

Capital structure with corporate and personal taxes.

When considering personal taxes in addition to corporate taxes, Modigliani and Miller's propositions would be modified to account for the impact of these taxes on the firm’s capital structure. However, the specific impact of personal taxes on their propositions is not straightforward and is more complex to pin down. Here's a general idea of how personal taxes could alter the propositions:

1. **Effect on Tax Shield**: The tax advantage of debt (the tax shield) that exists in a corporate tax environment might be reduced when personal taxes are considered. This is because investors, who are subject to personal taxes, may view the benefits of the corporate tax shield differently. The attractiveness of the tax shield provided by debt might be less compelling when personal taxes on interest income are taken into account.
2. **Investor Behaviour and Firm Valuation**: The preferences and tax situations of individual investors can influence their investment decisions and, consequently, the firm's capital structure. For instance, if a significant portion of investors are tax-exempt entities (like certain pension funds or endowments), they might not be as sensitive to the tax advantages of debt, which could influence the firm's decision on how much debt to use.

3. **Stability of Leverage Ratios**: The presence of personal taxes can contribute to the stability of leverage ratios observed in real-world firms. While debt offers a tax shield at the corporate level, the benefits might be offset by personal taxes, leading firms to balance the use of debt and equity in a way that optimizes their overall tax burden.

Hence, the introduction of personal taxes adds a layer of complexity to Modigliani and Miller's propositions. It affects how investors view the benefits of debt and can influence a firm's capital structure decisions. However, the exact modification to the propositions depends on the specific tax rates and regulations in place, as well as the tax status of the firm's investors.

The tradeoff hypothesis

If debt is so advantageous as a tax shield, why don't firms issue as much debt as possible? We rarely see firms with a 99% debt-equity ratio. Across the cross-section, many firms in fact have a pretty stable ratio. To explain why some firms have stable leverage ratios, we introduce the third major imperfection: bankruptcy costs.

The trade-off hypothesis in corporate finance suggests that firms balance the benefits and costs of debt to determine their optimal level of debt. Here's a simple breakdown of this idea:

1. **Benefits of Debt - Tax Shields**: One of the main advantages of using debt is the tax shield it provides. When a firm takes on debt, the interest it pays on this debt is tax-deductible. This reduces the firm's taxable income and, as a result, its tax liability. This tax saving is a significant benefit of using debt.
2. **Costs of Debt - Financial Distress Costs**: However, debt also comes with costs. The primary cost is the risk of financial distress. As a firm takes on more debt, the risk of not being able to meet its debt obligations (interest payments and principal repayment) increases. This risk can lead to financial distress or even bankruptcy. Financial distress costs can include legal fees, a loss of customer and supplier trust, and the disruption of normal business operations.
3. **Finding the Optimal Balance**: The trade-off hypothesis argues that there is an optimal amount of debt that a firm should have. This optimal level is where the benefit of the tax shield from additional debt is just balanced by the increase in financial distress costs. However, determining this exact optimal point is challenging. Financial economists don't have a clear formula for calculating the value of financial distress costs at different levels of debt, so firms often determine their target debt ratio through trial and error. Managers might have a target debt ratio in mind, but it's often based on a rough estimate rather than a precise calculation.

In practice, this hypothesis can help explain why different industries have varying levels of debt. For example, high-tech industries, which often have a lot of intangible assets and potentially more volatile earnings, tend to use less debt to avoid the high costs of financial distress.

Unfortunately, the trade-off hypothesis, while useful in explaining certain aspects of corporate capital structure, leaves some important observations unexplained. The trade-off hypothesis suggests that firms with low financial distress costs should leverage the tax shield benefits of debt to enhance their value. However, in reality, there are many highly successful and profitable companies that maintain very low levels of debt despite having low financial distress costs. This poses a question: why do these firms forego the apparent benefits of debt, such as the tax shield, which could potentially increase their value?

To address this question, finance academics typically turn to another model, the pecking order hypothesis. This hypothesis suggests that firms' capital structure decisions are influenced by asymmetric information, where internal managers have more information than external investors. The pecking order hypothesis provides an alternative explanation for why some firms might prefer equity over debt, or retain earnings instead of raising new capital, even when they could potentially benefit from the tax advantages of debt. We will discuss asymmetric information in lecture 6.

References and Further Reading

Modigliani, Franco, and Merton H. Miller, 1958, The cost of capital, corporation finance and the theory of investment, *American Economic Review* 48, 261-297.

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