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# How Derivatives Affect the Capital Structure and Cost of Capital of Financial Companies

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# Abstract

Our thesis' main goal is to understand how financial derivatives affect the capital structure and cost of capital of financial companies.
The reason for this study is that in today's financial industry, there is a high dependence on complex financial instruments like derivatives, rather than physical assets.
As a matter of fact, as we will see from their balance sheet, financial companies' operations are driven by equity, bonds, derivatives, and other financial instruments. Consequently, it is, in our opinion, crucial to better assess how these instruments impact financial stability, risk management strategies, and the strategic allocation of capital (Hull, 2018).
In particular, financial derivatives are our main focus, due to their crucial role on market stability and the economic well-being of financial companies.

To conduct the study, we will begin with an overview of the financial statements of two different companies: an asset-heavy company and a financial company. This will allow us to show the differences in the respective industries and operations.
By analyzing these two balance sheets we will also focus on how derivatives are disclosed, how they are used, and their interaction with key financial ratios, such as the debt-to-equity ratio, and the equity-to-total assets ratio. The analysis' ultimate goal is to analyze how derivatives are used, emphasizing their strategic importance and variability among firms.

After that, we will analyze the composition of the bank's capital structure, examining leverage ratios such as the equity-to-total assets ratio, the debt-to-equity ratio and the percentage of total liabilities derivatives over total assets.
In particular, our focus will be on how derivatives affect these ratios, and study their use in hedging financial risks, which helps to decrease exposure, and speculation, which on the other hand increases financial exposure.
Ultimately, the thesis is designed to assess how the capital structure of financial companies affects their cost of capital. Since we will first study how derivatives affect the capital structure, we will also understand how these financial instruments modify the weighted average cost of capital.

Additionally, to provide a deeper practical perspective, we will analyze derivatives liabilities of the 35 biggest banks, and from there we will perform an econometric analysis. This analysis will be performed through two regression analyses.
The first regression will have as the dependent variable the Equity-to-Total Assets Ratio, and as the main explanatory variable the total liabilities from derivatives. The control variables in this case will be the D/E ratio and the percentage of exposure to derivatives with respect to total assets. The second regression will have as the dependent variable the WACC and as the main explanatory variable the Equity-to-Total Assets Ratio, and the other variables as control variables. These two regression models will allow us to perform a comparative exploration of how derivatives affect the capital structure, analyzing their challenges and benefits derived from their use (Stulz, 2004).

Finally, our ultimate goal will be to identify the optimal level of derivatives that a financial company should keep to efficiently manage its financial stability, focusing in particular on the impact on the capital structure and cost of capital.

# INTRODUCTION

The capital structure is one of the most important decisions that a company must take to improve and maximize profitability. Indeed, each company should choose the set of securities it will issue to raise capital from the investors. This decision determines the firm's capital structure, which is the total amount of debt, equity, and other securities that a firm has outstanding.

This decision changes depending on the industry and the type of company. Companies with a significant number of fixed assets will have different needs compared to banks and financial institutions. Our goal is to focus on the latter, which are known as financial companies.
Financial companies have little to no fixed assets in their balance sheets. Instead, they have a considerable number of financial instruments, with which they trade daily and which are the main source of liquidity and profitability.

These financial instruments are the ones which constitute at the end the capital structure of financial companies. Among them, we find cash and monetary funds (which are highly liquid), bonds, equity, and derivatives.
We will focus on the last financial instrument listed, derivatives, which have many particular characteristics. They can be used for various reasons, from hedging to speculation, and they are becoming more and more important in the financial industry.
In particular, we will study in depth this kind of instrument, and how it affects the financial statements and the capital structure.

We will perform this analysis firstly by analyzing the amount of derivatives in the financial statements of two different companies operating in different industries.
Then, we will look at the amount of derivatives liabilities of the 29 G-SIBs banks plus 6 other important global banks. After building the dataset, we will perform two regression analyses to study the relationship between derivatives, capital structure and cost of capital.

From this, we will be able to see how the capital structure of these companies differs, and how it affects key financial parameters concerning profitability and cost of capital.
In order to achieve this, the study will be divided into two parts; the first part will focus on analyzing the financial statements of the companies, as well as the capital structure and the cost

of capital.
Indeed, in the first chapter we will introduce the financial statements and the balance sheet of the two companies that we will take into consideration. Then we will introduce the definition of derivatives and the different kinds of financial derivatives. We will also define which type of derivatives are used by the companies under consideration.

In the second chapter we will define the main profitability ratios, how the capital structure is composed, and its implications. We will analyze the capital structure composition theory and the importance of leverage, including the most important ratios, such as the debt ratio and the debt-to-equity ratio.
We will then look at the definition of cost of capital, and how it is composed and calculated. Finally we will define how derivatives affect this key financial parameter.

In the second part, we will take a more dynamic approach. In chapter three we will define our dataset and its main variables, so that we can perform the regression analyses, which will help us to study the relationships between our variables. From this we will understand the differences in banks' cost of capital and profitability when taking on financial derivatives.

In chapter four, we will discuss our main findings of the study, measuring how derivatives modify the cost of capital of our financial companies.
To achieve this, we will take into consideration all the formulas and definitions from the previous chapters, particularly focusing on the current and updated data of the companies taken into consideration.

We will conclude the thesis by suggesting how banks can obtain an efficient and low cost of capital, while still exploiting the benefits of using financial derivatives to maximize returns and minimize risk.

# PART I - THEORETICAL FRAMEWORK

# CHAPTER I - ACCOUNTING AND DERIVATIVES

How do investors learn enough about a company in order to analyze and value it?
Firms issue financial statements regularly to communicate financial information to investors. Financial statements are accounting reports with past performance information that a firm issues periodically (Berk, DeMarzo, 2019).

## 1.1 - The Importance of Financial Statements

U.S. public companies are required to file their financial statements with the U.S.Securities and Exchange Commission (SEC) on a quarterly or annual basis, on form 10-K. These reports ensure transparency and regulatory compliance.
Companies must also send an annual report, which is a document where it is possible to find a comprehensive overview of the company's financial health, including key financial statements, management's discussion and analysis, and detailed notes explaining the figures.
The annual report is then sent to the shareholders.

Annual reports are essential tools for investors, analysts, and other stakeholders, as they are used to help them assess a company's financial stability, growth potential, and overall strategy. Through the annual report we can start to analyze the operations and the position of the company we are taking into account. This is because, as stated above, this document contains key details concerning the preparation and analysis of the financial statements.

Regardless of the size or industry in which a company operates, there are many benefits of reading, analyzing, and understanding its balance sheet.
This is because firstly, balance sheets help to determine risk. This financial statement lists everything a company owns and all of its debt. A company will be able to quickly assess whether it has borrowed too much money, whether the assets it owns are not liquid enough, or whether it has enough cash on hand to meet current demands.

Balance sheets are also used to secure capital. Usually, to get a business loan, a company must send a balance sheet to the lender. Moreover, a corporation also gives a balance sheet to private investors trying to get private equity money.

Given their different business models and financial structures, the balance sheet is essential in our study to define the differences between asset-heavy companies, which use few financial instruments in their operations, and financial enterprises, which instead use a high volume of derivatives in their operations.
Consequently, from an accounting perspective, it is clear that the nature of their assets and operations is distinct.

Financial companies, also known as financial institutions, mainly deal with monetary transactions, such as lending, investing, and managing deposits. Consequently, their value is largely tied to financial assets rather than physical ones.
According to the Financial Crimes Enforcement Network (FinCEN), the term "financial institution" includes banks, securities brokers and dealers, money services businesses, and other entities that facilitate financial transactions.

On the other hand, asset-heavy companies, such as manufacturing firms, real estate developers, and infrastructure companies, are businesses that require substantial investments in physical assets to operate. The industry in which they operate is defined as heavy industry, which is a type of business that typically carries a high capital cost (capital-intensive), high barriers to entry, and low transportability. These companies often have high capital expenditures and rely heavily on their tangible assets to generate revenue.

The difference between financial companies and asset-heavy businesses becomes especially clear when examining the most important financial statement: the balance sheet.
Indeed, every public company is required to produce four financial statements: the balance sheet, the income statement, the statement of cash flows, and the statement of stockholders' equity.

The balance sheet, or statement of financial position, is a financial statement that records company assets, liabilities and shareholders' equity at a specific point in time and it is considered as a basis for computing rates of return and evaluating the capital structure of the company. By looking at the balance sheet it is possible to have an overview of what the company owns and owes as well as the amount invested by the shareholders.

When looking at the balance sheet, we can find the assets on the left side, comprising cash, inventory, property, equipment, and investments (among which we find derivatives) and on the right side the liabilities. Also shown on the right side of the balance sheet is the stockholders' equity, which is equal to the difference between the firm's assets and liabilities, and it is a measure of net worth. Investors can get a sense of a company's financial well-being by using a number of ratios that can be derived from a balance sheet, such as the debt-to-equity ratio, which will be analyzed in the following chapters.

Since it shows the degree of financial instrument exposure, and derivatives, that banks and other institutions hold, the balance sheet composition of a financial organisation is crucial for our study. Understanding this financial exposure is critical in assessing banks' risk, stability, and financial health.

In our study, the balance sheet has another important characteristic, since it is the document where we can analyze a firm's capital structure. In fact, we find information about the proportion of debt, equity, and financial instruments used by the company in its operations. From here, we can analyze the consequences of derivatives liabilities on the capital structure and cost of capital.

## 1.2 - The Balance Sheet

In order to better illustrate the differences between these two types of companies, we will make a practical example, and analyze the balance sheet of two companies: ExxonMobil and Goldman Sachs.

ExxonMobil operates in the oil and gas industry and it is considered one of the largest asset-heavy companies in the world. This characteristic can be seen in its balance sheet, where it is clear that ExxonMobil heavily relies on physical assets like refineries, drilling equipment, and infrastructure.

On the other hand, Goldman Sachs is one of the biggest investment banks in the world, and so it is a perfect example of a financial company. Indeed, its day-to-day activities are managing mergers and acquisitions, financial assets, and financial instruments like derivatives.

By comparing their balance sheets, we can analyze how their business models influence the way they structure and manage their assets, liabilities, and capital.
The consolidated balance sheets of both companies are shown below. Figure 1.1 presents ExxonMobil’s balance sheet, which offers a clear illustration of how asset-heavy companies structure their finances.

ExxonMobil's most valued asset, PPE, is equal to $214.94 billion of its $376.32 billion total assets, as shown in Figure 1.1. Consequently, PPE is about 57% of the business's total assets. This percentage makes us understand the importance of physical assets for this kind of company, which are essential for ExxonMobil’s operations, since it distributes oil products worldwide. As a matter of fact, PPE in this case includes assets like oil rigs, refineries, pipelines, and production facilities.

Figure 1.1 - Balance Sheet ExxonMobil

**CONSOLIDATED BALANCE SHEET**

| *(millions of dollars)* | Note Reference Number | December 31, 2023 | December 31, 2022 |
|---|---|---|---|
| **ASSETS** | | | |
| **Current assets** | | | |
| Cash and cash equivalents | | 31,539 | 29,640 |
| Cash and cash equivalents – restricted | | 29 | 25 |
| Notes and accounts receivable – net | 6 | 38,015 | 41,749 |
| Inventories | | | |
| Crude oil, products and merchandise | 3 | 20,528 | 20,434 |
| Materials and supplies | | 4,592 | 4,001 |
| Other current assets | | 1,906 | 1,782 |
| **Total current assets** | | **96,609** | **97,631** |
| Investments, advances and long-term receivables | 8 | 47,630 | 49,793 |
| Property, plant and equipment, at cost, less accumulated depreciation and depletion | 9 | 214,940 | 204,692 |
| Other assets, including intangibles – net | | 17,138 | 16,951 |
| **Total Assets** | | **376,317** | **369,067** |
| **LIABILITIES** | | | |
| **Current liabilities** | | | |
| Notes and loans payable | 6 | 4,090 | 634 |
| Accounts payable and accrued liabilities | 6 | 58,037 | 63,197 |
| Income taxes payable | | 3,189 | 5,214 |
| **Total current liabilities** | | **65,316** | **69,045** |
| Long-term debt | 14 | 37,483 | 40,559 |
| Postretirement benefits reserves | 17 | 10,496 | 10,045 |
| Deferred income tax liabilities | 19 | 24,452 | 22,874 |
| Long-term obligations to equity companies | | 1,804 | 2,338 |
| Other long-term obligations | | 24,228 | 21,733 |
| **Total Liabilities** | | **163,779** | **166,594** |
| Commitments and contingencies | 16 | | |
| **EQUITY** | | | |
| Common stock without par value (9,000 million shares authorized, 8,019 million shares issued) | | 17,781 | 15,752 |
| Earnings reinvested | | 453,927 | 432,860 |
| Accumulated other comprehensive income | 4 | (11,989) | (13,270) |
| Common stock held in treasury (4,048 million shares in 2023 and 3,937 million shares in 2022) | | (254,917) | (240,293) |
| **ExxonMobil share of equity** | | **204,802** | **195,049** |
| Noncontrolling interests | | 7,736 | 7,424 |
| **Total Equity** | | **212,538** | **202,473** |
| **Total Liabilities and Equity** | | **376,317** | **369,067** |

*The information in the Notes to Consolidated Financial Statements is an integral part of these statements.*

Other than PPE, also other assets, such as inventory, mainly consist of physical goods, and include crude oil, refined products, and raw materials. Consequently, the company's total tangible assets percentage is even higher than that represented by PPE. In contrast, financial investments and instruments are less used, and represent a minor part of the asset structure. Total investments, excluding cash, amount to 12.5% of total assets, and so they are significantly lower than PPE, confirming the secondary role played by financial instruments in this type of company's operations.

As a matter of fact, asset-heavy companies generate profit mainly through physical resources rather than financial instruments. As we will see, this balance sheet is different compared to that of financial institutions, which is based on investments and financial transactions.

Turning to Figure 1.2, we can now study Goldman Sachs' consolidated balance sheet, which provides a dramatic contrast to ExxonMobil's one. Compared to it, Goldman Sachs', one of the top financial organisations worldwide, runs with a completely distinct asset structure, and this is clearly shown on its balance sheet.

Indeed, unlike ExxonMobil, physical assets play an almost nonexistent role in Goldman Sachs's financial structure. The company does not rely on factories, machinery, or inventory to generate revenue.
Physical assets are included in the voice "Other assets", where we can find office buildings and some equipment. However, they represent only a portion of the "Other assets" which is already a secondary voice and contains a small number of assets, compared to the total.

If we analyze the numbers, we see that physical assets account for just $36.59 billion out of Goldman Sachs' total $1,641.59 billion in assets, making up a mere 2.23% of the company's total asset base. However, this amount of physical assets does not generate value or profit to the bank, so even this small percentage does not modify the structure of its operations.

As introduced above, it is important to recognize that the $36.59 billion is classified under "Other assets," a category that includes various non-core financial items in addition to physical assets. This means that the actual portion of purely physical assets, composed of office buildings, IT infrastructure, and equipment, is even lower than the reported 2.23%.

In contrast, the majority of Goldman Sachs' balance sheet consists of financial assets, as shown in figure 1.2, and it includes securities, trading assets, investments, and loans. These are the main financial instruments traded by the intermediary, and they represent the majority of the assets seen in the balance sheet.

This characteristic shows the main source of profit for banks, which do not generate profits from physical infrastructure like factories or equipment. Instead, their business revolves around financial transactions, such as managing deposits, executing M&A deals, making investments, and engaging in commercial banking activities.

A key point that can be made after analyzing banks' financial statements is that they are vulnerable to changes in the market. The reason is that financial institutions' operations are based on market and interest rate movements, and while this dynamic market makes them highly profitable, it also exposes them to external economic conditions.

Figure 1.2 - Balance Sheet Goldman Sachs

THE GOLDMAN SACHS GROUP, INC. AND SUBSIDIARIES

**Consolidated Balance Sheets**

| | As of December | |
|---|---|---|
| *$ in millions* | **2023** | 2022 |
| **Assets** | | |
| Cash and cash equivalents | **$ 241,577** | $ 241,825 |
| Collateralized agreements: | | |
| Securities purchased under agreements to resell (includes **$223,543** and $225,117 at fair value) | **223,805** | 225,117 |
| Securities borrowed (includes **$44,930** and $38,578 at fair value) | **199,420** | 189,041 |
| Customer and other receivables (includes **$23** and $25 at fair value) | **132,495** | 135,448 |
| Trading assets (at fair value and includes **$110,567** and $40,143 pledged as collateral) | **477,510** | 301,245 |
| Investments (includes **$75,767** and $78,201 at fair value) | **146,839** | 130,629 |
| Loans (net of allowance of **$5,050** and $5,543, and includes **$6,506** and $7,655 at fair value) | **183,358** | 179,286 |
| Other assets (includes **$366** and $145 at fair value) | **36,590** | 39,208 |
| **Total assets** | **$ 1,641,594** | $ 1,441,799 |
| **Liabilities and shareholders' equity** | | |
| Deposits (includes **$29,460** and $15,746 at fair value) | **$ 428,417** | $ 386,665 |
| Collateralized financings: | | |
| Securities sold under agreements to repurchase (at fair value) | **249,887** | 110,349 |
| Securities loaned (includes **$8,934** and $4,372 at fair value) | **60,483** | 30,727 |
| Other secured financings (includes **$12,554** and $12,756 at fair value) | **13,194** | 13,946 |
| Customer and other payables | **230,728** | 262,045 |
| Trading liabilities (at fair value) | **200,355** | 191,324 |
| Unsecured short-term borrowings (includes **$46,127** and $39,731 at fair value) | **75,945** | 60,961 |
| Unsecured long-term borrowings (includes **$86,410** and $73,147 at fair value) | **241,877** | 247,138 |
| Other liabilities (includes **$266** and $159 at fair value) | **23,803** | 21,455 |
| Total liabilities | **1,524,689** | 1,324,610 |
| **Commitments, contingencies and guarantees** | | |
| **Shareholders' equity** | | |
| Preferred stock; aggregate liquidation preference of **$11,203** and $10,703 | **11,203** | 10,703 |
| Common stock; **922,895,030** and 917,815,030 shares issued, and **323,376,354** and 334,918,639 shares outstanding | **9** | 9 |
| Share-based awards | **5,121** | 5,696 |
| Nonvoting common stock; no shares issued and outstanding | **–** | – |
| Additional paid-in capital | **60,247** | 59,050 |
| Retained earnings | **143,688** | 139,372 |
| Accumulated other comprehensive loss | **(2,918)** | (3,010) |
| Stock held in treasury, at cost; **599,518,678** and 582,896,393 shares | **(100,445)** | (94,631) |
| Total shareholders' equity | **116,905** | 117,189 |
| **Total liabilities and shareholders' equity** | **$ 1,641,594** | $ 1,441,799 |

## 1.3 - Derivatives

As stated above, our study focuses on a specific type of financial instruments, derivatives, which are fundamental for the operation of financial institutions. As we saw in the previous section, where we analyzed the balance sheets of ExxonMobil and Goldman Sachs, derivatives exposure differs depending on the industry.

However, by looking at the balance sheet in Figure 1.2, we do not see the voice "derivatives" since they are not explicitly listed as a separate item. This does not mean that they are absent. As a matter of fact, some companies report their financial assets and liabilities in the notes to the consolidated balance sheet, and here we can analyze derivatives exposure, where each item is broken down, analyzed, and explained in depth.
By looking at the notes, we would see that Goldman Sachs is heavily involved in derivatives trading, and this type of financial instrument is very important for their operations.

As a matter of fact, if we look at Figure 1.2, we find, looking at the notes, that a significant portion of the balance sheet, including securities, investments, loans, and trading assets, is mostly made up of derivatives. The same occurs for liabilities, which will be our focus since from here we can understand how derivatives affect the firm's overall exposure and risk profile.

But what are derivatives? Derivatives can be defined as a financial instrument whose value depends on (or derives from) the values of other, more basic, underlying variables. A stock option, for example, is a derivative whose value is dependent on the price of a stock.

Derivatives' value can depend on different variables, such as interest rates, bonds, foreign exchange, commodities, equities or index of asset values.
This is clearly seen in Figure 1.3, where we can look at gross fair value and notional amounts of Goldman Sachs' derivative contracts by major product type. Here the main types of derivatives are interest rate, credit, currency, commodities, and equities.

Figure 1.3 - Derivatives Exposure Goldman Sachs

| | As of December 2023 | | As of December 2022 | |
|---|---|---|---|---|
| *$ in millions* | **Derivative Assets** | **Derivative Liabilities** | Derivative Assets | Derivative Liabilities |
| **Not accounted for as hedges** | | | | |
| Exchange-traded | **$ 3,401** | **$ 1,129** | $ 675 | $ 1,385 |
| OTC-cleared | **67,815** | **64,490** | 74,297 | 72,979 |
| Bilateral OTC | **171,109** | **149,444** | 195,052 | 174,687 |
| **Total interest rates** | **242,325** | **215,063** | 270,024 | 249,051 |
| OTC-cleared | **1,271** | **1,533** | 1,516 | 1,802 |
| Bilateral OTC | **11,554** | **8,601** | 10,751 | 9,478 |
| **Total credit** | **12,825** | **10,134** | 12,267 | 11,280 |
| Exchange-traded | **708** | **15** | 1,041 | 22 |
| OTC-cleared | **1,033** | **1,632** | 520 | 589 |
| Bilateral OTC | **88,158** | **95,742** | 102,301 | 111,276 |
| **Total currencies** | **89,899** | **97,389** | 103,862 | 111,887 |
| Exchange-traded | **5,468** | **5,998** | 9,225 | 9,542 |
| OTC-cleared | **635** | **711** | 698 | 838 |
| Bilateral OTC | **10,739** | **11,234** | 30,017 | 22,745 |
| **Total commodities** | **16,842** | **17,943** | 39,940 | 33,125 |
| Exchange-traded | **31,315** | **39,247** | 26,302 | 26,607 |
| OTC-cleared | **122** | **171** | 685 | 19 |
| Bilateral OTC | **28,601** | **40,696** | 23,574 | 30,157 |
| **Total equities** | **60,038** | **80,114** | 50,561 | 56,783 |
| **Subtotal** | **421,929** | **420,643** | 476,654 | 462,126 |
| **Accounted for as hedges** | | | | |
| Bilateral OTC | **298** | **9** | 335 | 11 |
| **Total interest rates** | **298** | **9** | 335 | 11 |
| OTC-cleared | **–** | **7** | 29 | 29 |
| Bilateral OTC | **5** | **208** | 53 | 256 |
| **Total currencies** | **5** | **215** | 82 | 285 |
| **Subtotal** | **303** | **224** | 417 | 296 |
| **Total gross fair value** | **$ 422,232** | **$ 420,867** | $ 477,071 | $ 462,422 |

These financial instruments are very useful, especially for risk management practices. Indeed, they can reduce financial risk and hedge against various other exposures. However, they can also be used as investment strategies, to arbitrage, and to speculate.

As a matter of fact, in most cases, derivatives offer significant advantages over traditional securities, providing more flexibility, leverage, and the ability to capitalize on market inefficiencies. These characteristics make them a powerful tool for financial institutions, allowing them to optimize returns and manage risk in a more efficient way compared to traditional instruments.

Derivatives with standardised terms of the contracts are traded on organized exchanges, consequently the features of these contracts are not tailored to the needs of individual buyers and sellers. The quoted prices for this category of contracts are generally publicly available.

## 1.4 - Main types of derivatives

Derivatives have grown in popularity because they offer a combination of characteristics not offered by other assets. Generally we can separate derivatives into three macro categories:

– option-based
– swap-based
– forward-based.

An option is a financial contract that gives the buyer the right (but not the obligation), against payment of a premium, to buy or sell a certain quantity of an underlying asset at a fixed strike price at a future date. In particular, American type options allow the holder to exercise the right to purchase the underlying asset on or before the expiration date, whereas European type options allow for exercise only on the expiration date.

Options are called “asymmetric derivatives”, because of the fact that only the seller is obliged by the contract. The buyer, by paying the premium, is buying the possibility to exercise the options if he wants. Indeed, the holder will exercise the option only if the share price exceeds the strike price. The characteristics and flexibility of options give the possibility to implement different strategies, also depending on the aim pursued by the operator. The three main types of operators in the market are hedgers, arbitrageurs, and speculators.

Hedgers are those who use options to hedge against financial risk. In this case, derivatives are used as a risk management tool, which insures investments from unfavorable market fluctuations. Their main goal is to optimize the risk-return relationship.

Arbitrageurs are those who seek to profit from price asymmetries between different markets, guaranteeing zero risk gains. An example can be an option on a security issued in two different markets at different prices. In this case there is the opportunity for a risk-free gain, also called arbitrage opportunity.

Speculators are those who seek profit in the price changes of the options themselves, taking advantage of the fact that with a single option, and a reduced investment, you control a much higher number of units of the underlying (usually the ratio is 1:100). This is called leverage, and if used properly, it can exponentially increase profits. However, it also increases risk.

The second macro category is represented by forward-based derivatives, which are financial contracts that obligate the involved parties to settle at a predetermined point in the future at a specified price. These agreements define key parameters, including the reference rate (such as an interest rate or a currency exchange rate), the settlement date, and the notional value. A forward contract that is traded on an exchange is commonly referred to as a futures contract. Futures typically derive their value from stock market indices, interest rates, commodities, or foreign currencies and are subject to standardized regulations that ensure liquidity and minimize counterparty risk.

On the other hand, forward contracts that are traded in the over-the-counter (OTC) market are generally known as forward agreements. Indeed, OTC forward-based derivatives are different compared to exchange-traded futures. They are private and customizable agreements between two private parties, and this makes them more flexible in terms of contract specifications. These include the notional amount and the settlement terms. However, this customization also introduces higher counterparty risk, as there is no centralized clearinghouse to guarantee the transaction.

Within the OTC market, we find two categories of forward agreements: those based on interest rates and those linked to foreign exchange rates. Interest rate forwards, often referred to as Forward Rate Agreements (FRAs), allow investors to obtain a fixed interest rate for the future, protecting the company against interest rate fluctuations, borrowing costs, and investment returns. Similarly, foreign exchange forwards help investors to lock in a fixed exchange rate for a currency pair, hedging against potential currency fluctuations. These instruments are very important for banks and other intermediaries, since they manage risk through them, and so they can stabilize cash flows and engage in speculative strategies based on future price movements.

Lastly, we have swap-based derivatives, which are contracts in which counterparties exchange, over a period of time, one stream of cash flows for another stream of cash flows. The streams are usually referred to as 'legs' of the swap agreement. The cash flows are usually calculated with reference to a notional amount, which is often not exchanged by the counterparties. These are called interest rate swaps. Swap-based derivatives are a type of forward-based derivative because their structure is a series of forwards.

When entering into a swap, the two parties, called counterparties, will mutually agree on the terms of the swap contract, which concern the cash flows to be exchanged during the life of the contract. These cash flow terms are determined when signing the contract, and they are based on fixed or floating rates. Alternatively, the counterparties can also base the cash flows on other variables, with specific reference rates. They will also agree on the notional amount, known as the face value, which represents the amount from which cash flows are calculated, for example they can be 5% of the notional amount. In a swap, the notional amount is not usually exchanged, and so it is used just as a reference or as a margin requirement.

The downside of swaps is that the swapping parties are exposed to counterparty risk, which is the risk of default by the other party. To safeguard themselves against this risk, investors use credit assessments, ask for collateral requirements, and enter into swap agreements with trusted and creditworthy counterparties.

## 1.5 - The Global Derivatives Market

As stated in the previous section, most derivatives are based on one of four types of underlying assets: foreign exchange, interest rates, commodities, and equities. Since 2007, the major part is composed of interest rate derivatives, followed by foreign exchange while equity-linked and commodity contract amounts had been decreasing since 2008 both in gross market value and notional amount due also to their major presence in exchanged markets.

The derivatives market continues to be the largest single segment of the financial market. Looking at its historical evolution, the size of the market increased approximately by 15% per year since 1998 with a peak of 27 trillion USD in gross amount in 2008. However, since then, market volume contracted for the first time since 1998. This is mainly due to the financial and economic crisis.

In particular, the most dominant segment of the over-the-counter (OTC) derivatives industry has been the one of interest rate derivatives. They can be used to hedge or speculate on interest rate fluctuations, and this is what makes them so important for investors, as they can be used for numerous financial activities.

In the previous section we analyzed interest rate swaps, and these are the most used type of interest rate derivative used in the market, as it allows to exchange interest rate payments.
Looking at its history, we find that this type of derivatives was first used in 1981, with the first interest rate swap between IBM and the World Bank. Since then, the market activity for interest rate derivatives has expanded exponentially, reaching nearly $563 trillion by 2014. Out of this, interest rate swaps accounted for approximately 75%. This number attests the widespread use made by banks and other intermediaries to hedge against fluctuations in interest rates.

If we look at the overall OTC market, interest rate derivatives represent around 81% of the total market, highlighting their critical role in the financial industry. These instruments have revolutionized the way institutions deal with interest rate risk. Thanks to them, investors can hedge, manage debt costs, and enhance investment returns.
Also looking at Figure 1.3, we can see that Goldman Sachs interest rate derivatives amount to more than 50% of the total number of derivatives kept by the bank.

Another very important market is the foreign exchange (FX) derivatives market, which is the second-largest segment of the global over-the-counter (OTC) derivatives market, following interest rate derivatives. These instruments play a key role in global finance, allowing businesses, investors, and financial institutions to manage currency risk, speculate on exchange rate movements, and facilitate international trade.

The foreign exchange derivatives market has grown a lot in the years, and it currently stands at a notional amount of $75 trillion, accounting for approximately 12% of all OTC derivatives contracts. However, if we look at the gross market value, which measures the cost of replacing all outstanding contracts at current market prices, the FX derivatives market peaked in 2008, reaching $4 trillion. This increase was caused by the financial crisis, which increased volatility for currency hedging instruments. After the crisis, the gross market value declined, and now stands at about $2.5 trillion.

Despite this decline in market value, the FX derivatives is still one of the most important in international finance. The reason is that it mainly helps businesses hedge against currency fluctuations. Moreover, it enables investors to speculate on exchange rate movements, and it stabilizes global trade by allowing firms to lock in future currency prices.

The other two important types of derivatives, which characterize the market are forward rate agreement (FRAs) and options. FRAs allow parties to lock in interest rates for future periods. They represent roughly 16% of the total market.
Options, on the other hand, represent roughly 9% of the total market, and offer flexibility for hedging and speculation.

As mentioned above, derivatives are traded in the OTC market. Consequently, global regulators have made OTC market reform a central priority. Indeed, this kind of market could lead to systemic risks in the financial markets, in particular with counterparty risk.
As a result, regulators are pushing for more transactions to be executed through central clearing with central counterparties (CCPs). This shift is intended to enhance market transparency, reduce counterparty risk, and improve overall financial stability.

Looking specifically at interest rate derivatives by counterparty, there has been a trend toward increased central clearing. Indeed, the role of financial institutions in the derivatives market has expanded significantly, and this can be seen in the notional amount of derivatives found in Goldman Sachs' balance sheet.

On the other hand, the number of reports performed by non-financial institutions, such as corporate firms and governments, has declined over the years. This statistic reflects the growing number of transactions now being processed through CCPs. Also when looking at private active derivative dealers, the notional amount of contracts exchanged has been consistently declining. To be more precise, their share of notional amounts outstanding has been shrinking since 2007, due to this take over by financial institutions and clearinghouses, which took a dominant role in the market for managing and executing derivative contracts.

# CHAPTER II - THE CAPITAL STRUCTURE

One of the most important decisions that a firm or a bank has to make is how they should choose the set of financial instruments, or securities, it will issue to raise capital from investors. This is the definition of capital structure.
In particular, capital is raised to receive new funds in order to undertake new investments. Even when there is no need to undertake new investments, firms can issue new securities and use the funds to repay debt or repurchase shares, as to decrease its financial leverage.

## 2.1 - Capital structure definition

The choice of capital structure is critical for firms as it affects their cost of capital, risk exposure, and financial flexibility. According to Ross, Westerfield, and Jordan (2019), "*The capital structure decision is crucial because it impacts the risk and return of shareholders and the cost of capital to the firm*". A company's capital structure influences its ability to raise funds, undertake new projects, and ultimately create value for its shareholders.

In particular, capital structure can be defined as "*the mix of financing resources used by the company to finance its investments"* (Myers, 2001). This mix of financial resources is very important, since it determines the firm's capital structure, which is the total amount of debt, equity, and other securities that a firm has outstanding.

Debt represents funds borrowed by the company that must be repaid over time, usually with interest payments. Equity, on the other hand, represents ownership in the company, owned by shareholders with a claim to the company's assets and earnings.
For investors, this mix is a key characteristic when deciding whether to invest. This is due to the risks that a high amount of debt brings to the financial institution, as we will define later on.

The ratio of debt over equity is a key coefficient since it shows the firm's ability to ensure debt repayment. In other words, this ratio defines the firm's financial leverage.
If it is high, it means that the business frequently uses debt in order to fund its operations, and

this increases the probability of a bankruptcy.
On the other hand, if it is low, it shows that the business has less financial risk and can use more debt to increase its returns on investments.

Companies have different capital structures because each of them has different business models and so different financial needs. However, their shared main objective is profit maximization, and to achieve it, companies must choose an efficient capital structure composition.
To achieve this, there are three different viewpoints on how companies should select a finance mix.

The first is that the decision between debt and equity can be determined by a company's growth stage. High-growth companies will need less debt than older companies.
The second is that firms determine their financing mix by examining other companies in the industry and see how efficient they are in this respect.
The third viewpoint holds that firms have strong preferences for the types of financing they like to utilize, and so they want to maintain a certain mix all the time, changing these preferences only when they have no alternative.

## 2.2 - Equity and Debt

Most of the companies have two options to finance its activities: these are debt and equity (*Damodaran, 2014*). Usually, debt is defined as bonds, while equity is defined as stocks. However, there are a lot of different financial instruments other than bonds and stocks that can be defined as debt or equity. Indeed, the real difference lies in the cash flow claims of each type of financing.

As a matter of fact, the main difference is that a debt claim entitles the holder to a contractual set of flows, which are typically interest and principal payments. In this case, when issuing a form of debt, the holder will receive a periodic interest payment, followed by a repayment of the original sum borrowed when the contract is over.
On the other hand, an equity claim entitles the holder to any remaining cash flows after all other promised claims have been satisfied.

Indeed, another difference is that debt has a prior claim on both cash flows on a period-to-period basis (for interest and principal payments) and on the firm's assets (in the event of liquidation). For example, in the event of bankruptcy, shareholders will receive their money only after all the other stakeholders have been paid. This is a consequence of the nature of cash flow claims (contractual versus residual).

Moreover, the tax laws have typically viewed interest expenses, which accrue to debt holders, quite differently and frequently far more favorably than equity. Consequently, in most western countries, interest expenses are deductible from taxes. As an example, if a company has interest expenses higher than interest income, it will receive a tax shield benefit, where a percentage of this expense will be subtracted from the taxable income.

On the other hand, dividends or other cash flows that accrue to equity do not enjoy the same tax treatment, and are taxed according to standard rules. However, one of the benefits of holding equities is that the majority or whole control over management of the company is granted to shareholders, due to their claim over the remaining cash flows of the business.
Conversely, debt investors take on a far more passive role in management, having the ability to veto important financial choices at most.

Lastly, another characteristic that distinguishes equity and debt is their maturity. While equity often has an unlimited existence, debt typically has an established maturity date, which is when the principal repayment occurs.

## 2.3 - Capital Structures theories

The topic of capital structure is one of the most important in corporate finance. Consequently, it is also one of the most discussed. In particular, the debate "*is exacerbated by the absence of a single, comprehensive theory about the usage of debt vs equity"* (Myers, 2001).
The first and most known capital structure theory, formulated by ***Modigliani and Miller*** in *1958* states that the distribution of debt and equity has no bearing on a company's value in a perfect market. This theory is the starting point of numerous subsequent research.
As a matter of fact, the existence of a perfect market is questioned. Indeed, a perfect market exists with specific assumptions, which are a market free from taxes, bankruptcy costs, transportation costs, and asymmetric information. Also, investors cannot influence stock prices,

the same interest rate is charged for both borrowers and lenders, there are the same business expectations for all investors, and managers maximize shareholders value without incurring agency costs.

These assumptions for a perfect capital market are unrealistic and cannot be found in the real market. However, this model, as stated, was the first one and serves as the basis for further studies conducted and developed in time, in order to include market dynamics.
Indeed, subsequent studies demonstrated that in a not-perfect capital market, as the real market is, the choice of the capital structure will affect the firm's value.
Consequently, the amount of equity and debt that a company keeps affects its risk in the market, and so the capital structure becomes a key financial parameter in the determination of the cost of capital.

Also Modigliani and Miller (1958), looking at the growth of the capital market, realized that many assumptions do not exist in reality and so expanded them taking into account tax purposes. Always Modigliani and Miller (1963) demonstrate that the enterprise value rises with more leverage for the tax shield of interest benefit. This implies that enterprises will profit from adopting greater leverage in certain conditions of financial health.

There are several debates for this interpretation of Modigliani and Miller. In particular, studies conducted by *Stiglitz (1969)* to test the idea of Modigliani and Miller found that certain businesses might pay interest rates greater than others, and that individuals could pay higher interest rates than businesses overall. In addition, the cost of loans differs amongst lenders. Consequently, Modigliani and Miller's assumptions that all loans or investors would pay the same interest rate are not consistent with what can be analyzed in the real capital markets. *Stiglitz's (1974)* subsequent research also found that the theoretical framework is not consistent also regarding no bankruptcy costs and net expectation of corporate profit.
Moreover, *Wald (1999)*, examining the capital structure by businesses in countries such as the USA, France, Germany, Japan, and the UK, found that these nations' capital structure decisions differ, especially when taking leverage into account. These differences are caused by economic variables such as disparity in agency costs, tax policies, and asymmetric information that exists between creditors and shareholders. Therefore, even though Modigliani and Miller's are limited when applied to the real market, their findings are still crucial since they have been the foundation for other important academics' contributions to the current financial economy.

## 2.4 - Leverage

Financial leverage refers to the use of debt to finance investments, projects, or operations with the objective of increasing potential returns. As a matter of fact, companies use debt instead of equity in order to increase their Return on Equity (ROE). This happens when their Return on Investment (ROI) exceeds the cost of debt. Indeed, if the ROI is greater than the cost of debt, the company is financially healthy and can take on more debt to maximize returns. However, leverage also amplifies financial risk, making firms more vulnerable to economic downturns and interest rate fluctuations. Consequently, if the ROI is smaller than the cost of debt, it means that the company is not financially healthy and has too much debt, which increases the risk of bankruptcy if there is not enough liquidity.
These characteristics make financial leverage very important, and companies must find an efficient balance between maximizing shareholder value and maintaining financial stability.

Leverage is commonly employed in both corporate finance and the banking sector. Companies use leverage to finance acquisitions, expand operations, and invest in capital-intensive projects, while banks utilize leverage by transforming customer deposits and borrowed capital into long-term lending activities. As stated, leverage and financial stability have a close relationship. As a result, after heavy past financial crises caused by excessive use of leverage, international regulatory frameworks, such as the Basel Accords, have been introduced to control the level of leverage financial institutions can take on.

The level of financial leverage that a company has can be measured through different financial ratios, which calculate the amount of debt used relative to assets, equity, and earnings. These ratios are essential for evaluating the financial risk and financial health of such companies.

One of the most common ratios to measure financial leverage is the debt ratio, which calculates the proportion of a company's total assets that are financed through debt. The formula for the debt ratio is expressed as total debt divided by total assets. In particular:

$$Debt\ Ratio\ =\ Total\ Debt/Total\ Assets$$

In order to understand it, we can state that a value of 1.0 indicates that all assets are financed through debt, while a value greater than 1.0 suggests that the company holds more debt than assets, implying a highly leveraged position. On the other hand, a ratio lower than 1.0 indicates that the firm has more assets than debt, and so it has less financial risk and a more safe approach.

Instead, a higher debt ratio increases financial risk, as firms with a greater reliance on debt must pay interest and obligations regardless of economic conditions.

Another important ratio to measure leverage is the debt-to-equity (D/E) ratio, which calculates the total amount of debt over shareholders' equity. This ratio is useful to analyze how much debt versus equity a company employs to finance its operations. The formula for the debt-to-equity ratio is:

$$Debt - to - Equity\ Ratio = Total\ Debt/Total\ Equity$$

A D/E ratio greater than 1.0 means that the firm has more debt than equity, and so it has more financial risk, especially if the company does not have enough earnings to cover the debt position. However, different industries have different levels of leverage, and so a high D/E does not necessarily mean that the company is going bankrupt. In our case, banks use a lot of debt to finance its operations, even when they are financially healthy. Indeed, their business model relies on borrowing at a low interest rate and lending at a higher rate. As a consequence, if they do not borrow, they cannot perform their normal activities, and so they usually have more debt than equity. This is in contrast with other industries which rely primarily on equity financing from investors, such as early-stage technology firms.

The last widely used leverage ratio that we will analyze is the debt-to-EBITDA ratio, which measures a company's total debt relative to its earnings before interest, taxes, depreciation, and amortization, also known as EBITDA. The formula for this ratio is:

$$Debt - to - EBITDA\ Ratio = Total\ Debt/EBITDA$$

This ratio is used in order to understand whether the company generates a sufficient operating income to cover its debt obligations. A higher debt-to-EBITDA ratio means that a company cannot cover debt with its operating activities, and so it does not produce enough to repay debt. This can lead to difficulties in paying interest and debt maturities.
On the other hand, a lower ratio indicates that operating income is enough to repay debt, and so there is a lower risk of financial distress. Usually, established manufacturing and telecommunications companies have a low debt-to-EBITDA ratio, while banks have a high debt-to-EBITDA ratio, since their business model is based on borrowing.

Turning our attention to the banking industry, leverage is one of the most important topics.

Banks use it to borrow and so expand their lending capacity to maximize profits. Banks operate with a high level of leverage, indeed they take in customer deposits, investing them in the capital market for a higher return to then be able to provide loans. Even though this model is profitable, banks also have to be careful about the level of financial leverage that they take, since it can lead to bankruptcies, especially during economic crises.

In order to tackle this issue, regulatory bodies impose leverage restrictions on financial institutions to control financial risk. The most important regulatory leverage measures are the leverage ratio and the CAR, which we will analyze.
The leverage ratio indicates the bank's capital relative to its total debt exposure. Banks must maintain a minimum leverage ratio of 3%, in order to be sure to maintain enough capital relative to their total assets and debt exposure. Under this regulation, banks have a limited amount of debt that they can accumulate.

Finally, the capital adequacy ratio (CAR) evaluates a bank's capital reserves relative to its risk-weighted assets. This ratio must maintain a minimum level of 8%, to ensure that banks have sufficient capital to withstand losses during financial crises, and so reduce the probability of bankruptcies.

## 2.5 - How Derivatives Affect the Capital Structure

As our study focuses on the role that derivatives have on the capital structure of financial intermediaries, we can now analyze the relationship between this type of financial instrument and leverage. Derivatives influence both financial flexibility and risk exposure. Firms can trade options, futures, swaps, and credit derivatives to hedge or speculate on their risk profiles without altering the nominal value of their debt or equity. As a matter of fact, derivatives can be both used for hedging purposes, which means to reduce financial risk, or to speculate, since derivatives have a higher leverage than standard equity instruments.
These characteristics will impact a firm's solvency, liquidity, and overall financial stability. Since a lot of market players use derivatives, they are also heavily regulated.

Turning to the capital structure, derivatives are able to alter it due to the role played by leverage. Indeed, the main benefit, as we stated, is that by taking leverage, companies do not alter their debt exposures. For example, interest rate derivatives, the most common type of derivative, is used by firms to convert variable-rate debt into fixed-rate debt. This is done when one party has too many variable-rate obligations, whereas the other has too many fixed-rate obligations. By entering into an interest rate swap, the company with too much exposure to variable rates can stabilize its risk exposure to fluctuations in interest rates. Instead, the company with high exposure to fixed rates can optimize returns by being more exposed to market movements.

Another way to stabilize risk and optimize the capital structure is to use currency derivatives when there is an exposure to international operations. This type of derivative can be used to hedge against exchange rate fluctuations and to ensure stable cash flows, reducing the need for capital buffers. In this way, the company has less financial risk and can take on more debt to increase its efficiency in creating profits, while at the same time it increases leverage thanks to the use of derivatives.

However, leverage through derivatives is not only used for hedging purposes. Indeed, these financial instruments are efficient also in speculative activities, where companies gain exposure to financial assets without holding them.
Futures and options usually include 10 or 100 contracts in one single trade, and so they enable firms to control large positions with relatively small capital outlays. This creates implicit leverage, and so amplifies gains and losses. When firms or financial institutions want to speculate, they trade significant amounts of these contracts, and their leverage increases exponentially, even though this is not often reflected in the traditional debt-to-equity ratio. As the capital structure remains stable, this hidden leverage can create vulnerabilities, as losses on derivative positions may require sudden liquidity injections, forcing firms to modify their capital structure, by fire selling assets and raising additional capital.

These characteristics make derivatives heavily regulated by international bodies, as to improve risk management practices. The Basel III framework, for example, requires banks to account for derivative exposures when calculating risk-weighted assets and leverage ratios to prevent excessive risk-taking.
However, as stated in the first chapter, derivatives exposure is often not clearly stated on the balance sheet, and this makes it difficult to measure true leverage levels accurately. Companies exploit this to maintain leveraged positions while minimizing risk on the financial statements.

The major financial risk when trading derivatives is liquidity risk. Derivatives can trigger margin calls that require firms to add cash and collaterals, minimizing cash reserves. This risk was evident in cases such as the collapse of Long-Term Capital Management in 1998 and the financial distress of Archegos Capital Management in 2021, where excessive derivative leverage led to rapid and uncontrolled losses.

In conclusion, while derivatives can be used efficiently, they reshape the capital structure in many ways. Consequently, they can reduce risks or amplify financial vulnerabilities. The challenge for companies is to use these instruments efficiently, as to maximize profits while keeping an acceptable level of leverage. This is why companies are increasingly improving their risk management practices and why derivatives are heavily regulated.

## 2.6 - Cost of Capital

In analyzing the capital structure and its importance, we mentioned that it ultimately affects one of the main financial parameters in the market; the cost of capital.

The cost of capital is the expected rate of return that the market participants require in order to attract funds to a particular investment. In economic terms, the cost of capital for a particular investment is an opportunity cost, that is the cost of foregoing the next best alternative investment. In this sense, it relates to the economic principle of substitution, and so an investor will not put funds in a particular asset if there is a more attractive substitute.

The cost of capital usually is expressed in percentage terms, that is, the annual amount of dollars that the investor requires or expects to realize, expressed as a percentage of the dollar amount invested.

In particular, since the cost of anything can be defined as the price one must pay to get it, the cost of capital is the return a company must promise in order to get capital from the market, either debt or equity. A company does not set its own cost of capital; it must go into the market to discover it. Yet meeting this cost is the financial market's one basic yardstick for determining whether a company's performance is adequate. (Pratt & Grabowski, 2008).

From the last sentence we can understand how most of the information for estimating the cost of capital for any company, security or project comes from the investment markets. It is the competitive return available in the market on a comparable investment, with risk being the most important component of comparability.

The cost of capital is usually associated with the weighted average cost of capital (WACC). To determine cost of capital, business leaders, accounting departments, and investors must consider two primary factors, directly connected to the capital structure: the cost of debt and the cost of equity.

The cost of debt refers to the effective rate a firm pays on its borrowed funds, including loans, bonds, and other forms of credit. The cost of debt is different for each company and it depends on the financial exposure of the company. A healthy company will be able to borrow at a lower rate, since it has collateral to use to repay debt. On the other hand, if a company is heavily leveraged or if it is in financial distress, it will have a higher cost of debt.

A company's cost of debt is very important to evaluate whether the financial leverage is managed efficiently. The formula to calculate it is:

$$\text{Cost of Debt} = (\text{Risk-Free Rate of Return} + \text{Credit Spread}) \times (1 - \text{Tax Rate})$$

where the risk-free return is usually derived from the 10-year government bonds yield, the credit spread reflects the difference in yields between corporate and government bonds, and the tax rate accounts for corporate tax benefits.
As previously stated, taking debt can be beneficial for companies to maximize returns, but it will be convenient only when the cost of debt is low and anyway lower than the return on investment that the company can undertake by borrowing. Conversely, it would destroy value and so borrowing will raise potential solvency issues.

The cost of equity measures the return that a company must offer investors to compensate for the risk associated with holding equity securities. Equities give the shareholder residual interest in the assets of a company after all the liabilities are paid.
Consequently, it reflects the ownership stake held by shareholders and represents the main component of a firm's long-term financial strategy. The return that shareholders seek is not like that of debtholders, which expect periodic payments in the form of interest. Instead, equity holders seek to increase the profitability of the company, in order to receive a return which is commensurate with the level of risk they undertake.

The cost of equity is one of the most studied topics, with decades of research searching for the most efficient formula to calculate it. This is due to the fact that the cost of equity influences investment decisions, capital budgeting, and overall financial planning. As for the cost of debt,

the cost of equity serves as a benchmark to evaluate the profitability of a project. It provides insight into the attractiveness of investments, both for managers and investors.
However, the cost of equity is almost always higher than the cost of debt, because equity is riskier than debt. This is caused by the subordination of equity claims in the event of liquidation compared to debt claims.

As mentioned above, the cost of equity is very difficult to calculate and it is an ongoing research topic. On the other hand, the cost of debt is easier to calculate, since interest rates are explicitly stated. Nowadays, firms rely on many financial models to estimate the expected return from equity. The most widely used when calculating the WACC is the Capital Asset Pricing Model (CAPM), which calculates the relationship between a single asset's risk in relation to the overall market. CAPM is expressed as follows:

Cost of Equity = Risk-Free Rate of Return + Beta × (Market Rate of Return - Risk-Free Rate of Return)

In this equation, the risk-free rate of return represents the 10-year yield on government securities, which is considered as a benchmark for investments with no to little default risk. Beta measures the sensitivity of a company's stock to market movements, and so indicates its volatility relative to a broad market index, called the market portfolio. Finally, the market rate of return reflects the expected return on this market portfolio, ideally represented by the overall stock market. This can be defined as the compensation investors require for bearing systematic risk.

From the cost of debt and the cost of equity it is possible to calculate the weighted average cost of capital (WACC), which represents a company's cost of capital, or overall cost of financing. The WACC is widely used as a discount rate when companies make investment decisions, and it reflects the combined required return by both debt and equity holders. The formula for WACC is:

$$WACC = (E/V \times Re) + ((D/V \times Rd) \times (1 - T))$$

where E represents the market value of equity, D represents the market value of debt, V is the total value of capital (E + D), Re is the cost of equity, Rd is the cost of debt, and T is the corporate tax rate.

## 2.7 - The Relationship between Cost of Capital and Capital Structure

The relationship between cost of capital and capital structure is one of the most studied topics in corporate finance. As we saw, the WACC is important for firms because it includes the benefit of using debt, which means that the company will have interest tax deductions. Consequently, it will be smaller than the expected return of the firm's assets. However, it is an important financial measure because it provides the benefit of evaluating a project with the same financing as the firm itself.

The theory that links the WACC, or cost of capital, to the capital structure was first introduced by Modigliani and Miller, who studied why the cost of capital differs for different companies, even though they had previously concluded that a firm's financing choice does not affect its value. The main reason is the impact of leverage modifies the risk of a firm's stock, and consequently the debt cost of capital is exactly offset by a higher equity cost of capital.
We can use Modigliani and Miller's first proposition to derive an explicit relationship between leverage and the equity cost of capital.

The first proposition states that the total market value of the firm's securities is equal to the market value of its assets, whether the firm is unlevered or levered.
Indeed, we can use this equality as a homemade leverage; by holding a portfolio of the firm's equity and debt, we can replicate the cash flows from holding unlevered equity.
From this statement, we can calculate the unlevered equity, which will be equal to the first part of the WACC, (E/V x Re) + ((D/V x Rd).

This relationship reveals the effect of leverage on the return of the levered equity. There is an extra kick due to leverage. This extra effect pushes the returns even higher when the unlevered return is higher than the cost of debt, but makes them drop even lower when the firm does poorly, and so the cost of debt is higher. It is equal to the analysis that we made between the return on equity and the cost of debt.
The amount of additional risk depends on the amount of leverage, which in turn depends on the debt-to-equity ratio, D/E. That is, on the capital structure.

The relationship that we studied is the Modiglian and Miller's second proposition, which states that the cost of capital of levered equity increases with the firm's market value debt-equity ratio.

This explains the difference in cost of capital of the various companies and financial intermediaries. To better illustrate, we can use the insight of Modigliani and Miller to understand the effect on leverage and the capital structure on the WACC.

In particular, if a firm is financed with both equity and debt, then the risk of the underlying assets will match the risk of a portfolio of its equity and debt. Thus, the appropriate cost of capital for the firm's assets is the weighted average of the firm's equity and cost of capital, which is defined as pre-tax WACC. That is, with perfect capital markets, the WACC is independent of its capital structure and is equal to its equity cost of capital if it is unlevered.

Now, if we measure the firm's leverage in terms of its debt-to-value ratio, D/V, we will find that with no debt the WACC is equal to the unlevered equity cost of capital. As the firm borrows at the low cost of capital for debt, its equity cost of capital rises. The effect is that the cost of capital remains unchanged. Naturally, as the amount of debt increases, it will increase financial risk, and so the debt cost of capital also rises. With 100% debt, it will become as risky as equity, but anyway the WACC remains constant.

However, corporations must pay taxes on the income that they earn. Because they pay taxes on their profits after interest payments are deducted, interest reduces the amount of corporate tax that companies must pay, which is the most important benefit of debt.
Consequently, leverage creates profits and brings a tax benefit to the bank, which is why it is widely used. In particular, the gain that investors receive from the tax deductibility of interest payments is known as the interest rate shield. It is found by multiplying the corporate tax rate by the interest payments.

As we defined in the introduction of the section, the tax benefit of leverage is expressed in the cost of capital, that is on the WACC. Compared to the pre-tax WACC, the tax-deductibility of interest payments lowers the effective after-tax cost of debt of the company. From this, we arrive at the final formula for the WACC:

$$WACC = (E/V \times Re) + ((D/V \times Rd) \times (1 - T))$$

The conclusion that we can state is that, the higher the firm's leverage, the more the firm exploits the tax advantage of debt, and so the lower its WACC is. This shows the importance of capital structure and its consequences on a company's financial decisions. Companies need to efficiently balance it in order to maximize their profits.

## 2.8 - How Derivatives Affect the Cost of Capital

Our study focuses on analyzing the relationship between derivatives, the capital structure, and the cost of capital. Having analyzed how the WACC is connected to the capital structure, we now turn our attention to how derivatives affect the cost of capital.

As a matter of fact, financial derivatives heavily impact the WACC. In particular, both the cost of debt and the cost of equity are affected by the use of this financial instrument.

As stated in the previous section, the WACC is the return required by both debt and equity investors, and it depends on the overall risk of the company's stock and borrowing capacity.

Consequently, derivatives play a big role since they can lower financing costs and enhance stability, and so mitigate the overall financial risk. If they are used efficiently, the WACC will be lower and companies will be able to borrow at a lower rate.

The cost of debt is the primary financial rate affected by derivatives. Indeed, we saw in the first chapter that the main type of financial derivative used by intermediaries is linked to interest rates. Interest rate swaps help them convert floating rates into fixed rates, decreasing the exposure to market movements and to interest rate volatility.

By using this type of derivative, companies can achieve lower perceived default risk and so decrease their cost of debt. Also the other types of derivatives, such as credit-linked and foreign exchange derivatives can help achieve the same result. Consequently, if the cost of debt is lower, the WACC will be lower. This finding explains the main relationship between derivatives and cost of capital.

Even though the cost of debt is the most affected, derivatives are also used to reduce firm-specific risk and earnings volatility. As a consequence, the cost of equity can be optimized and decreased. Indeed, as mentioned above, by hedging using the various types of derivatives, the company can reduce financial risks such as interest rate fluctuations, commodity price volatility, or currency depreciation. By doing this, the company will have more stable earnings. As a consequence, also the equity risk premium demanded by investors will decrease. Since the equity risk premium is directly related to the overall cost of equity, by decreasing it we will also decrease the cost of equity. Moreover, derivatives can also influence the cost of equity by ensuring more stable dividends payouts through stable cash flows, further reducing its perceived risk.

# PART II - EMPIRICAL RESEARCH

# CHAPTER III - DATA SELECTION

As we mentioned throughout the first part, the goal of this thesis is to study the relationship between derivatives, capital structure, and the cost of capital. In particular, our goal was to understand the impact of financial derivatives on the other two variables, and how financial intermediaries can improve their efficiency when employing them in their operations.
To analyze these relationships, we performed an econometric analysis.

## 3.1 - Econometric Analysis

"Econometrics uses economic theory, mathematics, and statistical inference to quantify economic phenomena. In other words, it turns theoretical economic models into useful tools for economic policymaking." (International Monetary Fund), and it is today the main tool used to study financial relationships. Indeed, to perform an econometric analysis, we need to collect real world data, and then study their relationship and volatility with respect to the variables we are studying.

Nowadays, financial research is based on this kind of statistical tools, which are very helpful to test theories, uncover patterns, and understand the connection between different financial variables in a transparent and replicable way.
Consequently, the result is that ongoing research is not anymore based simply on abstract models and ideas, but it relies on practical numbers, thanks to econometrics. In this way, the research will be practical and will have evidence-based conclusions.

But why is econometrics becoming so important for finance? The key characteristic that makes econometric analysis so valuable for the financial world is its ability to analyze economic data in a structured way. In fact, by employing this statistical tool, we will be able to find a clear and numerical relationship between our variables, while also taking into account also the influence of other factors. In this way, the assumptions of a model will be more realistic and visible.
Financial data are influenced by numerous diverse economic forces, and so this approach becomes invaluable when studying this type of data.

In particular, in our study, we performed an econometric analysis to understand how derivatives, heavily employed by financial intermediaries in their operations, affect two key financial aspects of a firm: its capital structure and cost of capital. We analyzed whether this type of financial instrument has a measurable impact on bank's operations, and how they can enhance their return-risk relationship by efficiently employing derivatives. This was done following also the study performed by Said on the positive correlation between banks' performance and the usage of derivatives (Said, A., 2011)

In order to practically measure these relationships, we ran two regression models based on international banks data.

In the first model, we took as a dependent variable the Equity-to-Total Assets Ratio, which is a key leverage ratio used to study the capital structure of a company.

Since our goal was to understand whether the banks that carry more derivatives exposure tend to rely less on equity financing, we took as explanatory variables the amount of derivative liabilities. Moreover, to make the analysis more robust, we included two additional control variables: the Debt-to-Equity ratio and the Derivatives-to-Total Assets ratio. This is because the first makes us understand better the capital structure of banks, while the second reflects the bank's exposure to derivatives taking into account the size of its operations.

In the second regression model, we measured the relationship between the Weighted Average Cost of Capital (WACC) and the capital structure. The WACC was our dependent variable, since it represents the cost of capital and how a company pays to finance itself.

On the other hand, to measure the capital structure, we used as a variable the Equity-to-Total Assets ratio, which is the main explanatory variable. The goal was to analyze whether a greater reliance on equity capital corresponds to higher financing costs.

Similarly to the first regression, we used control variables, that are the Debt-to-Equity Ratio and the total amount of derivatives liabilities. In this way, we were able to show in a clearer way the pure effect of the capital structure on the WACC, without being affected by the other variables.

Furthermore, to make our analysis stronger, we also included a dummy variable, which was the country of origin of our banks. To be more precise, the country where their headquarters are located. The dummy variable was used to include at least one categorical data to help us capture the effect of countries of origin on our dependent variable. In particular, it allows us to capture the impact of different financial environments and regulations across the countries.

By performing these two econometric analyses, we found important numerical relationships between our variables, which we will discuss below. Moreover, we were able to answer our main research question, which was to understand how derivatives affect the capital structure of financial companies, based on practical data.

Before discussing the findings of the study, we will now clearly explain how we chose our variables and how we run the regression models, explaining our tests and general methodology.
In this way it will be clearer how derivatives ultimately affect the profitability of the biggest international financial intermediaries.

## 3.2 - Data and variables definition

The issue we encountered with the economic regression was to find an adequate dataset, with all the variables needed to understand the financial relationship between derivatives, capital structure and cost of capital. Due to the lack of a structured dataset available online, we built our own dataset from scratch.

Our focus was financial intermediaries, and so we chose to include the 29 international banks classified as Global Systemically Important Banks (G-SIBs). This list was taken from the Financial Stability Board's annual list. The choice of these banks was based on the fact that they are the largest and most influential financial intermediaries in the market, and they are of vital importance for the health of the financial industry. Consequently, it is very important for us to study how these banks are affected by derivatives liabilities and how they manage them to optimize their capital structure allocation.
Moreover, to make the dataset more complete, we added 6 other big international banks, selecting them based on their size and importance for the domestic and financial market. Consequently, the total number of banks included was 35.

For each of these banks, we collected the data across a six-year time span, covering the years from 2018 to 2023. The decision to take into account these years was based on the availability of annual reports for the different banks. In fact, some banks still have to publish their 2024 annual report, while they are all public and easy to find from 2023.

Financial statements were fundamental to collect the data on the amount of derivatives liabilities and the capital structure, and so we reviewed them carefully to understand the bank's exposure and risk management practices performed through derivatives.
Furthermore, by looking at the financial statements, we were able to understand each bank's market trends and evolution of balance sheet composition over time.

After reading the numbers from the financial statements, we continued by calculating the financial ratios and variables used in the econometric analysis. Our variables were the total amount of derivatives liabilities for each bank, the Equity-to-Total Assets ratio, the Debt-to-Equity ratio, and the Derivatives-to-Total Assets ratio.
Moreover, the Weighted Average Cost of Capital (WACC), which is our measure for the cost of capital, was calculated using the banks' cost of equity, cost of debt and corporate tax rate. This is because there was no public information about this measure, and we had to retrieve it ourselves.

**Dependent Variables**

In the econometric analysis, we performed two regression models, and so we identified two dependent variables, selected to study the financial structure and cost of capital of our banks.
The first dependent variable, used in the first regression model, is the Equity-to-Total Assets ratio. We chose this ratio because it was used as our proxy for each bank's capital structure, since it measures the proportion of total assets financed by shareholders' equity (Rajan & Zingales, 1995, p. 1425). The formula is:

Equity-to-Total Assets Ratio = Total Equity/Total Assets

When this ratio is high, it means that the bank maintains a more conservative financial structure, and so when it has to raise capital, it uses internal financing to fund the new investments. Consequently, the higher the Equity-to-Total Assets Ratio, the lower the financial risk. In our case, we chose this ratio as our dependent variable to assess how a high use of derivatives liabilities affects the ratio and so the capital structure of the financial intermediaries analyzed.

The second dependent variable, analyzed in the second regression model, was the Weighted Average Cost of Capital (WACC). This is a key metric both for our study and in the financial industry, since it is used to measure the average rate of return that a company has to pay to its equity and debtholders, when it wants to raise new capital.

The WACC was important in our regression model because this metric is directly affected by the capital structure. Consequently, we were able to study the numerical relationship between these two parameters, and add the consequence of using derivatives for both.
In particular, our goal was to understand whether differences in the capital structure, such as the extensive use of debt, would increase the WACC, and so the financial risk of the bank. In fact, the lower the WACC the safer the company is considered.

By using these two dependent variables, we will be able to analyze the impact of derivatives on the capital structure, and the impact of the capital structure on the cost of capital.
Ultimately, we will connect the two analyses to understand the impact of derivatives on the cost of capital, and so, on the financial stability and efficiency of the banking sector.

**Explanatory Variables**

When choosing the explanatory variables, our objective was to choose relevant variables, which would efficiently measure the relationship between derivatives and the capital structure for the first regression, and between the capital structure and the cost of capital for the second regression.

In the first regression, where the dependent variable is the Equity-to-Total Assets Ratio, we chose as the explanatory variable the total amount of derivatives liabilities, which represents all the bank's obligations for derivatives contracts, and so it was used as our proxy for the overall derivative exposure of each bank. This variable also allowed us to better capture the size of each company, since each of the banks has a different one. In this way, we had a better understanding of how many derivatives contracts are covered by the bank's assets. The formula is:

Derivatives-to-Total Assets Ratio = Derivatives Liabilities/Total Assets

The other explanatory variable included in the regression analysis was the Debt-to-Equity Ratio, which is the most used leverage ratio, as it indicates the proportion of banks' debt relative to their equity. The formula is:

Debt-to-Equity Ratio = Total Liabilities/Total Equity

On the other hand, in the second regression, where the dependent variable is the Weighted

Average Cost of Capital (WACC), the primary explanatory variable chosen was the Equity-to-Total Assets ratio, which is another leverage ratio useful to calculate the proportion of total assets covered by shareholders' equity. The formula is:

Equity-to-Total Assets Ratio = Total Equity/Total Assets

This ratio is used as a representation of banks' capital structure, making us understand by how much equity instead of debt our banks are financed.
These variables helped us to define a clearer and numerical relationship between our three main financial parameters under study, namely derivatives, capital structure, and cost of capital of the largest banks in the world.

**Control Variables**

In order to make our econometric analysis more complete, we included in both regression some control variables, (Hünermund, P., & Louw, B., 2023), as to make our models more thorough by studying external financial parameters that could influence the impact of derivatives on capital structure and cost of capital. In this way, both regressions will be more robust and reliable.

In both regression models we included as control variable the nation in which each bank has its headquarters. By including this variable, we accounted for factors such as political influences on the financial markets in different countries, different regulatory frameworks, and macroeconomic decisions. All these variables affect the financial decisions of the banks under study, (Demirgüç-Kunt and Maksimovic, 1999).
As a matter of fact, since we are analyzing big international banks in our dataset, we came across banks in different continents and consequently different legal systems, taxation policies, financial regulations, and market practices which ultimately affect both their capital structure and their cost of capital.

To achieve our goal, we included the country variable in the regression model as a dummy. As a matter of fact, apart from big countries such as the United States, Germany, and China, we will see that the coefficients are close to 0, and so it does not affect the relationship between our variables. Consequently, we can use the countries as our dummy.
In this way, we included the effect of different countries' financial markets and regulations in our variables.

Country dummies allowed us to control the biases of our main variables, such as derivatives liabilities and Equity-to-Total Assets ratio, for geographic differences.
The result was a clearer statistical result and a more robust regression analysis, enabling us to measure the relationship between our main variables with greater confidence.

## 3.3 - Descriptive Statistics First Regression

As stated before, the role of econometric analysis is becoming more and more important in the financial industry. To perform them, we could choose different statistical programs and tests. In our case, we choose Python, since it allows us to run regression and visualize the results very well. In the first regression model, the dependent variable was the Equity-to-Total Assets Ratio, which was the main leverage ratio in our analysis and so it was the main ratio for the firm's capital structure. As explanatory variables, we chose Derivatives Liabilities, which was the total amount of obligations in derivatives form for each bank.
Moreover, to make the regression more robust, we used the Debt-to-Equity ratio as the control variable, which is another important leverage ratio. Finally, we introduced a dummy variable for the country, in order to include international regulatory frameworks.

We used different statistical parameters to analyze our results. In particular, we measured the R-squared and Adjusted R-squared of the model to understand the strength of our regression, that is, to what extent the independent and control variables explain the variation in the dependent variable.
Moreover, we measured the F-statistic and its corresponding p-value, which are parameters used to understand if the regression is statistically significant. Indeed, they were used to understand whether our econometric analysis has statistical significance in the explanation of the dependent variable.

We also examined the Durbin-Watson statistic (1950), which is a test used to measure autocorrelation in the residuals of the regression model. It takes values from 0 to 4, and if it is equal to 2, there is no autocorrelation, which is important since a high or low level can make the model less valid. In addition, the Jarque-Bera test (1980) was performed, which is used to study whether the residuals are normally distributed, and to achieve this, it uses the levels of skewness and kurtosis. We also calculated multicollinearity, which is a measure of instability. A high multicollinearity means that independent variables are correlated between them, and if this happens the coefficients cannot be defined as reliable and their standard errors increase.

The latter was between our last statistical parameters, including t-values and p-values of each coefficient, which indicate their statistical significance. Overall, all these parameters ensure a robust and practical analysis of the variables, which leads to reliable and observable results, which can be seen below:

**OLS Regression Results Table 3.1**

| | | | |
|---|---|---|---|
| **Dep. Variable:** | Equity_to_TotalAssets | **R-squared:** | 0.992 |
| **Model:** | OLS | **Adj. R-squared:** | 0.991 |
| **Method:** | Least Squares | **F-statistic:** | 1452. |
| **Date:** | Tue, 20 May 2025 | **Prob (F-statistic):** | 1.43e-191 |
| **Time:** | 22:02:55 | **Log-Likelihood:** | 728.39 |
| **No. Observations:** | 210 | **AIC:** | -1423 |
| **Df Residuals:** | 193 | **BIC:** | -1366 |
| **Df Model:** | 16 | **Covariance Type:** | Nonrobust |
| **Country dummies:** | **YES** | | |

| | coef | std err | t | P>\|t\| | [0.025 | 0.975] |
|---|---|---|---|---|---|---|
| Intercept | 0.0381 | 0.002 | 16.450 | 0.000 | 0.034 | 0.043 |
| Derivatives_Liabilities | -3.196e-08 | 6.49e-09 | -4.923 | 0.000 | -4.48e-08 | -1.92e-08 |
| Debt_to_Equity | 0.3885 | 0.008 | 47.475 | 0.000 | 0.372 | 0.405 |
| Derivatives_Exposure | 0.0352 | 0.009 | 3.773 | 0.000 | 0.017 | 0.054 |

| | | | |
|---|---|---|---|
| **Omnibus:** | 61.818 | **Durbin-Watson:** | 2.055 |
| **Prob(Omnibus):** | 0.000 | **Jarque-Bera (JB):** | 1752.673 |
| **Skew:** | 0.276 | **Prob(JB):** | 0.00 |
| **Kurtosis:** | 17.142 | **Cond. No.:** | 4.18e+06 |

## Graph

As to explain our results in a clearer way, we inserted the scatter plot of our regression model below, which is a graphical representation of the first econometric analysis. In this case the scatterplot shows the relationship between derivatives liabilities and the capital structure of the banks in our dataset. Specifically, in the vertical axis we find plotted the Equity-to-Total Assets Ratio, which was our dependent variable, while in the horizontal axis we find plotted the Derivatives Liabilities in millions, which is our explanatory variable in the regression.

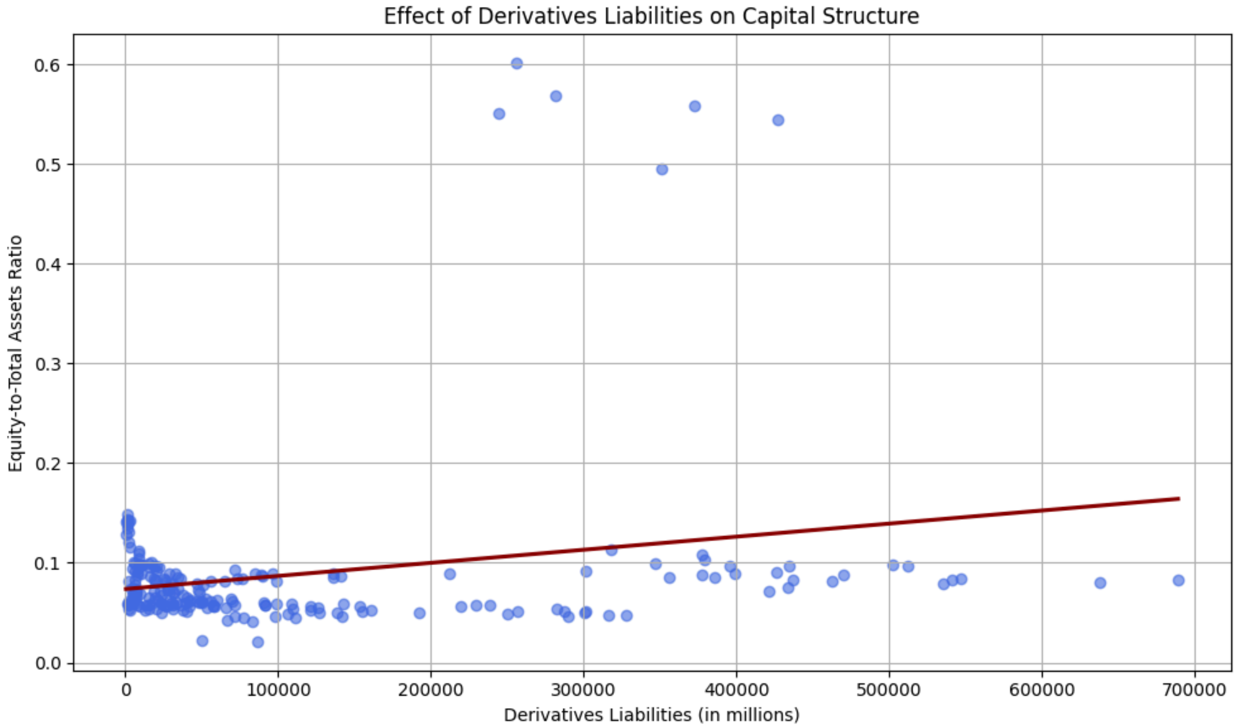
Analyzing the graph, we see the blue dots, which correspond to the value of a specific bank in a specific year across the dataset. In particular, they represent different amounts of derivatives liabilities for each bank and their corresponding amounts of equity financing.
In the regression model we used the Ordinary Least Squares (OLS) method, which is a statistical method which works by minimizing the sum of the squared differences between the observed values and the values predicted by the regression model. The OLS is plotted by the red regression line, which is the line that best fits the data using the OLS method.

In particular, we can see that the OLS line is upward trending. Even though it seems strange, the line is affected also by the other control variables. Indeed, the line is affected by the Debt-to-Equity ratio and the Derivative-to-Total Assets ratio, which are positive and statistically significant.
The Derivatives-to-Total Assets ratio suggests that banks with a greater exposure to derivatives have a higher Equity-to-Total Assets ratio, and since it has a rather significant coefficient, equal to 0.0352, it influences the graph, causing the upward trend.

Consequently, the graph confirms the results found in the regression analysis, which is that while, when analyzed alone, derivatives liabilities negatively affect the amount of equity financing, when combined with the capital structure and the other variables, the relationship becomes positive. The graph was fundamental in analyzing this result.

The scatterplot is very useful to give a clear explanation of the results we found. In particular, its value is to visually show any anomaly or outlier in the model, which could negatively influence the regression.
In our analysis, we can clearly see a density of points clustered near the origin and only few outliers, suggesting heterogeneity in the dataset. Consequently, the model seems reliable and it finds a statistical relationship between our variables. The scatterplot of the regression model is essential in capturing this relationship between derivatives liabilities and capital structure.

Figure 3.1 - Graph First Regression




## 3.4 - Descriptive Statistics Second Regression

Our second econometric analysis was structured to understand the relationship between our banks' capital structure and their cost of capital, studying the role played by equity financing in this matter. As for the first regression, we used Python as the statistical tool, alongside the Bloomberg Terminal, used to collect the data for the cost of capital. These two programs helped us to retrieve, study and visualize the data in an accurate way.

In this model, the dependent variable was the Weighted Average Cost of Capital (WACC), which is the main proxy used in the financial industry to calculate the average rate of return that a company is expected to pay to its debt and equity holders to raise capital and finance new investments. Instead, our main explanatory variable was the Equity-to-Total Assets Ratio, which, as we stated before, is a very important leverage ratio and was our proxy for the capital structure, since it shows how much equity our banks have.

As for the first regression, to make the model more robust and reliable, we included some control variables which could influence the WACC. We chose the Debt-to-Equity Ratio, the Derivatives Liabilities-to-Total Assets ratio, and a country dummy variable, which was the same for the first regression model, and accounted for differences in legislative frameworks and market regulations. By including these control variables, we made sure that our WACC was not affected by external financial factors.

As we did for the first analysis, we included different statistical tests to perform our regression. In particular, we calculated the R-squared and Adjusted R-squared, which show the power of our model, then we measured the F-statistic, the t-test, and the p-values.

Moreover, for the same reasons of the first regression model, we used the Durbin-Watson statistic test to see if there was any autocorrelation or heteroskedasticity. In this case, the test was fairly good in this model, since the value was not too far from 2, confirming that there was almost no autocorrelation between our variables.

In conclusion, we also included the Jarque-Bera test to study whether our residuals were normally distributed. All these tests were performed to ensure that the relationship between our variables followed the Ordinary Least Squares (OLS) method with accuracy and without statistical issues.

The second regression model was very useful in describing how banks' capital structure and equity financing affect their cost of capital, providing a reliable and significant result.

**OLS Regression Results Table 3.2**

| | | | |
|---|---|---|---|
| **Dep. Variable:** | WACC | **R-squared:** | 0.375 |
| **Model:** | OLS | **Adj. R-squared:** | 0.323 |
| **Method:** | Least Squares | **F-statistic:** | 7.235 |
| **Date:** | Tue, 20 May 2025 | **Prob (F-statistic):** | 4.93e-13 |
| **Time:** | 22:02:55 | **Log-Likelihood:** | 563.47 |
| **No. Observations:** | 210 | **AIC:** | -1093 |

| | | | |
|---|---|---|---|
| **Df Residuals:** | 193 | **BIC:** | -1036 |
| **Df Model:** | 16 | **Covariance Type:** | Nonrobust |
| **Country dummies:** | | | **YES** |

| | **coef** | **std err** | **t** | **P>\|t\|** | **[0.025** | **0.975]** |
|---|---|---|---|---|---|---|
| Intercept | 0.0910 | 0.016 | 5.698 | 0.000 | 0.059 | 0.122 |
| Equity_to_TotalAssets | -0.0440 | 0.016 | -2.694 | 0.008 | -0.076 | -0.012 |
| Debt_to_Equity | 0.0011 | 0.016 | 0.070 | 0.944 | -0.030 | 0.033 |
| Derivatives_Exposure | -0.0029 | 0.016 | -0.189 | 0.851 | -0.034 | 0.028 |

| | | | |
|---|---|---|---|
| **Omnibus:** | 1.654 | **Durbin-Watson:** | 1.459 |
| **Prob(Omnibus):** | 0.437 | **Jarque-Bera (JB):** | 1.505 |
| **Skew:** | 0.088 | **Prob(JB):** | 0.471 |
| **Kurtosis:** | 2.625 | **Cond. No.:** | 27.8 |

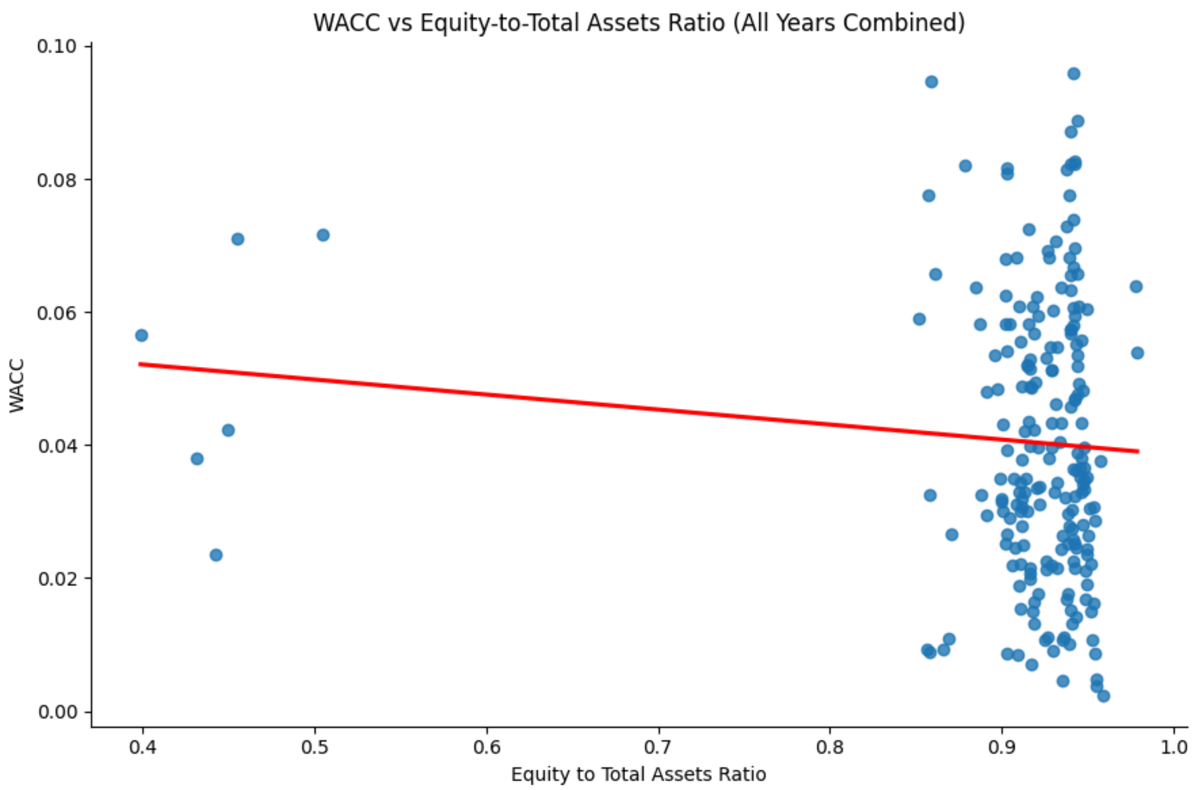
## Graph

The graph below shows the visual representation of the second regression model, and it includes the dependent variable, which is the Weighted Average Cost of Capital (WACC), and the explanatory variable, the banks' Equity-to-Total Assets ratio, both measured over the years. Looking at the graph, the horizontal axis shows the explanatory variable, whereas in the vertical axis the dependent variable, the WACC, is plotted.

As before, we need to understand the blue dots, and here each dot corresponds to a single bank in the dataset, with its position reflecting its WACC over the years relative to its Equity-to-Total Assets ratio. Moreover, as explained before, the red regression line is the line that best fits the OLS model, and explains the relationship between the two variables.

From the graph, we arrive at a graphical solution for our regression model, and visualizing the data helps us explain the variability of our data and any outlier. In this way, the relationship becomes clearer and measurable, since we could easily see an outlier and study the results of that particular data. As with the first regression, the scatterplot makes the analysis complete and easily comprehensible.

Figure 3.2 - Graph Second Regression



# CHAPTER IV - RESULTS AND OBSERVATIONS

While before we explained what we included in our econometric analysis and why, in this last chapter we now turn to discussing the numerical and statistical results of our first and second regression models, following the ordinary least squares (OLS) method.
We will discuss the numerical data and final results, focusing on the final answers to our research questions and on what they mean for the financial industry and subsequent studies on this topic.

## 4.1 - First Regression Results

In this first model, we analyzed how derivatives liabilities affect the capital structure of the banks in our dataset, and as stated in the previous chapter, to study this relationship, we used the Equity-to-Total Assets ratio as our dependent variable, as this was our main proxy for the capital structure, and the amount of derivatives liabilities as our main explanatory variable. Moreover, we used the Debt-to-Equity ratio and the Derivatives Liabilities-to-Total Assets ratio as the control variables, to make the model more robust. Finally, we used a dummy variable, represented by the nations where the banks have their headquarters, to account for different macroeconomic and regulatory environments.

The first measure that we looked at was the R-squared of our model, which is used to measure the explanatory power of the regression. In our case, the model has an exceptionally high explanatory power, with an R-squared of 0.992, which means that 99.2% of the variability in the Equity-to-Total Assets ratio is explained by the total amount of derivatives liabilities.
To confirm the results we looked at the regression adjusted R-squared, which according to Woolridge (2013) is a more reliable measure, which is employed to prevent overfitting. It is equal to 0.991, confirming that our previous measure was not a statistical mistake.
The issue with this excessively high R-squared value of 0.992 is that it is not usual to find such a high explanatory variable in a statistical regression on economic data. However, in our case it can be explained by the fact that we are dealing with accounting measures which are interconnected through the banks' financial statements. Consequently, this high R-squared does not mean that there is overfitting in the model.

Moreover, we looked also at the F-statistic, which measures the joint significance of all the explanatory variables in the model. It is equal to 1452, with a p-value of 1.43e^-191, which is basically equal to zero. According to Greene (2018) a significant F-statistic explains the variations in the dependent variable. The results confirm the previous two measures, and means that the variable chosen actually explains the overall variation in the capital structure. Consequently, we can state that the regression analysis is statistically significant and reliable.

To understand in a better way our dummy variable, we looked at the intercept of the regression, which is equal to 0.0381, and so it is statistically significant since $p < 0.001$, and it measures the Equity-to-Total Assets ratio, assuming that all the other variables are equal to zero (Gujarati, 2003).

Instead, for the dummy variable, the banks that have the headquarters in China, Germany, and the United States show positive coefficients, 0.012, 0.0371, and 0.0197, respectively. This means that the banks in these countries usually keep a higher level of equity. On the other hand, Danish banks show a negative coefficient of -0.0099, which means that they usually keep less equity.

These differences come mainly from corporate governance norms and financial regulations, as explored by La Porta et al. (1998), who studied that differences in financial regulations are related to differences in the capital structure.

However, we also found some unexpected findings. For example, derivatives liabilities has a negative coefficient, -3.196e^-08, which, while still very close to zero, it shows an interesting relationship, which is that a greater amount of derivatives liabilities is associated with a smaller amount of equity capital, and so the Equity-to-Total Assets ratio tends to slightly decrease.

From this, two conclusions can be made: the first result would be that using more derivatives creates more obligations to repay and so more financial risk, which increases and so diminishes the need for equity financing.

The second result is a potential substitution effect, highlighted also by Black and Scholes (1973), where derivatives increase the off-balance sheet leverage of banks, and so they reduce the need to raise equity, since returns are already increased by using the implicit leverage found in derivatives.

On the other hand, the Debt-to-Equity ratio, which is another measure of the capital structure, shows a positive and extremely statistically significant coefficient of 0.3885, with $t = 47.475$, which is a natural consequence since this variable is related with the Equity-to-Total Assets ratio, as they are both proxies for the capital structure, (Myers, 2001).

Our third main variable was the amount of derivatives liabilities over total assets, and we can see from the model that it is positive and statistically significant, with a coefficient of 0.0352, meaning that banks which trade and keep a high amount of derivatives tend to maintain more equity.

This relationship provides a clear result; since trading derivatives increases volatility and financial risk, banks tend to keep a higher level of equity in order to cover their exposure. Moreover, since derivatives carry implicit leverage, they can exploit this characteristic to decrease their debt exposure, increasing the equity ratios.

This relationship is at the basis of risk management practices, which predicts that volatility is usually kept under control with the use of a reinforced capital base, which insures investors from potential fluctuations in the market.

Furthermore, in order to measure the model diagnostics, we focused on one of the main aspects of the OLS method, which is the reliability of the residuals. To achieve this, we run different statistical tests, aimed at testing the classical linear regression.

The first test that we looked at is the Durbin-Watson statistic, which is used, as stated in the previous chapter, to see if there is autocorrelation in the residuals. In our first regression model, we get a value of 2.055, on an overall statistical scale which ranges from 0 to 4. Indeed, a value of 2 (the middle value) indicates the absence of autocorrelation. In our case, the value is rather close to 2, and so this means that our residuals are independently distributed.

This result is very good, since the presence of autocorrelation would lead to biased standard errors and overstated statistical significance. Since in this case the value is close to 2 we can conclude that there is no strong serial correlation, confirming a fundamental assumption of the OLS regression method.

The second test that we ran was the Jarque-Bera test, which is used to test the normality assumption of the residuals. In our model, the value we found was of 1752.673, with a p-value almost equal to zero. This is a very high number which strongly rejects the null hypothesis, which was that residuals are normally distributed. This result is further confirmed by the residuals' kurtosis, equal to 17.142, which suggests the presence of extreme values, also known as "heavy tails", and a skewness of 0.276, meaning that there is moderate asymmetry in the analysis.

The last test run was the Omnibus test, which is used to merge skewness and kurtosis into a single test for normality. In our model, it has a high value, equal to 61.818, and so this confirms the findings of the Jarque-Bera test, and we can conclude that the residual distribution is not normally distributed, (D'Agostino & Pearson, 1973).

The issue of non-normality of the residuals, highlighted by both the Jarque-Bera and Omnibus tests, should be analyzed. First of all, both tests strongly reject the null hypothesis of normal distribution in the residuals. However, the non-normality of the residuals does not mean that there is a violation in the basic assumptions of the ordinary least squares (OLS) method, which consist in the unbiasedness of the coefficients.

The reason for the non-violation is that, in our case, the Gauss-Markov theorem holds, which states that as long as the classical assumptions (linearity, no perfect multicollinearity, homoscedasticity, and no autocorrelation) are respected, the OLS regression model remain the Best Linear Unbiased Estimator (BLUE), (Kennedy, 2008). Consequently, our econometric analysis is still robust and reliable at evaluating the relationship between derivatives and the capital structure.

From the tests run, we can see that the OLS regression method explains in a proper way the relationship between derivatives exposure on financial institutions' capital structure. Its explanatory power is also outstanding, and the coefficients are statistically significant. However, the residuals pose some questions on the single variables due to their non-normality and potential multicollinearity. For this reason, we will further analyze the results later and understand what this means for the relationship between our variables.

## 4.2 - Second Regression Results

In the second OLS regression model we studied the relationship between the weighted average cost of capital (WACC) and the capital structure. The WACC was used as our proxy for the banks' cost of capital, since it takes into account the average returns of both bond and equity holders, (Brealey, Myers & Allen, 2020).

Instead, the three variables used to predict the relationship were the Equity-to-Total Assets ratio (which measures the capital structure), the Debt-to-Equity ratio (a leverage ratio), and the Total

Derivatives Liabilities over Total Assets ratio, which measures the impact of derivatives directly in the cost of capital, which is our ultimate research question.

As for the first regression model, we looked at different statistical parameters; the first was the R-squared of the model, which is equal to 0.375, meaning that 37.5% of the variation in the WACC is explained by the main explanatory variable in the analysis, that is the Equity-to-Total Assets ratio, which is a sign of fairly strong explanatory power.
This result is confirmed also looking at the adjusted R-squared, which we found that it is equal to 0.323, which means that our model stays consistent also after taking into account the other explanatory variables, which is a sign of reliability in our analysis.
This similarity suggests that our variables are good at explaining the variation in the dependent variable, and so we can draw reliable results from our model.

To deepen our analysis, we looked at the F-statistic, which tests the joint significance of all regressors, and it is equal to 7.235, with an associated p-value close to zero.
Consequently, also the F-statistic is statistically significant, and so this means that the model's predictors, when taken all into account, have a clear and strong influence on the variation in the WACC.

We also studied the intercept and its coefficients, and we found that it is equal to 0.091 and it is statistically significant at the 1% level, with a coefficient of 5.698 and a p-value of 0.000. The intercept is the value that the WACC assumes when all other variables included are equal to zero.

We also studied the intercepts of the country dummies, because, even though they are not fundamental, they are still helpful to interpret the differences between countries. As a matter of fact, between the country dummies, many nations are statistically significant. Indeed, the coefficient on the China dummy is negative (-0.0189) and statistically significant at the 1% level ($p = 0.003$), suggesting that banks in China tend to have a lower cost of capital.
Similarly, the Denmark dummy variable is negative and strong, with coefficient equal to -0.0345 and p-value smaller than 0.001, indicating a lower cost of capital for Danish firms. This could be attributed to Denmark's stable macroeconomic environment and favorable financial regulations, which make the national market more stable.

Other countries, such as Finland, France, Germany, the Netherlands, and the United Kingdom have negative coefficients, suggesting that developed countries' cost of capital benefits from lower risk premiums thanks to their advanced financial market and regulatory framework.

On the other hand, looking at the coefficients of the other countries, including those of Italy, Switzerland, and the United States, we found that their coefficients are statistically insignificant. This confirms that our dummy variables do not affect the WACC heavily, and the country where the bank has the headquarters is not so important in the definition of the cost of capital. Also, these coefficients show that in advanced western countries the cost of capital is similar, since they also have similar financial environments. This result suggests that in developed countries, the cost of capital tends to converge, (Bekaert & Harvey, 2003).

Moving to the other regressors, we found that the Equity-to-Total Assets ratio has a negative coefficient, equal to -0.044, meaning that banks with higher equity in their books have a lower cost of capital. This result follows our theoretical approach proposed in the first part of the thesis; more equity means less debt, and so a company with lower leverage will face lower financial risks. Consequently, due to its increased safety, investors will require a lower equity premium and so the cost of capital will be lower, according to the pecking order theory (Myers & Majluf, 1984).

Moreover, the regressor is statistically significant at the 1% level, since its p-value is equal to 0.008, which, together with the confidence interval (from -0.076 to -0.012) confirms the robustness of this variable.
Conversely, looking at the Debt-to-Equity ratio, we see that it has a small positive coefficient, equal to 0.0011, confirming our previous statement: a more heavily leveraged bank will have higher financial risks and therefore a higher cost of capital, since the premium required by investors will increase proportionally with debt. Nonetheless, the result is not statistically significant, since its p-value is equal to 0.944 and it also has a slightly wide confidence interval.

Instead, the most economically significant variable included in the regression model was the Total Amount of Derivatives Liabilities over Total Assets, which has a negative coefficient of -0.0029. Even though this regressor is not statistically significant, since its p-value is equal to 0.851, it further confirms the theoretical framework proposed, since it means that banks that trade a high number of derivatives, especially for hedging purposes, will decrease financial risks and consequently lower their cost of capital, (Stulz, 1996).
In this case they will be hedged from financial variables such as interest rate fluctuations,

currency volatility, and commodity prices, becoming more stable and robust in the eyes of investors.
All three of our variables confirm the theory proposed, and so, even though taken singularly they are not statistically significant, when looking at all the coefficients we can see a clear relationship and economic result.

Moreover, in order to further test the robustness of the model, we looked, as in the first regression, at the residuals, performing different analyses.
The first one was the Durbin-Watson statistic, equal to 1.459, while the ideal value should be 2. Consequently, there is some moderate positive autocorrelation in our model. This is explained by the fact that we used observations across time within the same unit, that is banks. The result is still good overall, even though not fundamental in a cross-sectional analysis.

To confirm the results, when looking at the distribution of the residuals, there are limited issues. The Omnibus test and the Jarque-Bera test both have non-significant p-values (0.437 and 0.471, respectively), showing that the residuals are normally distributed. Moreover, the skewness is close to zero (0.088) and the kurtosis is very close to the normal value of 3, since it is equal to 2.625. This means that residuals are distributed in a symmetrical way and they do not have heavy tails. Consequently, the assumption of normality in the residuals of the OLS model is confirmed.
Even though these tests are not the most critical components of an econometric analysis, they confirm that our results are good and reliable.

To conclude, this second econometric analysis was helpful and showed a clear relationship between capital structure and cost of capital.
Indeed, even though some coefficients are not statistically significant, they all point to the same direction, which is that each bank with a high level of equity has a lower WACC, while those that have a higher Debt-to-Equity ratio tend to have an increased cost of capital.
Moreover, derivatives trading, especially when executed for hedging purposes, is negatively correlated with the WACC, since it decreases the bank's debt exposure. In this case, the result suggests that the more derivatives trades the bank performs, the lower its cost of capital.
However, we need to be careful when using these financial instruments, since having an excessive exposure will not bring benefits, but financial risks (Bartram, Brown, and Fehle, 2009). Consequently, we will try to assess, based on the regression results, how much can banks

expose themselves to derivatives in order to maximize the benefits of these financial instruments.

## 4.3 - Impact on the Capital Structure

Now that we analyzed the numerical regression results, we can draw our final conclusions on our research questions. Indeed, the econometric analysis of the first OLS regression gave us some insightful conclusions for understanding how derivatives affect the capital structure of the banks in the dataset. As we expected when posing the research question, the relationship between these two variables is important in the financial industry.

Indeed, this was our first finding: there is clear econometric evidence that trading a high volume of financial derivatives affects the way banks design their capital structure.
In particular, the result found from the first regression model showed that banks with a high level of derivatives liabilities over total assets have a higher level of equity compared to banks with low levels of derivatives liabilities. The reason for this result is that when banks trade derivatives, they exploit their speculative function, which increases returns but makes the overall financial risk of the bank higher, and so a higher equity buffer is needed to ensure solvency and stability.

In fact, derivatives are instruments that can take two forms: hedging and speculative.
When used as a hedging instrument, they become important for risk management strategies, ensuring banks against interest rate fluctuations, currency risks, and other financial variables.
Consequently, banks can either choose to hedge and lower financial risks, having the chance to keep lower equity capital buffers. This is shown in the regression model by the main explanatory variable, which shows a negative relationship between the Equity-to-Total Assets ratio and the Derivatives Liabilities. On the other hand, when they use derivatives to speculate, banks need to maintain higher equity buffers and so the relationship becomes positive, as explained before.
From this, the result that we found was that derivatives can be used as a substitute for debt.
By using these financial instruments, banks can create implicit leverage and exploit its benefits, while keeping attention to the overall risk profile by using more equity in the capital structure.

However, a potential issue to be aware of is that, even though the relationship between derivatives and capital structure is logical and robust from an economic point of view, its statistical significance was not so strong.

This means that, while a clear relationship exists, it is not so large and so it has to be further studied and observed in the future, analyzing how the markets and this relationship will develop, as well as its benefits and issues. In particular, our relationship was affected by the way derivatives are used (hedging vs speculative), and regulatory frameworks that affected the functioning of the different capital markets across the world.
Consequently, even though the model provided reliable results, it also shows that derivatives taken alone cannot explain all the differences in banks' capital structures.

Another important conclusion that we can draw from the analysis is that derivatives have to be used carefully. Even though they can be used as a substitute for debt, an excessive exposure to this type of instrument can increase the financial risks of banks, especially if the portfolio of derivatives becomes too complex and the strategies become very difficult to hedge.
Consequently, while the model suggests that using derivatives can decrease the level of debt and so stabilize cash flows and earnings, it also warns against overexposure. Hedging through derivatives is efficient until a certain threshold, which varies for each bank, and beyond which there is the risk of an increase in systemic and liquidity exposure (Froot, Scharfstein & Stein, 1993).

Furthermore, the econometric analysis shows that derivatives are a strategic choice made by banks, which affect risk management practices.
In markets where the regulatory framework is more strict, derivatives can be used more to reduce debt and increase the equity percentage in the capital structure and so comply with the control bodies rules. Consequently, the relationship found is not just statistical or casual, but it is the result of a mindful financial strategy performed by banks in order to maximize their returns while minimizing the risks.

Other than purely financial results, we can also draw juridical conclusions from our analysis, since from a regulatory perspective, these conclusions have major implications. Indeed, policymakers should not treat all derivatives exposure in the same way, since they are created in different environments.
In particular, it is fundamental to differentiate between derivatives held for hedging purposes, which decrease the financial risk of banks, and derivatives used for speculative or trading reasons, which increase financial risk. The reason is that the analysis shows that when used as risk management strategies, derivatives make a bank more robust and solvent, and so there should not be rules against them. Indeed, a missing differentiation could discourage hedging

activities which are beneficial, and so firms are forced to take on more debt to maintain an efficient capital structure.

Moreover, tied to the regulatory analysis, another insight of the model is that we found clear evidence of a balance between capital structure practices and financial innovation.
As the financial industry continues to evolve, risk management practices become more and more sophisticated, and so the belief that just a good equity ratio can guarantee financial stability is doubtful. Derivatives are a clear example of this result, since, while they are risky assets, they are effective risk management tools that can guarantee financial stability.

In conclusion, the first regression model provided good results and financial insights, highlighting a clear relationship between our variables and so providing an answer to our research question, which was how derivatives impact the capital structure of financial companies. While the effect should be treated carefully since it does not have a lot of statistical strength, we can conclude that derivatives are very important in explaining a part of the variations visible in the capital structure, providing new solutions for policymakers and risk management officers.

## 4.4 - Impact on the Cost of Capital

The second econometric analysis studied the relationship between the banks' capital structure and their weighted average cost of capital (WACC), and provided important results.
Indeed, the regression model showed significant economic patterns which are in line with our theoretical framework proposed in the first part of the thesis.

First of all, the most important conclusion that we can draw from the analysis is that in fact the capital structure is a key variable in the definition of the cost of capital. This is a very important result for us since it was our main research question.
In particular, our results show that banks with a higher Equity-to-Total Assets ratio have a lower cost of capital, represented by the WACC. This is in line with our theory, which was that maintaining more equity reduces the financial risks brought by debt, and so both debt and equity holders require lower returns. Consequently, our main result was that higher equity buffers bring lower financial risks, and so decrease the overall cost of capital.

The relationship found confirms the corporate finance theory discussed in the first part about the cost of capital. Indeed, we analyzed that, according to the trade-off theory, debt can be beneficial until a certain point, thanks to the tax shield, but beyond that, banks can experience excessive leverage, which results in financial distress and higher risk premiums (Jensen and Meckling, 1976).
This is the reason why higher debt is related with a higher cost of capital, and so financial intermediaries should be aware and keep an efficient leverage level.

Another important conclusion can be made regarding the Debt-to-Equity ratio. Indeed, as confirmed by the theoretical framework, this variable was positive, and so it further confirms that higher debt is associated with a higher WACC.
However, this coefficient was not statistically significant. Consequently, while the result is logical and consistent with the theory, we can state that debt is not the only factor which affects the WACC. Indeed, other financial variables are directly tied to the cost of capital, such as regulations, collateralization, and exotic financial instruments. This means that not all debt is the same and that even with a low level of debt we can find banks with a high cost of capital, affected by other external factors.

For this reason, our thesis' objective was to understand how derivatives, which are not debt and can take exotic forms, implicitly affect the WACC. As a matter of fact, our regression model included as a variable the Total Derivatives Liabilities over Total Assets ratio, to study the relationship between derivatives and the WACC.
In our case, the coefficient was negative, confirming that, if derivatives are used for hedging purposes, they can stabilize the banks' earnings and so decrease the cost of capital. However, this relationship was not statistically significant, and the reason is quite clear. Indeed, if derivatives are used for speculative reasons, they can destabilize the WACC and so even with an efficient level of leverage, they increase the overall financial risk, increasing volatility.

Moreover, the decision to include the country dummies made the analysis more complete. Indeed, we found that the banks with headquarters in China, Denmark, and other developed European economies have a lower cost of capital, which means that the macroeconomic environment and regulatory framework are very important in the determination of the WACC. This is because a more stable capital market, and predictable economic environment, decreases the risk premium required by investors and consequently the cost of capital (Graham and Harvey, 2001).

However, as it was a dummy variable, most countries had statistically insignificant coefficients, meaning that in developed markets, such as the ones analyzed, the capital structure definition is way more fundamental in affecting the banks' WACC than the country where they have the headquarters.

By analyzing our results, we found that for banks capital management is a key component in the determination of the cost of capital. Since the choice of the efficient level of equity in the capital is so important, we try to measure a range which makes the capital structure efficient.
From the regression model, we found different efficient equity capital buffers for the different banks, but on average we analyzed that keeping an Equity-to-Total Assets ratio in the range of 10% to 15% results in an efficient maximization of the risk-return relationship. Consequently, the WACC is low and stable while at the same time not conservative, and so return on equity and growth capacity are not diminished.

However, beyond the 15% threshold, the benefits of the higher equity buffers decrease and the WACC increases. This means that the benefits of a high level of equity are lower than those brought by the tax shield effect of leverage, reducing profitability.
On the other hand, banks with equity levels below 10% suffer from the opposite problem, and indeed have a high debt ratio, which raises doubts for the bank's solvency and stability. Consequently, when banks have an equity ratio in the 10%-15% range, they are more stable and investors require lower risk premiums, and so a lower cost of capital.

Coming to derivatives, their use is directly tied to this strategy. Even though their coefficients were not statistically significant, derivatives are still important in the determination of the WACC, whether or not they are used for hedging purposes.
Indeed, derivatives, as discussed, help to protect against sudden shocks when used properly, increasing the credibility of the banks' positions and so improving the cost of capital. However, they can also increase the risks tied to movements in the market, and so the cost of capital increases in this case. Consequently, their economic significance is very high, and should be defined properly, as we will do next.

In conclusion, the second econometric analysis shows how equity is a fundamental variable in the definition of the cost of capital for financial intermediaries. Indeed, while debt and other instruments such as derivatives are important too, maintaining the efficient level of equity capital of around 10% to 15% is fundamental to ensure financial strength and stability. In this way, banks can lower their cost of capital and become more robust and efficient (Miller, 1977).

## 4.5 - How Derivatives Affect the Capital Structure and Cost of Capital

Finally, we come to answer the main research question of this thesis: how and to what extent do derivatives affect the capital structure and cost of capital of financial companies?
By putting together the two regression models we can answer this question and also come to a conclusion about how this financial instrument affects the financial stability and funding costs of banks.

If we first look at the results of the first regression, it was clear that derivatives exposure, which was represented by the amount of derivatives liabilities over total assets, are a key variable in the variations found in the capital structure of the different banks (Fama and French, 2002).
The result was based on the variation found in the Equity-to-Total Assets ratio, which confirmed our theoretical framework. The positive correlation between the two variables was attributed to the hedging benefits of derivatives, which safeguard the bank from market movements tied to interest rates, FX commodities, and foreign exchange volatilities.
Indeed, the main finding was that derivatives take a substitution effect form, where they are used also for their implicit leverage, which brings the total level of debt down. This characteristic increases the equity percentage in the capital structure, hence the positive correlation between the two variables.

The second regression model also proved invaluable results. We analyzed how a more robust capital structure, represented by the Equity-to-Total Assets ratio, is fundamental in the determination of the cost of capital, represented in our case by the WACC.
The result found was very important: a more financially stable company has a lower cost of capital. This is due to the fact that having strong equity buffers leads to less exposure in the event of a financial distress situation, and so investors see the bank as more stable, and so require a lower return for funding new investments since the latter is safer.
Moreover, even though the coefficients between derivatives liabilities and the cost of capital were not statistically significant, the regression model showed a clear relationship between derivatives and the WACC.
The conclusion that we can draw from the analysis is very important for our study, since it shows

that when used efficiently for risk management purposes, derivatives improve financial stability and improve the cost of capital, which decreases. The result is in line with our research question, which aimed at finding a positive relationship between derivatives exposure and the WACC.

To make our analysis more useful and complete, we studied a numerical efficient level of derivatives exposure that is efficient for banks. The numerical range is based on the results of our econometric analyses, which showed that between the banks across our dataset, those who have a Total Derivatives Liabilities over Total Assets ratio between 15% and 25% have a more efficient capital structure and a good financial stability, with moderate risk.
In particular, within the 15% to 25% range, banks have a higher Equity-to-Total Assets ratio, and so a stronger capital structure, and a lower WACC, in line with both the first and second regression model. To test this range, we analyzed what happens below and above it: below the 15% threshold there is a limited use of derivatives which does not exploit all the benefits attainable in risk management and capital structure definition, whereas above the 25% threshold, the banks have too many derivatives instruments in their balance sheets and so they exceed the risk management benefits and become risky. Indeed, investors could perceive a bank with such a high amount of derivatives as too speculative, and so the cost of capital increases.
The regression model also showed that a high level of derivatives was related with a greater residual autocorrelation, meaning that above this threshold, external variables affect both derivatives exposure and the cost of capital, lowering the financial benefits (Merton, 1977).

Conversely, inside the 15% to 25% range, the banks in our dataset show positive results. The exposure to derivatives is optimal in this amount and maximizes returns while not compromising the financial stability of the company.
Moreover, maintaining this ratio allows the bank to become more transparent and reliable to investors, also improving its risk management strategies. As a consequence, the capital structure becomes stronger and the cost of capital decreases.

Consequently, our research question was answered successfully, highlighting important results and a strong relationship between our variables. Derivatives do indeed affect the capital structure of financial companies, and, through it, also affect the cost of capital.
Banks and other financial institutions should use this instrument not only for short-term trading operations, but as a fundamental variable, which stabilizes risk and improves the financial structure of the company, allowing the bank to grow and prosper in today’s competitive financial environment.

# CONCLUSION

This thesis, which aimed at studying the relationship that financial derivatives have on important financial parameters such as the capital structure and the cost of capital, was able to provide a practical and numerical basis from which further studies can be developed. Indeed, our theoretical framework suggested that a higher level of derivatives is related with higher equity buffers and with a lower cost of capital.

As a matter of fact, the hypotheses presented at the beginning of the study were confirmed by both the regression models run, from which we were able to show a positive relationship between derivatives and equity, thanks to their hedging benefits.
We also found, thanks to the econometric analyses, that there exists an inverse relationship between equity buffers and the cost of capital, which was also in line with our theoretical framework, which suggested that big and stable financial institutions are regarded as less risky by the market, and consequently have a lower WACC.

The analyses were performed using a self-constructed dataset, which comprised 35 big banks, of which 29 were the Global Systemically Important Banks (B-SIBs). This dataset made from scratch enabled us to include, in our regression models, those financial intermediaries which are the most affected by the use of derivatives. Moreover, since it was based on the study of their financial statements, the dataset provided a reliable base for our study.

One of the most significant results we got from the thesis was that derivatives are important not only for speculative reasons, but primarily as risk management tools which optimize the capital structure. Furthermore, the efficient use of derivatives also improves the cost of capital, together with the capital structure.

Consequently, these results are a very important base for the ongoing research on the role of derivatives in the modern financial industry. The results should be further developed in subsequent academic papers.
In particular, further research could strengthen the reliability of our estimates, specifically on the meaning of notional versus fair value derivatives, which is very important to understand when analyzing the financial statements.

To conclude, we can state that our thesis successfully answered our main research questions and helped us understand how derivatives affect the capital structure and cost of capital of big international banks. It provided quantitative and statistically significant results which are reliable and practical for both the academic literature and the banking industry.

Our goal was to pave the way for further and more detailed studies about derivatives, and we were able to do so in a practical and efficient way.

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