

***DEPARTMENT OF BUSINESS AND MANAGEMENT***

***Master's Degree in Corporate Finance***

Chair of Advanced Corporate Finance

***The Impact of Financial Leverage on Profitability in the European  
Tech Sector: A Multiple Linear Regression Analysis***

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## Table of Contents

<b>Introduction</b> .....	3
<b>Chapter 1 – Theoretical Framework</b> .....	4
1.1 Financial Leverage: definition and components .....	4
1.2 Business profitability: indicators and determinants .....	7
1.3 Theoretical relationship between Financial Leverage and Profitability .....	11
1.4 Financial Specificities of the Technology Sector .....	14
1.5 Review of the Scientific Literature .....	17
<b>Chapter 2 – Economic and Financial Context of the European Technology Sector</b> .....	19
2.1 Evidence on the Technology Sector .....	19
2.2 Research within the European Context .....	20
2.3 Evolution of the Technology Sector in Europe (2019–2023) .....	21
2.4 Relevant Macroeconomic and Financial Indicators .....	23
2.5 Analysis of the Main Global Industry Players.....	26
<b>Chapter 3 – Research methodology</b> .....	34
3.1 Objective of the Empirical Analysis .....	34
3.2 Sample Selection and Firm selection criteria .....	34
3.3 Description of the variables .....	35
3.4 Data Sources and Observation Period .....	37
3.5 Regression Model: Multiple Linear Regression.....	38
3.6 Model Hypotheses and Statistical Tests.....	40
<b>Chapter 4 – Analysis of Data and Results</b> .....	41
4.1 Regression Results .....	41
4.2 Interpretation of the Coefficients .....	44
4.3 Discussion of the Results in Light of the Literature .....	46
<b>Conclusions</b> .....	49
<b>Bibliography</b> .....	51

# **Introduction**

## *Context and purpose of the study*

The European technology sector has become a strategic engine of growth, innovation, and competitiveness, driving structural transformation across the continent's economy. Over the past decade, its contribution to GDP, employment, and value creation has expanded rapidly, supported by breakthroughs in software, semiconductors, digital services, and artificial intelligence. At the same time, the sector's financial landscape is uniquely complex. Technology firms typically combine high R&D intensity and intangible assets with volatile cash flows and rapid product cycles, features that challenge traditional financing models and capital-structure decisions.

Within this environment, financial leverage—the use of debt relative to equity—plays a central role in shaping corporate strategy and shareholder returns. Classical finance theory suggests that leverage can amplify returns when the cost of debt remains below the return on assets, yet it also raises the risk of financial distress. Empirical evidence remains mixed, varying by industry, economic cycle, and firm characteristics. In Europe, this question has become more pressing in recent years as technology companies have navigated a turbulent macroeconomic context: the COVID-19 pandemic (2020–2021), a rapid rebound and digital surge in 2021, and an abrupt shift to high inflation and monetary tightening from 2022 onward. These events altered access to capital, cost of debt, and investor expectations, directly affecting financing choices and profitability.

## *Research objectives*

Despite an extensive global literature on capital structure, relatively few studies focus specifically on the European technology sector in the post-pandemic period. This thesis addresses that gap by examining how financial leverage influences corporate profitability in a representative panel of 20 listed European technology firms between 2019 and 2023. By integrating both cross-sectional heterogeneity and time-series dynamics, the analysis captures a full macro-financial cycle and tests whether leverage ratios such as Debt/Equity and Debt/Assets explain differences in firm performance.

The empirical strategy relies on multiple linear regression estimated by Ordinary Least Squares (OLS). Two profitability measures—Return on Assets (ROA) and Return on Equity (ROE)—serve as dependent variables, allowing the study to distinguish between operational efficiency and the direct amplification of equity returns. Control variables for growth, tangibility, capital intensity, and R&D

intensity are included to isolate the independent effect of leverage. This framework makes it possible to assess whether capital-structure decisions enhance or constrain profitability once firm-specific characteristics and macroeconomic conditions are taken into account.

Beyond its academic relevance, the research contributes to managerial and policy debates. For corporate managers, understanding the leverage–profitability nexus informs optimal financing strategies and risk management in an industry defined by rapid innovation and intense global competition. For policymakers and investors, the findings offer evidence on how European technology firms respond to shifting monetary conditions and how capital-structure choices may influence the sector’s capacity to scale and compete internationally.

## **Chapter 1 – Theoretical Framework**

### ***1.1 Financial Leverage: definition and components***

Financial leverage represents one of the most relevant analytical tools in corporate finance, as it allows the interpretation of a firm’s capital structure in relation to the mix between internal resources and external financing. It is defined as the ratio between capital obtained through external financing (debt) and capital originating from internal sources (equity), i.e., the funds contributed by shareholders or derived from retained earnings. Leverage plays a decisive role in assessing the firm’s risk-return profile and, consequently, in shaping financial and investment strategies.<sup>1</sup>

From a theoretical perspective, the use of financial leverage is aimed at increasing the profitability of equity capital. This objective is pursued through a mechanism known as the leverage effect: if the return on investments financed with debt capital exceeds the weighted average cost of that debt (i.e., the effective interest rate net of tax savings), the resulting surplus translates into an increase in ROE (Return on Equity), to the benefit of shareholders. However, this positive effect only manifests itself in contexts of stable and predictable economic performance, whereas in situations of declining operating margins or exogenous shocks—such as financial crises or generalized increases in interest rates—high financial leverage may generate severe challenges, reducing the firm’s ability to meet financial obligations and increasing the risk of insolvency.<sup>2</sup>

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<sup>1</sup> Brealey, R. A., Myers, S. C., & Allen, F. (2017).

<sup>2</sup> Damodaran, A. (2010).

The measurement of financial leverage is based on a set of synthetic indicators of capital structure, which make it possible to analyze the level of indebtedness, self-financing capacity, and the balance between sources of financing. The main ones are the following:

1. *Debt-to-Equity Ratio (D/E):*

$$D/E = \text{Total Debt} / \text{Equity}$$

This indicator highlights the proportion between debt capital and shareholders' equity. Values above one indicate a prevalence of external financing over internal resources, and therefore a higher degree of financial risk. Its interpretation, however, must consider the industry sector and the firm's stage in its life cycle.<sup>3</sup>

2. *Debt Ratio (DR): Short-Term and Long-Term Debt Structure*

$$DR = \text{Total Debt} / \text{Total Assets}$$

It expresses the share of company assets that is financed by debt. This measure provides a concise indication of the firm's dependence on external capital for operational and strategic management.<sup>4</sup>

3. *Equity Ratio (ER): Short-Term Debt*

$$ER = \text{Equity} / \text{Total Assets}$$

It reflects the percentage of total assets financed with equity. It is often interpreted as an indicator of financial solidity and the firm's ability to withstand reduced profitability or limited access to credit.<sup>5</sup>

4. *Short-Term and Long-Term Debt Structure*

An important distinction in the analysis of financial leverage concerns the maturity structure of debt, i.e., the proportion of short-term and long-term liabilities in a firm's capital structure. This dimension provides essential insights into the risk profile and financial sustainability of corporate strategies, complementing the synthetic indicators of leverage previously discussed.

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<sup>3</sup> Ross, S. A., Westerfield, R. W., & Jaffe, J. (2013).

<sup>4</sup> Brigham, E. F., & Ehrhardt, M. C. (2014).

<sup>5</sup> Fraser, L. M., & Ormiston, A. (2016).

## 5. *Short-Term Debt*

Short-term debt refers to obligations maturing within one year, such as bank overdrafts, trade payables, commercial paper, and short-term loans. Its main advantage lies in the lower cost of financing, since lenders generally apply reduced interest rates to short maturities. Furthermore, short-term debt may represent a flexible tool for covering temporary liquidity needs, adapting to fluctuations in working capital. However, excessive reliance on short-term liabilities exposes firms to refinancing risk and to the volatility of credit markets. In periods of tightening financial conditions, companies with high levels of short-term debt may find it difficult to roll over obligations, with potential negative effects on solvency and profitability.

## 6. *Long-Term Debt*

Long-term debt, on the other hand, includes bank loans, bonds, and other obligations with maturities exceeding one year. Its primary function is to provide stability in financing, supporting strategic investments with extended payback periods, such as acquisitions, infrastructure, or R&D projects. By spreading repayment obligations over a longer horizon, long-term debt reduces liquidity pressures and allows more accurate financial planning. Nevertheless, it also introduces rigidity, due to fixed interest charges and contractual covenants, which may limit managerial flexibility and increase the firm's exposure to long-term shifts in interest rates or credit spreads.

## 7. *Other specific ratios*

The measurement of the maturity structure of debt is commonly based on specific ratios, such as:

- *Short-Term Debt Ratio (STDR)*

$$\text{STDR} = \text{Short-Term Debt} / \text{Total Assets}$$

- *Long-Term Debt Ratio (LTDR)*

$$\text{LTDR} = \text{Long-Term Debt} / \text{Total Assets}$$

- *Debt Maturity Structure (DMS)*

$$\text{DMS} = \text{Short-Term Debt} / \text{Total Debt}$$

The optimal composition between short- and long-term debt depends on several factors, including the firm's size, creditworthiness, investment horizon, and industry characteristics. In technology firms, the limited availability of tangible collateral and the volatility of cash flows tend to reduce access to traditional long-term financing, while increasing reliance on flexible, short-term or hybrid

instruments. This specificity underscores the importance of evaluating not only the overall level of leverage but also its maturity profile, in order to capture the actual risk-return dynamics of the firm.

Other complementary indicators, such as the Times Interest Earned (TIE) and the Debt Service Coverage Ratio (DSCR), provide additional information on debt sustainability in terms of the firm's ability to generate sufficient cash flows to cover interest and principal payments. These tools are particularly useful when analysing the financial soundness of highly leveraged firms, such as those operating in capital-intensive sectors or subject to high revenue volatility.

The financial structure is not a static variable: it evolves according to the economic cycle, growth needs, dividend policy, investment opportunities, and the conditions of financial markets.

Consequently, the optimization of financial leverage cannot be conceived in absolute terms, but must be evaluated within the overall framework of corporate strategies and medium-to-long-term sustainability. Firms in the expansion phase, for example, may accept a higher level of debt to finance strategic investments, whereas companies in the maturity stage may prefer conservative policies aimed at reducing debt.

## ***1.2 Business profitability: indicators and determinants***

Business profitability represents one of the cornerstones of economic-financial analysis and one of the main managerial objectives in modern firm theory. It reflects the ability of an organization to generate profit, that is, added economic value, from the resources invested in its production and management processes. In other words, profitability measures the efficiency with which a firm is able to convert inputs (capital, labor, raw materials, know-how) into positive monetary outputs.

This concept plays a central role in performance evaluation, not only retrospectively (ex post), but also prospectively (ex-ante), as it serves as a synthetic indicator of a firm's ability to sustain itself over time, remunerate its investors, and attract risk capital.<sup>6</sup>

The measurement of profitability can be carried out using a wide range of tools and indicators. In general, two macro-categories are distinguished: on the one hand, absolute indicators, which express in monetary terms the profit generated in a given period (e.g., operating income, net income, gross margin, EBITDA); on the other hand, relative indicators, which relate the economic result to other

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<sup>6</sup> Penman, (2013).

balance sheet, income, or financial figures, in order to obtain a more informative and comparable evaluation across firms and sectors.<sup>7</sup>

Among the most widely used relative profitability indicators in academic and professional contexts are the following:

1. *Return on Assets (ROA)*

$$\text{ROA} = \text{EBIT} / (\text{Average Total Assets})$$

ROA measures the return generated by the firm in relation to the total resources invested, regardless of their source (equity or debt). In this sense, it represents a “neutral” indicator with respect to financial structure and provides an estimate of overall efficiency in asset management. High ROA values indicate a strong ability of the firm to use its operating capital effectively. However, this indicator may be influenced by the presence of high-value fixed assets, which can reduce the intensity of returns.<sup>8</sup>

2. *Return on Equity (ROE)*

$$\text{ROE} = \text{Net Income} / (\text{Average Equity})$$

ROE is one of the most commonly used indicators in financial analysis, employed to estimate the return generated by equity capital. In other words, it indicates the expected or actual rate of return for shareholders, taking into account the level of risk assumed. ROE is particularly sensitive to capital structure choices: for the same level of net income, an increase in debt reduces the denominator (equity) and therefore increases the value of the index. This phenomenon is referred to as the positive leverage effect. However, if the cost of debt exceeds the return on assets, a negative leverage effect occurs, eroding equity profitability.

3. *Return on Sales (ROS)*

$$\text{ROS} = \text{EBIT} / (\text{Net Sales Revenues})$$

ROS expresses the firm’s ability to convert revenues into operating profit. It is an indicator of operating profitability and is particularly useful for comparing firms with similar business models but different revenue volumes. A high ROS indicates that the company is able to control operating costs

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<sup>7</sup> White, G. I., Sondhi, A. C., & Fried, D. (2003).

<sup>8</sup> Higgins, R. C. (2012).

relative to its sales level, maintaining wide margins. Conversely, a low ROS may indicate managerial inefficiencies or intense competitive pressure.<sup>9</sup>

#### 4. *Net Profit Margin (NPM)*

$$\text{NPM} = \text{Net Profit} / \text{Revenue}$$

The Net Profit Margin measures the percentage of revenue that remains as net income after all operating expenses, financial charges, taxes, and extraordinary items have been deducted. It is a comprehensive indicator of the firm's overall profitability and efficiency, capturing both operational and financial dimensions of performance. A high NPM suggests that the company is able to retain a significant portion of its revenues as profit, while a low or negative margin highlights structural inefficiencies, elevated cost burdens, or weak pricing power. When comparing firms across sectors, it is crucial to consider industry-specific benchmarks, as capital-intensive industries typically operate with narrower margins compared to technology or service-oriented businesses.

##### 1. *Revenue Growth*

Revenue growth represents one of the fundamental determinants of profitability, as it allows the firm to expand its market share and exploit economies of scale. Rapid increases in revenues contribute to diluting fixed costs and enhancing operating leverage, thereby improving margins. However, unbalanced or excessively rapid revenue growth may lead to diseconomies of scale, managerial inefficiencies, or overexpansion. In technology firms, revenue growth is often a reflection of successful product innovation, market adoption, and scalability of digital platforms.

##### 5. *Cost Efficiency*

Cost efficiency refers to the ability of the firm to minimize production, distribution, and administrative expenses while maintaining output quality. Efficient cost structures directly enhance profitability by widening the gap between revenues and expenditures. Key practices include process optimization, automation, outsourcing, and effective supply chain management. Firms with strong cost efficiency are better positioned to sustain profitability even in highly competitive environments. In the technology sector, efficiency gains often stem from economies of scale in software development and digital infrastructures.

##### 6. *Capital Intensity*

Capital intensity indicates the extent to which production processes require significant fixed asset investments relative to revenues. Highly capital-intensive industries (e.g.,

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<sup>9</sup> Ross, S. A., Westerfield, R. W., & Jordan, B. D. (2018).

manufacturing, energy) generally face higher depreciation costs and fixed financial charges, which can compress profitability. Conversely, less capital-intensive firms, such as many technology companies, may enjoy greater flexibility and scalability with comparatively lower fixed-cost burdens. Nevertheless, certain subsectors within technology, such as semiconductors or telecommunications, display considerable capital intensity, which strongly influences their profitability dynamics.

#### 7. *R&D Investments*

Research and Development (R&D) expenses represent a critical driver of long-term profitability, particularly in technology-intensive sectors. Although R&D involves high upfront costs and uncertain outcomes, successful innovations can generate sustainable competitive advantages, premium pricing, and new revenue streams. The impact of R&D on profitability is often nonlinear: in the short term, high levels of investment may reduce margins, but in the medium-to-long term they can significantly enhance performance by fostering innovation, intellectual property development, and market differentiation. Firms that manage to balance R&D spending with financial sustainability tend to achieve superior and more resilient profitability profiles.

#### *Practical Example*

For illustrative purposes, consider a European technology company that, in a given fiscal year, reports the following figures: operating income (EBIT) of €12 million, net income of €6 million, average total assets of €120 million, average equity of €50 million, and net sales revenues of €80 million. The main profitability ratios would be as follows:

- $ROA = 12 / 120 = 10\%$
- $ROE = 6 / 50 = 12\%$
- $ROS = 12 / 80 = 15\%$

These values highlight an efficient profitability profile, both in terms of managing total resources (ROA) and remunerating equity capital (ROE). Moreover, the 15% ROS indicates strong operating margins. The fact that ROE is higher than ROA suggests the existence of a positive leverage effect, consistent with the sustainable use of debt. However, it is necessary to also monitor the evolution of these indicators over time, in order to determine whether such profitability is structural or contingent.<sup>10</sup>

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<sup>10</sup> Brigham, E. F., & Houston, J. F. (2016).

## Determinants of Profitability

Numerous factors influence a firm's profitability, which can be classified into two main categories: endogenous factors, internal to the firm and controllable by management, and exogenous factors, linked to the external environment and not directly controllable.<sup>11</sup>

Among the endogenous factors are:

- *Operational efficiency*, i.e., the ability to maximize output given a certain level of input, through optimization of production, logistics, and administrative processes;
- *Pricing strategies*, which influence the firm's ability to capture value in the market;
- *The composition and structure of costs*, particularly the weight of fixed costs, which can increase the volatility of operating income;
- *Investment policies*, especially in sectors with high intellectual capital intensity, where R&D expenditure can generate sustainable competitive advantages.
- *The exogenous factors*, on the other hand, include:
  - *The macroeconomic environment*, which affects consumer purchasing power and the cost of capital;
  - *The tax and regulatory system*, which influences the tax burden and capital allocation;
  - *Access to credit and the conditions of financial markets*, which can either support or constrain the expansion of production activity;
  - *The level of competition and the maturity of the reference market*.

Finally, it should be considered that profitability is a variable that can endogenously interact with other corporate dimensions. For example, highly profitable firms may prefer internal financing, reducing reliance on debt, in line with the pecking order theory. Conversely, lower profitability may induce firms to rely more heavily on external capital, especially if interest rates are favorable.

### ***1.3 Theoretical relationship between Financial Leverage and Profitability***

The relationship between financial leverage and profitability represents one of the central themes in corporate finance theory and has been the subject of extensive and multifaceted academic debate.

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<sup>11</sup> Damodaran, A. (2007).

Since the pioneering contributions of the mid-twentieth century, the scientific literature has sought to model firms' behavior in choosing their capital structure—that is, the optimal combination of equity and debt capital—by evaluating its effects on economic and financial performance.

The core issue lies in the possibility that financial leverage, when properly calibrated, can generate an amplifying effect on the profitability of equity capital (ROE), without undermining the firm's solvency. However, this effect is neither linear nor universally positive: it is conditioned by multiple structural, sectoral, macroeconomic, and institutional factors.<sup>12</sup>

### *The Neoclassical Perspective: The Modigliani and Miller Model*

The first systematic attempt to formalize the relationship between financial structure and profitability dates back to the famous Modigliani and Miller theorem (1958), considered the theoretical foundation of the modern theory of capital structure. In its original form, the model postulates that, under conditions of a perfect market—that is, in the absence of taxes, transaction costs, information asymmetries, and opportunistic behavior—the value of the firm is independent of the composition of its capital structure. In other words, indebtedness does not create value, and the expected profitability for investors depends exclusively on the operating risk of the underlying economic activity<sup>13</sup>.

Subsequently, the same authors (1963) reformulated the model by including the effect of corporate taxation, introducing the concept of the tax shield. In this context, the use of debt becomes advantageous because interest expenses are tax-deductible, resulting in a reduction of the overall tax burden. Consequently, the value of the firm increases in direct proportion to the level of indebtedness, at least up to a certain point<sup>14</sup>.

### *Static and Dynamic Trade-Off Theory*

On the basis of these premises, the so-called trade-off theory was developed, according to which there exists an optimal level of financial leverage that maximizes the value of the firm. This level results from a balance between the benefits of indebtedness (primarily fiscal) and the implicit costs associated with insolvency risk, financial rigidity, and agency costs. The static version of the theory assumes that firms position themselves in equilibrium around this optimal level, whereas the dynamic

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<sup>12</sup> Harris, M., & Raviv, A. (1991).

<sup>13</sup> Modigliani, F., & Miller, M. H. (1958).

<sup>14</sup> Modigliani, F., & Miller, M. H. (1963).

version allows for gradual adjustments toward the target in response to exogenous shocks and changes in the operating environment.<sup>15</sup>

Within the context of the trade-off theory, profitability assumes an ambiguous role: more profitable firms may be able to tolerate a higher level of debt, as they are capable of sustaining greater financial charges. However, they may also have less incentive to borrow, given the availability of abundant internal resources. The theory, therefore, leaves room for multiple interpretations, which must be verified empirically.

### *The Pecking Order Theory and the Priority of Internal Financing*

In sharp contrast to the previous approach, the pecking order theory, formulated by Myers and Majluf (1984), offers an alternative view of firms' financial behavior. According to this theory, firms do not operate on the basis of an optimal level of leverage; rather, they follow a hierarchy of financing sources, which reflects the degree of information asymmetry between managers and external investors. In this hierarchy, internal financing (self-financing through retained earnings) is preferred over debt, and debt is preferred over external equity. Profitability, within this framework, directly influences financial structure: more profitable firms tend to accumulate liquidity and reduce their reliance on debt, leading to a negative relationship between leverage and profitability.<sup>16</sup>

The pecking order theory has found significant empirical support, particularly in contexts characterized by high uncertainty or less developed financial markets, where the problem of information asymmetry is especially severe. However, it is unable to explain phenomena of target leverage (i.e., convergence toward an optimal level of indebtedness) or the existence of structural differences among firms within the same industry.

### *Agency Cost Theory*

Another relevant theoretical strand is that concerning agency costs, introduced by Jensen and Meckling (1976), according to which the conflict between managers and shareholders can be mitigated through the use of debt. Indebtedness, in fact, binds management to respect deadlines and financial objectives, thereby limiting opportunistic behavior and excessive spending. In this sense, leverage can have a disciplining effect, contributing to improved profitability.<sup>17</sup>

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<sup>15</sup> Kraus, A., & Litzberger, R. H. (1973).

<sup>16</sup> Myers, S. C., & Majluf, N. S. (1984).

<sup>17</sup> Jensen, M. C., & Meckling, W. H. (1976).

However, debt can also generate new conflicts between shareholders and creditors, especially in the presence of risky investments or speculative strategies, with the risk of overinvestment or asset substitution. These negative effects can lead to an increase in the cost of capital and a reduction in firm value if not properly managed.

### *Integrated Perspective and Empirical Results*

The combination of these theories has contributed to the construction of a complex framework in which the relationship between leverage and profitability cannot be interpreted in univocal terms. Several empirical studies have shown that the effect of leverage on performance varies depending on the economic sector, firm size, the degree of development of the financial system, and the phase of the economic cycle.

In particular, in the technology sector—the focus of this thesis—firms display characteristics that tend to make the relationship between indebtedness and profitability less linear. The predominance of intangible assets, the volatility of cash flows, and the reliance on risk capital make the use of traditional debt less frequent and reduce the disciplining effect typically associated with leverage.<sup>18</sup>

Therefore, the empirical analysis conducted in the following chapters aims to verify, on the basis of real data, the validity of these theoretical approaches within a representative sample of European firms operating in the technology sector during the period 2018–2023.

## ***1.4 Financial Specificities of the Technology Sector***

The technology sector represents, in the contemporary economic landscape, one of the most dynamic, innovative, and complex industries, both from an industrial and a financial perspective. The rapid evolution of technologies, the ongoing disintermediation in business models, the growing importance of intellectual capital, and the centrality of innovation in value creation processes call for a specific analysis of companies operating in this field, particularly with regard to their financial choices and capital structure. Unlike traditional manufacturing sectors, technology firms exhibit structural and operational characteristics that strongly influence their financial behavior and risk management. These peculiarities have a direct impact both on the determination of the optimal financial leverage and on the ability to generate sustainable profitability in the medium to long term<sup>19</sup>.

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<sup>18</sup> Frank, M. Z., & Goyal, V. K. (2009).

<sup>19</sup> Hall, B. H., & Lerner, J. (2010)

One of the most relevant characteristics of firms operating in the technology sector is the high incidence of intangible assets within total assets. These include, among others, patents, software, algorithms, digital platforms, registered trademarks, usage licenses, technical know-how, and, above all, highly specialized human capital. The intangible nature of these resources entails significant difficulties in their accounting valuation, since the applicable regulations (in particular, the International Accounting Standards/International Financial Reporting Standards – IAS/IFRS) impose restrictive criteria for their recognition on the balance sheet. This results in a potential undervaluation of company assets, with distortive effects on leverage indicators, profitability ratios, and the perception of risk by external investors<sup>20</sup>.

Moreover, the lack of tangible collateral reduces the access of technology firms to traditional bank credit, especially in the absence of a consolidated financial track record. In such circumstances, companies in the sector are forced to resort to alternative forms of financing, such as venture capital, private equity, equity crowdfunding, convertible bonds, and, in some cases, Initial Public Offerings (IPOs) on regulated markets or specific segments for innovative firms, such as Euronext Growth.<sup>21</sup>

Another distinctive feature of the sector is its strong propensity for investment in Research and Development (R&D). These investments represent a significant share of the operating budget, especially in the early stages of a firm's life cycle, and are often undertaken without the guarantee of immediate economic returns. The uncertain nature of R&D outcomes increases financial uncertainty and leads to greater variability in cash flow generation. This makes the extensive use of debt risky, as debt servicing requires regularity and predictability of payments. For this reason, numerous studies have observed that technology firms tend to maintain lower levels of leverage compared to the market average, particularly during the early-stage and growth phases.<sup>22</sup>

The volatility of cash flows is further exacerbated by the reliance on short product cycles, typical of the sector, and by accelerated technological obsolescence. The life cycle of tech products—particularly in the software, semiconductor, and electronic device industries—has progressively shortened, forcing firms to invest continuously in updates, as well as in incremental and disruptive innovations.

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<sup>20</sup> Lev, B. (2001)

<sup>21</sup> Davila, A., Foster, G., & Gupta, M. (2003)

<sup>22</sup> Brown, J. R., Fazzari, S. M., & Petersen, B. C. (2009)

This makes it increasingly difficult to accurately plan future revenues and, consequently, to ensure coverage of fixed costs, including interest expenses arising from financial debt<sup>23</sup>.

Another crucial aspect is the scalability of business models, which strongly characterizes many technology firms, especially those operating in the digital services and software-as-a-service (SaaS) sectors. With decreasing marginal costs, these firms can achieve exponential growth rates once a critical threshold of market penetration is reached. However, reaching this stage requires an initial period of heavy investment, often financed through venture capital or self-financing. In this context, financial structure choices must balance the need for rapid expansion with the containment of insolvency risk. The use of leverage, if not supported by solid strategic planning, can compromise the sustainability of the business model.<sup>24</sup>

From a theoretical perspective, the aforementioned peculiarities find partial confirmation in the pecking order theory, according to which firms tend to prioritize internal financing over external sources due to the presence of informational asymmetries. Technology firms, given their highly innovative and intangible nature, are particularly exposed to asymmetric information problems, since the value of future projects is difficult for external investors to assess. This phenomenon increases the cost of debt capital and makes the use of internally generated resources more efficient, at least in the initial stages.<sup>25</sup>

At the same time, in the presence of particularly favorable market valuations, some high-tech firms may take advantage of equity financing to raise significant capital on advantageous terms, thereby reducing the need to resort to debt. It is also worth noting that, in the technology sector, the distinction between equity and debt capital may appear blurred, due to the frequent use of hybrid financial instruments such as convertible bonds, subordinated loans, stock options, and participatory instruments. These instruments address the need to reconcile managerial flexibility with capitalization requirements, representing an “adaptive” response to a competitive environment characterized by high uncertainty.

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23 Carpenter, R. E., & Petersen, B. C. (2002)

24 Pagano, M., Panetta, F., & Zingales, L. (1998)

25 Myers, S. C. (1984)

The theoretical implications are significant, as such instruments challenge the traditional dichotomies of capital structure, requiring more sophisticated and flexible valuation models.<sup>26</sup>

In summary, the analysis of financial structure in the technology sector requires an approach that goes beyond standardized models of corporate finance. Firms operating in this field must deal with a variety of challenges, including the measurement of intangible assets, the management of uncertainty, the balance between innovation and financial sustainability, and the interaction between traditional and alternative forms of capital.

As will be observed in the following chapters, these specificities have significant effects on the relationship between financial leverage and profitability, requiring a targeted empirical verification based on updated data and econometric models capable of capturing the complexity of the phenomenon.

### ***1.5 Review of the Scientific Literature***

The relationship between financial leverage and firm profitability has sparked, since the second half of the twentieth century, a wide-ranging theoretical and empirical debate within the economic-financial literature. This debate is part of the broader field of studies on the optimal capital structure, which seeks to understand whether and to what extent the composition of a firm's financing sources influences its economic performance and the creation of value for shareholders. However, the evidence gathered over the years has been heterogeneous, and often divergent, mainly due to differences in institutional contexts, firm sizes, industrial sectors, and historical periods analyzed.<sup>27</sup>

#### *International Studies and Comparative Approaches*

One of the most frequently cited empirical contributions is that of Rajan and Zingales (1995), who conducted a cross-country analysis on a large sample of firms from seven industrialized countries (United States, Japan, Germany, France, United Kingdom, Italy, and Canada). The results showed a negative relationship between leverage and profitability, consistent with the predictions of the pecking order theory. According to the authors, more profitable firms rely less on debt, preferring self-financing, whereas less profitable ones are more exposed to indebtedness.<sup>28</sup>

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26 Tirole, J. (2006)

27 Harris, M., & Raviv, A. (1991)

28 Rajan, R. G., & Zingales, L. (1995)

This evidence was also confirmed by Booth et al. (2001) in a sample of firms operating in emerging markets. The authors, while observing significant differences in the absolute levels of leverage, found consistency in the determinants of capital structure, including profitability, asset tangibility, firm size, and growth opportunities. Moreover, in contexts with less developed financial markets, profitability plays an even more crucial role in determining leverage, as it reduces dependence on external capital, which is often either scarcely available or excessively costly.<sup>29</sup>

In another relevant analysis, Frank and Goyal (2009) empirically tested a wide range of factors associated with capital structure, classifying those that proved to be “robust” in explaining firms’ behavior. Once again, profitability was found to be negatively correlated with the level of indebtedness, suggesting that firms prefer internal sources of financing when they generate high profits. However, the authors emphasize that the strength of this relationship can vary significantly between large and small firms, as well as across industries with different levels of capital intensity<sup>30</sup>.

A more recent contribution is provided by Dragomir (2024), who analyzed a broad sample of technology and healthcare firms operating across the European Union, the United Kingdom, Norway, and Switzerland over the period 2013–2022. The study focused on the role of intangible resources, with particular attention to structural capital, in shaping corporate profitability. The results showed a negative correlation between structural capital intensity and firm profitability, suggesting that an excessive reliance on intangible assets may weaken financial performance. According to the author, this outcome is partly explained by the accounting treatment of intangibles, which often leads to distortions in the measurement of firm value and profitability, and by the difficulties in effectively managing and monetizing intangible capital in volatile sectors such as technology and healthcare<sup>31</sup>.

Similarly, Seckanovic (2021) examined the relationship between leverage and profitability in the context of UK-listed technology companies. The findings highlighted that higher debt levels are associated with a significant reduction in ROE, indicating that leverage, rather than enhancing shareholder returns, may erode equity profitability in the specific case of the technology industry. This evidence is consistent with the idea that technology firms, due to their structural characteristics—high volatility of cash flows and predominance of intangible assets—may not fully benefit from the

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<sup>29</sup> Booth, L., Aivazian, V., Demircüç-Kunt, A., & Maksimovic, V. (2001)

<sup>30</sup> Frank, M. Z., & Goyal, V. K. (2009)

<sup>31</sup> Dragomir, V.D. (2024)

positive leverage effect theorized in classical models. Instead, excessive indebtedness exposes them to financial fragility and reduced capacity to generate sustainable shareholder value.<sup>32</sup>

## **Chapter 2 – Economic and Financial Context of the European Technology Sector**

### ***2.1 Evidence on the Technology Sector***

The peculiarities of the technology sector, examined in the previous paragraph, make the study of the relationship between leverage and profitability particularly interesting in this context. More recent empirical literature has focused on the characteristics of tech firms, highlighting their structural tendency to maintain low levels of indebtedness, especially in the early stages of the life cycle. For instance, Balakrishnan and Fox (2018) analyze the behavior of U.S. technology firms and find that they tend to finance expansion primarily through equity, since the intangible nature of their assets and the high volatility of cash flows limit access to bank debt.<sup>33</sup>

Startups and growth-stage firms rely primarily on venture capital and hybrid instruments rather than conventional loans. However, once they move beyond the initial stage and reach a certain degree of stability, technology firms may begin to gradually increase their leverage, for instance to finance strategic acquisitions or international expansion. This behavior confirms the dynamic hypothesis of the trade-off theory, according to which firms progressively approach the optimal level of indebtedness as a function of their internal evolution.<sup>34</sup>

A concrete example is represented by companies such as Amazon, which for years financed its expansion through self-financing and limited use of debt, maintaining a policy of reinvesting profits. Only after consolidating its position in the global market did it more substantially increase its indebtedness to support diversification strategies. European firms such as SAP and ASML also

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32 Seckanovic, E. (2021)

33 Balakrishnan, K., & Fox, I. (2018)

34 Huyghebaert, N., & Van de Gucht, L. M. (2007)

exhibit similar behavior, favoring internal financing sources or equity until reaching operational maturity<sup>35</sup>.

## ***2.2 Research within the European Context***

In the European context, the relationship between leverage and profitability has gained increasing relevance also due to the regulatory and macroeconomic transformations of the past two decades. Recent studies conducted in the aftermath of the 2008 financial crisis and, more recently, during the COVID-19 pandemic, have sought to assess the impact of systemic shocks on firms' capital structures. Hasan et al. (2021), for instance, show that firms with greater financial flexibility - often associated with lower levels of indebtedness - achieved better performance in terms of resilience during the most critical phases of the pandemic<sup>36</sup>.

In an analysis conducted by the European Central Bank (2023), it was found that European technology firms made limited use of bank debt even during phases of particularly favorable interest rates, preferring financing instruments more compatible with the sector's volatility. Moreover, the report highlights that the negative correlation between leverage and profitability tends to strengthen during periods of high uncertainty, due to the higher risk premium required by investors and the difficulty in obtaining credit under favorable conditions.<sup>37</sup>

Overall, the scientific literature thus confirms that the relationship between financial leverage and profitability is neither linear nor univocal. It depends on a complex system of variables that include endogenous factors (size, age, governance, strategies) and exogenous factors (institutional context, monetary policies, access to capital markets). In particular, in the European technology sector, the relationship tends to be negative in the early stages of the life cycle, consistent with the pecking order theory, but may become more neutral or even positive during consolidation phases, where leverage can contribute to maximizing shareholder profitability without compromising financial stability.

In light of these findings, there is a clear need for a rigorous and context-specific empirical verification for the post-pandemic European environment, one that accounts for the dynamism of the tech sector, the differentiation among subsectors (hardware, software, biotech, etc.), and the growing importance of alternative capital markets.

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35 Pagano, M., Panetta, F., & Zingales, L. (1998)

36 Hasan, I., Hoi, C. K., Wu, Q., & Zhang, H. (2021)

37 European Central Bank (2023)

## ***2.3 Evolution of the Technology Sector in Europe (2019–2023)***

Between 2019 and 2023, the European technology ecosystem went through a full cycle: an expansionary phase driven by pandemic-induced digitalization (2020–2021), a correction associated with the tightening of financial conditions (2022–2023), and a subsequent reallocation of capital flows towards “mission-oriented” domains such as energy and climate technologies, healthcare, and artificial intelligence.

Evidence from institutional sources and leading reports (Atomico, Dealroom, OECD, EIB, ECB, Eurostat) allows us to outline the key economic and financial trends shaping this evolution.

In 2019, Europe was already experiencing an acceleration in venture capital (VC) activity, with Dealroom reporting a record €9.3 billion invested in the second quarter alone, largely driven by mega-rounds.

Despite the shock of the COVID-19 pandemic in 2020, total investment in European technology reached a new all-time high of approximately \$41 billion, supported by the forced digitalization of activities such as e-commerce, teleworking, and cloud services.

The year 2021 represented the peak of the cycle, with close to \$100 billion invested, the creation of 98 new unicorns, and a startup pipeline comparable to that of the United States, marking Europe’s emergence as a global technology player.

From 2022 onwards, however, monetary tightening and macroeconomic uncertainty compressed valuations and deal volumes. The ECB’s Financial Stability Reviews highlighted stretched valuations, lower liquidity, and risks of disorderly market adjustments in 2023, particularly against the backdrop of rising interest rates and weak euro area growth.

While VC investment levels remained historically high, the 2023 total was roughly half of the 2021 peak.

### *Long-term outlook*

Atomico estimates place the figure at around \$45 billion, while Dealroom reports approximately \$63 billion raised across more than 10,000 rounds. Notably, resilience was observed at the early stage, alongside a clear sectoral reallocation of capital.

A long-term reading of the ecosystem reveals structural consolidation. Atomico (2023) reports: (i) stability of early-stage dealflow in the past two years; (ii) a European tech workforce exceeding 2.3 million employees; (iii) an ecosystem valuation approaching \$3 trillion, a forty-five-fold increase over the last two decades.

The sectoral reorientation of 2023 is particularly striking: climate and energy technologies accounted for roughly 27-30% of total VC investment, surpassing fintech and software; artificial intelligence emerged as the second largest theme, with strong late-stage pipelines; while healthtech increased its share compared to the pandemic period.

*Examples illustrate this restructuring:*

Energy and climate technologies: European scale-ups in energy storage and efficiency secured major growth rounds, aligned with the EU's green transition priorities and supported by both public and private capital, as highlighted in the EIB's Investment Report 2023/24.

Artificial Intelligence: in 2023, AI accounted for nearly 30% of all European mega-rounds (\$100M+), consolidating its role as the leading theme at seed stage and an increasingly prominent late-stage segment.

From a geographical perspective, the United Kingdom, Germany, and France remain the core hubs, but the ecosystem is increasingly polycentric, with the Nordics, Benelux, Spain, Italy, and Central and Eastern Europe contributing significant volumes.

Investor structures have also shifted: Atomico (2023) shows that domestic investors supported 79% of early-stage capital, sustaining resilience, though a structural funding gap remains compared to the United States, particularly in late-stage and growth financing.

This insufficiency of "patient capital" (e.g., pension funds) continues to be cited as a bottleneck that drives some European scale-ups to list abroad or relocate outside the EU.

Capital markets dynamics reflected this fragility. The IPO window remained largely closed in 2022–2023, with M&A transactions, down rounds, and "extension" rounds prevailing instead. Atomico (2023) highlights a sharp contraction in software multiples (down by around one-third), more than 10,000 layoffs in Q1 2023 alone, and a decline in invested capital compared to 2021. The ECB's assessments on adverse financial conditions and the delayed effects of monetary tightening are consistent with the weakness of the European IPO pipeline.

At the structural level, Eurostat and JRC PREDICT data underscore the weight of ICT in European value added, employment, and R&D intensity, with both ICT manufacturing (hardware, components) and ICT services (software, telecommunications) playing critical roles.

OECD reports confirm that the pandemic accelerated digital adoption across Europe, catalyzing investment in cloud infrastructure, digital skills, and new organizational models (e.g., hybrid work).

Meanwhile, the EIB stresses that, despite progress in digitalization and energy efficiency, European firms remain under pressure from competitiveness challenges and the high cost of capital, requiring pro-investment policies and better financial instruments for scaling up.

Taken together, the 2019–2023 period highlights the transition of the European tech sector from a phase of quantitative expansion (volume of investment, unicorn creation, mega-rounds) to one of

qualitative consolidation, characterized by more selective capital allocation, a growing focus on sectors with high social externalities (climate, health), and the centrality of deep technologies such as AI, semiconductors, and space.

Despite persistent gaps with the United States in late-stage financing and capital market depth, Europe demonstrates significant strengths: a dense talent base, a rich growth-stage pipeline, regulatory leadership on issues such as AI governance, and an increasing reorientation towards impact-driven investment.

### *Global Share and Ecosystem Value*

In 2023, Europe reached a record 19% share of global venture capital investment, up from 13% in 2013, consolidating its position as a central hub in the international technology landscape. The overall valuation of the European tech ecosystem is estimated at approximately \$3.4 trillion, marking a forty-five-fold increase over the past two decades.

From a sectoral perspective, deep tech, energy, and defense technologies have emerged as dominant investment themes. In 2023, energy and climate-related solutions absorbed nearly 30% of total VC investment, overtaking fintech and software as the leading category of capital allocation. The deep tech segment is expanding rapidly, encompassing artificial intelligence, healthtech, space technologies, robotics, and semiconductors—areas characterized by high R&D intensity and long-term strategic relevance.

In addition, defense and security technologies have gained prominence, driven by geopolitical tensions such as the Russia–Ukraine war. In 2024, investment in the European defense tech sector reached a record \$5.2 billion, representing a year-on-year growth rate of 24%, according to analyses published by Cinco Días and the Financial Times.

## ***2.4 Relevant Macroeconomic and Financial Indicators***

The five-year period 2019–2023 represented, as previously noted, a phase of extraordinary complexity for the global economy and, in particular, for the technology sector, which assumed an increasingly central role in production, communication, and consumption processes.

The analysis of key macroeconomic and financial indicators makes it possible to understand the profound transformations that shaped this industry, tested by exceptional events such as the COVID-19 pandemic, unconventional monetary policies, geopolitical instability, and the resulting inflationary pressures.

By its very nature, the technology sector—focused on innovation and scalability—proved to be particularly sensitive to variables such as GDP growth, inflation, interest rates, equity market trends, venture capital flows, labor dynamics, and exchange rates. Each indicator acted as a conditioning

lever, at times stimulating the development and diffusion of digital technologies, at other times compressing profitability and imposing structural challenges on firms.

### *GDP Growth and Accelerated Digitalization*

The first indicator to be considered is Gross Domestic Product (GDP), the main parameter used to assess the overall health of economies. The period began with 2019, characterized by moderate yet stable growth, consistent with the consolidated trends of globalization. In 2020, however, the spread of the pandemic caused a collapse in aggregate demand and global supply chains, resulting in a contraction of global GDP of  $-3.1\%$ .

Paradoxically, this dramatic recession generated a peculiar effect: the health crisis stimulated demand for digital technologies, which became essential to ensure the operational continuity of firms and institutions. Smart working, e-learning, e-commerce, and communication platforms experienced unprecedented growth. In 2021, with the gradual economic recovery, global GDP rose by  $5.9\%$  (IMF, 2023), driven precisely by investment in innovation and digitalization. This confirms the countercyclical role of the technology sector, capable of stimulating growth even in adverse macroeconomic environments.

### *Inflation, Monetary Policy, and the Cost of Capital*

A second crucial indicator concerns price dynamics and monetary policy. In 2020–2021, the major central banks adopted ultra-expansionary strategies: the Federal Reserve and the European Central Bank, for instance, kept interest rates near zero and implemented historically large quantitative easing programs. These policies encouraged massive liquidity inflows into financial markets and, in particular, into the technology sector, whose firms appeared especially attractive due to long-term growth prospects.

From 2022 onwards, however, the scenario shifted radically. Rising energy and commodity prices—linked to the Russia–Ukraine conflict and supply chain bottlenecks—pushed global inflation to levels unseen in decades. The response of central banks was an exceptionally intense interest rate hike cycle. This produced a significant increase in the cost of capital, penalizing especially high-capitalization technology firms, whose valuations are heavily based on the discounted value of future cash flows (OECD, 2023).

### *Financial Markets and Venture Capital*

The immediate reflection of these dynamics was visible in financial markets. The NASDAQ Composite Index, the benchmark for the technology sector, recorded exponential growth between 2020 and 2021, supported by strong digital demand and abundant liquidity. It reached its all-time

high in November 2021. In 2022, however, a sharp correction occurred: the index lost more than 30% of its value. This volatility demonstrates how the technology sector is highly reactive to liquidity conditions and macroeconomic expectations: on the one hand, investors perceive it as a high-potential industry; on the other, in periods of monetary tightening, it becomes the primary target of downward adjustments.

Venture capital markets mirrored this cycle. After years of expansion culminating in record investments in 2021, 2022 marked a 35% contraction. This phenomenon is explained by two main factors: (i) the higher cost of money, which made financing high-risk projects more expensive; (ii) stricter investor selection, favoring firms with solid and sustainable business models. As a result, many startups saw their financing opportunities shrink dramatically, with direct consequences on innovation and scalability.

### Labor Market Dynamics

The technology labor market experienced a bifurcated trend. During the pandemic, the demand for digital skills increased sharply, creating new employment opportunities and wage growth for highly specialized professionals. From 2022 onwards, however, macroeconomic slowdown and cost-containment needs led to a wave of mass layoffs. According to Statista (2023), more than 300,000 technology employees worldwide were affected in 2022–2023, including staff reductions at giants such as Meta, Amazon, and Google. This shows how even big tech firms, despite extraordinary margins accumulated in previous years, had to adapt rapidly to the new macroeconomic context, sacrificing part of their workforce to preserve profitability.

### Exchange Rates and Geopolitical Tensions

Exchange rates added a further layer of complexity. The appreciation of the US dollar in 2022 penalized American multinationals, reducing revenues from foreign markets. Geopolitical competition compounded this dynamic. The strategic rivalry between the United States and China over the control of key technologies—such as semiconductors, artificial intelligence, and 5G—resulted in trade restrictions, export barriers, and reshoring strategies. These elements affected both operational costs and long-term business uncertainty.

To better capture the dynamics of the sector, it is useful to present a numerical synthesis of the main macroeconomic and financial indicators during the 2019–2023 period.

*Indicatori macroeconomici e finanziari del settore tech (2019-2023)*<sup>38</sup>

Anno	Crescita PIL (%)	Inflazione (%)	NASDAQ (% var.)	VC (mld USD)	Licenziamenti tech (000)
2019	2,9	2,5	35,2	300	10
2020	-3,1	2,0	43,6	280	15
2021	5,9	3,5	21,4	620	20
2022	3,4	8,7	-33,1	400	160
2023	2,1	6,8	11,6	350	140

The table summarizes the main values related to global GDP growth, average global inflation, the annual variation of the NASDAQ Composite, the volume of venture capital investment, and the number of layoffs in the technology sector. The data highlight the strong cyclicity of the industry and its dependence on exogenous macroeconomic shocks.

The analysis conducted in this chapter shows that, during the period 2019–2023, the technology sector stood at the center of global economic transformations, acting at once as a beneficiary and as a victim of macro-financial dynamics. As illustrated in the Table, the evolution of macroeconomic indicators—GDP growth, inflation, equity markets, venture capital flows, and labor market dynamics—reveals marked cyclicity and a strong interconnection with external phenomena, ranging from pandemic shocks to geopolitical tensions.

It can therefore be argued that the five-year period under review demonstrates how the technology sector cannot be considered in isolation from global macroeconomic dynamics. On the contrary, it emerges as a highly systemically interdependent industry, capable of driving global economic growth but at the same time vulnerable to fluctuations in interest rates, monetary policies, inflationary pressures, and geopolitical risks.

## ***2.5 Analysis of the Main Global Industry Players***

The period 2019–2023 represented a phase of unprecedented transformation for the global technology industry. The concurrence of exogenous events—such as the COVID-19 pandemic, geopolitical tensions between the United States and China, and regulatory reforms in both Europe and the U.S.—together with endogenous drivers—such as the growth of cloud computing, the development of generative artificial intelligence, and the surge in demand for digital infrastructure—contributed to reshaping the role of the so-called Big Tech firms.

Apple, Microsoft, Alphabet, Amazon, and Meta progressively consolidated their oligopolistic position, integrating different vertical markets—from hardware to digital services, from advertising to

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<sup>38</sup> Elaborazione propria su dati World Bank, IMF, Bloomberg, Crunchbase, Statista.

cloud computing—and exerting increasing influence over global economic governance. At the same time, new players emerged, including NVIDIA, which became the undisputed leader in accelerated computing semiconductors, and ByteDance, which through TikTok redefined digital content consumption on a global scale. This complex scenario requires a multi-level analysis—economic, regulatory, geopolitical, and socio-cultural.

1. *Apple*

Apple progressively transitioned toward the “servitization” of its business model. The Services division reached revenues of \$85.2 billion in 2023 (Apple, 2023), strengthening the firm’s ability to generate recurring profits. A notable case is Apple One, a bundled subscription integrating streaming, cloud, and gaming services, designed to increase customer retention.

2. *Microsoft*

Microsoft consolidated its leadership in enterprise cloud through the rapid expansion of Azure. During the pandemic, the widespread adoption of Microsoft Teams positioned the company as a central actor in remote work, reinforcing its Microsoft 365 ecosystem. The introduction of AI-based tools (Copilot) marked a new paradigm of productivity (Microsoft, 2023).

3. *Alphabet*

Alphabet continued to derive more than 75% of its revenues from advertising (Alphabet, 2023). However, Google Cloud was the fastest-growing division, reflecting the company’s attempt to diversify income streams. Alphabet’s investment in artificial intelligence (e.g., Bard) underscores its strategy to remain competitive against emerging rivals.

4. *Meta*

Meta experienced a phase of instability, aggravated by heavy investments in the metaverse. Despite substantial losses from Reality Labs, 2023 marked a revenue rebound driven by advertising and a cost-cutting program labeled the “year of efficiency.” The example of the Quest Pro headsets illustrates the challenges of converting hardware innovation into mass adoption.

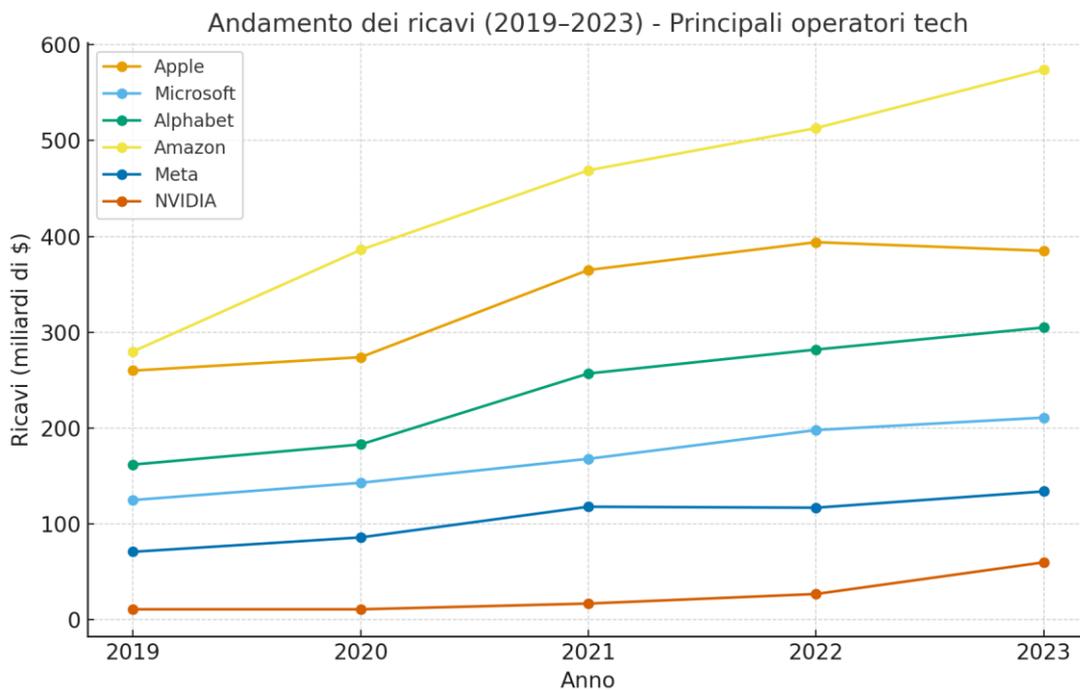
5. *Amazon*

Amazon reported net sales of \$575 billion in 2023, with AWS contributing \$91 billion (Amazon, 2023). The cloud division remains the company’s financial backbone, sustaining the low-margin retail operations. At the same time, logistics optimization enabled efficiency gains in a cost-intensive segment.

6. *NVIDIA*

The rise of NVIDIA signals the beginning of a new industrial cycle. In 2024, the company

reported revenues of \$60.9 billion (+126% YoY), driven by the soaring demand for GPUs powering generative AI models (NVIDIA, 2024). Strategic partnerships with Microsoft and Google established NVIDIA as a pivotal actor in the global technology landscape.



### In Europe

The contribution of the Information and Communication Technology (ICT) sector to European GDP has progressively increased, rising from a share of 4.5% in 2019 to approximately 5.3% in 2023. In parallel, there has been a marked growth in intangible capital investment, particularly in research and development (R&D), software, patents, and digital training.

Private R&D expenditure in the tech sector exceeded €110 billion in 2023, accounting for around 20% of total R&D spending across the continent. However, Europe continues to display a significant gap compared to other global technology hubs, especially in terms of venture capital: in 2023, total investments in European tech startups amounted to €45 billion, compared to €140 billion raised by their U.S. counterparts.

### Leading European Technology Players

Within this framework, several companies stand out for having consolidated or expanded their sectoral leadership.

#### 1. SAP SE (Germany)

SAP remains the leading European player in enterprise software and ERP (Enterprise Resource Planning) solutions. Between 2019 and 2023, the company increased its cloud

services revenues by +82%, surpassing €13 billion in 2023 alone. The operating margin in the cloud segment also improved significantly, rising from 24% in 2019 to 31% in 2023, confirming the efficiency of the SaaS (Software-as-a-Service) model.

2. Spotify Technology S.A. (Sweden)

Spotify significantly expanded its user base, reaching over 600 million monthly active users in Q4 2023. Revenues from premium subscriptions accounted for roughly 75% of the total, while operating margins showed signs of improvement after years of aggressive investment in exclusive content production and podcasts.

3. Infineon Technologies AG (Germany)

Infineon, specialized in semiconductors for automotive and industrial applications, benefitted from the rising demand for solutions in electric mobility and Industry 4.0. Revenues grew from €8.0 billion in 2019 to approximately €16.3 billion in 2023, with an EBIT margin of 19.4%.

The analysis highlights that, despite a turbulent macroeconomic context and the persistent difficulty for Europe in creating a fully integrated digital single market, some players have managed to compete successfully at the global level. The presence of firms with strong R&D investment capacity, strategic positioning within the technological value chain, and solid governance remains a key factor of resilience and growth. However, in order to close the gap with the United States and China, it will be essential to strengthen the coordination of European industrial policies and to stimulate the emergence of continental digital champions.

EU Industrial and Strategic Policies Supporting the Tech Sector

During the period under consideration, the European Union progressively recognized the need to develop strategic technological autonomy, promoting a series of legislative and industrial initiatives aimed at supporting innovation and competitiveness in the digital sector.

In particular, the Horizon Europe programme (2021–2027), with an overall budget of €95.5 billion, allocated significant funding for research and development in artificial intelligence, quantum computing, sovereign cloud, and emerging digital technologies.

Other key initiatives include:

1. *Digital Europe Programme (DEP)*: with a budget of €7.5 billion for 2021–2027, designed to strengthen the EU’s strategic digital capacities, including supercomputing, cybersecurity, and advanced digital skills.
2. *European Chips Act (2022)*: adopted to stimulate semiconductor production within the EU, with the objective of doubling Europe’s global market share in chips by 2030 (from 10% to 20%).
3. *European Innovation Council (EIC)*: created to support high-risk deep tech startups through equity funding via the EIC Fund and blended grant/equity instruments.

Despite the breadth of these measures, fragmentation among Member States and the slowness of implementation processes continue to represent obstacles to the full effectiveness of European policies.

### *Comparison with the U.S. and Asian Tech Sectors*

The comparison between the European technology sector and its U.S. and Asian counterparts reveals significant structural disparities. As of 2023, among the world’s top 20 technology companies by market capitalization, only one—ASML—was based in Europe, compared with 13 in the United States and 6 in Asia.

The United States, in particular, benefits from:

1. greater availability of late-stage venture capital;
2. a unified regulatory ecosystem favorable to innovation;
3. a domestic digital market significantly larger than that of Europe.

The gap is also evident in terms of productivity: according to McKinsey (2023), U.S. tech companies exhibit average labor productivity 20–25% higher than their European counterparts, partly due to larger investments in automation, big data, and artificial intelligence.

China, for its part, has developed a protected and highly subsidized tech ecosystem, dominated by large digital conglomerates and strongly supported by public intervention, as seen in the cases of Huawei, Tencent, and ByteDance.

Europe, although penalized by regulatory fragmentation, stands out positively for its high standards in privacy protection (GDPR) and advanced regulation on AI (AI Act adopted in 2024).

### *The European Startup Ecosystem and Its Structural Challenges*

Between 2019 and 2023, Europe experienced a significant expansion of its startup ecosystem, with over 360 companies classified as “unicorns” (valuation > \$1 billion), up from 223 in 2019 (Dealroom & Atomico, 2023).

Despite this dynamism, structural problems persist:

1. Scale-up capital deficit: many startups tend to be acquired by non-European operators in the expansion phase, reducing the ability to create true continental champions.
2. Regulatory barriers among Member States that hinder cross-border integration.
3. Tech brain drain: many founders and high-skilled professionals relocate to more mature ecosystems, particularly Silicon Valley.

### *ESG Integration in European Tech*

The integration of ESG (Environmental, Social, Governance) criteria has become a strategic component for European tech companies. Since 2021, many firms in the sector have adopted voluntary (e.g., GRI, SASB) or mandatory (CSRD, from 2024) ESG standards, with tangible impacts on industrial strategies and financial performance.

Notable examples include:

1. ASML, which achieved carbon neutrality in its operations in 2023.
2. SAP, which since 2020 has published an Integrated Report compliant with GRI and TCFD standards, with net zero targets set for 2030.
3. Infineon, which invested more than €700 million in low-impact environmental technologies for semiconductor production.

According to Morningstar (2023), 68% of European thematic funds in the tech sector integrated ESG metrics into their selection criteria, reflecting growing demand from institutional investors for sustainable business models, particularly in areas such as green data centers, circular economy, and ethical cybersecurity.

## ***2.6 Effects of the Economic Environment on Leverage and Profitability***

The period between 2019 and 2023 represents a paradigmatic phase for understanding the relationship between the macroeconomic environment, firms' financial structure, and their ability to sustain profitability. The so-called Big Tech companies - Apple, Microsoft, Alphabet, Amazon, Meta, and, more recently, NVIDIA - faced a rapidly evolving global environment: initially an expansionary

phase fueled by pandemic-induced digitalization, followed by a restrictive cycle marked by high inflation, aggressive monetary policies, and geopolitical tensions.

### *Leverage in Times of Macro-Financial Volatility*

Technology firms have traditionally been characterized by relatively low levels of indebtedness, due to scalable, cash-generative business models. This is particularly true of Apple and Microsoft, which in 2023 maintained substantial net cash positions and adopted capital return strategies centered on share buybacks and dividends. Such financial prudence reflects not only abundant operating cash flows but also the desire to preserve strategic flexibility in a context of increasing regulatory scrutiny.

*Amazon* represents a different case. Its asset-intensive logistics and the rapid expansion of its distribution network during the pandemic required greater reliance on debt, raising leverage levels compared to its peers. Consequently, the sharp rise in interest rates from 2022 had a more significant impact on Amazon's weighted average cost of capital than on Microsoft or Alphabet.

*Meta*, while less exposed to financial debt, faced internal leverage pressures due to heavy capital expenditures in Reality Labs, often funded through internal resources but with material implications for free cash flow.

### *Profitability Across the Cycle*

The biennium 2020–2021 was historically unique, with unprecedented revenue acceleration driven by soaring demand for digital services and collaborative platforms. Profitability reached record levels: Apple surpassed a trillion-dollar market capitalization in less than twelve months, while Microsoft sustained double-digit growth rates in its cloud divisions.

The subsequent period (2022–2023), however, revealed a structural slowdown. Global inflation - largely triggered by supply chain disruptions and rising energy prices - affected both operating costs and consumer demand.

*Meta*, heavily dependent on advertising, suffered a decline in net profitability: shrinking margins, intensified competition from TikTok, and the heavy costs of metaverse-related projects led to a deterioration in profitability ratios, with ROE contracting relative to the previous biennium.

*Amazon*, despite the resilience of AWS, recorded declining margins in its retail division due to high logistics costs. AWS itself illustrates the asymmetry: in 2023, it generated \$91 billion in revenues with operating margins above 25%, effectively serving as the profit engine of the conglomerate.

*Microsoft* maintained remarkable earnings stability, with high operating margins supported by its SaaS model (Office 365, Teams) and the expansion of Azure.

*Alphabet*, although affected by the cyclicity of advertising, mitigated the impact through the growth of Google Cloud, which reduced reliance on advertising as the sole source of profitability.

### *Theoretical Determinants: Optimal Leverage and Earnings Resilience*

From a theoretical standpoint, the 2019–2023 period offers fertile ground to apply the trade-off paradigm of capital structure. Big Tech firms occupy a peculiar position: their massive cash flows reduce the relevance of debt as a tax shield, leading them to prioritize self-financing and liquidity as instruments of resilience. However, the rising cost of equity, following financial market volatility and contracting valuation multiples (especially in 2022), raised the issue of rebalancing capital structures, highlighting leverage as a potential tool of strategic flexibility.

At the same time, the profitability models of digital platforms show how scalability can mitigate the cyclicity of margins compared to traditional industries, though not eliminating it entirely. The experience of 2022 demonstrates that even “quasi-essential” markets - cloud, software, advertising - are not immune to macro-financial shocks, but tend to recover more rapidly than other sectors.

### *Implications*

The cyclical effects on leverage and profitability among Big Tech yield two central implications. First, a consolidation of prudent financial models, with preference for liquidity buffers and low debt exposure, aimed at safeguarding investment capacity in strategic areas such as artificial intelligence and semiconductors. Second, the emergence of internal competitive differentiation: while firms such as Microsoft and Apple strengthened both profitability and financial solidity, others like Meta and Amazon proved more vulnerable to external shocks and cyclical demand shifts. Looking ahead, managing leverage and defending profitability will remain central to navigating a future characterized by economic volatility, regulatory pressures, and geopolitical challenges.

## **Chapter 3 – Research methodology**

### ***3.1 Objective of the Empirical Analysis***

The empirical objective of this study is to evaluate how financial leverage affects the profitability of European technology firms over the period 2018–2023. To capture profitability, two complementary dependent variables are employed: Return on Assets (ROA), which measures operational efficiency independently of capital structure, and Return on Equity (ROE), which directly reflects the distributive impact of leverage on shareholders. By estimating parallel models with ROA and ROE, the analysis seeks to disentangle whether leverage primarily influences asset utilisation or whether its effects emerge more strongly through equity returns.

The key independent variables are four leverage ratios: Debt/Equity, Debt/Assets, Short-Term Debt/Assets, and Long-Term Debt/Assets.

This distinction allows us to test not only the overall role of financial leverage, but also the different implications of maturity structure, as short-term debt may increase liquidity and refinancing risks, while long-term debt may provide more stability at the cost of flexibility.

In addition, a set of control variables is included to account for firm-specific characteristics that the literature identifies as relevant determinants of profitability: growth (measured by sales variation), tangibility (proxied by fixed assets over total assets), capital intensity (fixed assets over sales), and R&D intensity (R&D expenditure over sales). The combined specification makes it possible to assess whether leverage exerts an independent and significant effect on profitability once firm growth opportunities, asset structure, and innovation investment are taken into account.

In line with prior studies (Rajan & Zingales, 1995; Booth et al., 2001; Frank & Goyal, 2009; Dragomir, 2024; Seckanovic, 2021), the comparison between ROA- and ROE-based models provides a robust framework to verify whether financial leverage in the European technology sector serves primarily as a mechanism of financial amplification for shareholders, or whether it also constrains operational efficiency and long-term value creation.

### ***3.2 Sample Selection and Firm selection criteria***

The empirical analysis is based on a panel dataset of European technology firms observed over the period 2019–2023. The sample was constructed with the aim of ensuring both representativeness of

the sector and comparability across firms. To this end, only publicly listed companies were included, as they provide consistent and reliable financial reporting over time. Within the technology domain, firms were selected based on their primary classification in software, hardware, semiconductors, digital services, and related ICT activities, thereby excluding conglomerates whose revenues are predominantly generated outside the technology field.

In addition, firms were required to meet the following criteria: (i) continuous availability of financial statements for the entire observation period; (ii) disclosure of information on debt structure, including short-term and long-term components; (iii) reporting of R&D expenditure, either directly or through industry-standard estimates; and (iv) location of headquarters within the European Union or other major European markets (e.g., United Kingdom, Switzerland, Norway). To avoid distortions, companies undergoing mergers, acquisitions, or major restructuring events during the sample period were excluded.

The final sample consists of 20 firms, selected among the largest and most representative players in the European technology sector. This choice reflects a balance between data availability and the need to capture the behaviour of firms that significantly contribute to the dynamics of the industry. The relatively small number of firms is compensated by the panel structure of the dataset, which yields 100–150 firm-year observations and allows for a robust econometric analysis while maintaining focus on the most relevant actors in the sector.

### ***3.3 Description of the variables***

#### **Dependent Variables**

In order to capture firm profitability, two dependent variables are considered.

1. *Return on Assets (ROA)*, calculated as net income over total assets, which measures the efficiency with which firms use their resources to generate returns, regardless of the capital structure. This indicator is particularly relevant for technology firms, which often present a large share of intangible assets and limited reliance on debt financing.
2. *Return on Equity (ROE)*, calculated as net income over shareholders' equity, which reflects the profitability from the perspective of investors. Unlike ROA, it is directly influenced by leverage, as higher debt reduces the equity base and may amplify returns, positively or negatively. Including both measures allows us to distinguish between operational efficiency and financial amplification effects.

### Independent Variables

The main explanatory variables are different measures of financial leverage, in line with previous literature on capital structure.

1. *Debt-to-Equity ratio* (D/E): total debt divided by shareholders' equity. This traditional indicator shows the relative weight of debt financing compared to equity.
2. *Debt-to-Assets ratio* (D/A): total debt divided by total assets. It reflects the share of firm resources that are financed through external borrowing.
3. *Short-Term Debt-to-Assets* (STD/A): short-term liabilities divided by total assets. This variable captures refinancing and liquidity risks, which are particularly relevant in periods of financial tightening.
4. *Long-Term Debt-to-Assets* (LTD/A): long-term liabilities divided by total assets. This measure reflects the role of more stable financing and allows us to test whether maturity structure matters for profitability.

### Control Variables

In addition to leverage ratios, the regressions include a set of control variables commonly used in the literature:

1. *Growth*: measured as the annual variation in sales, representing firms' growth opportunities.
2. *Tangibility*: fixed assets over total assets, used as a proxy for collateral availability.
3. *Capital Intensity*: fixed assets over sales, which reflects the structural rigidity of the production process.
4. *R&D Intensity*: R&D expenditure over sales, capturing the role of innovation investment in shaping firm performance.

This specification follows earlier empirical studies (Rajan & Zingales, 1995; Frank & Goyal, 2009; Margaritis & Psillaki, 2010) and adapts them to the specific characteristics of the European technology sector, where asset-light models and high R&D intensity may alter the relationship between leverage and profitability.

ROA	Net Income / Total Assets	Dependent variable
ROE	Net Income / Shareholders' Equity	Dependent variable
D/E	Total Debt / Equity	

		Independent variable
D/A	Total Debt / Assets	Independent variable
STD/A	Short-Term Liabilities / Total Assets	Independent variable
LTD/A	Long-Term Liabilities / Total Assets	Independent variable
Growth	$\Delta \text{Sales} / \text{Sales (year } t - \text{year } t-1)$	Control variable
Tangibility	Fixed Assets / Total Assets	Control variable
Capital Intensity	Fixed Assets / Sales	Control variable
R&D Intensity	R&D Expenditure / Sales	Control variable

### ***3.4 Data Sources and Observation Period***

The empirical analysis is based on a balanced panel of 20 European publicly listed technology companies observed over the five-year period 2019–2023. This five-year horizon captures a full macro-financial cycle: the pre-pandemic phase, the Covid-19 shock, the unprecedented expansion of digital services, and the subsequent period of monetary tightening and high inflation in 2022–2023. By covering such diverse contexts, the dataset ensures that the results capture the sensitivity of profitability and capital structure dynamics under heterogeneous economic conditions. Sample selection focused on companies operating in software, semiconductors, and digital services, with continuous listing on European exchanges and a market capitalization exceeding €500 million. The final sample includes firms from major technology hubs such as the Nordics, DACH region, and Southern Europe.

Financial data were primarily retrieved from TradingView annual financial statements (Income Statement and Balance Sheet) and cross-checked with company annual reports for the years 2019–

2023. Key items include Net Income, Total Revenue, Total Assets, Total Equity, Total Debt, Short- and Long-Term Debt, Property, Plant & Equipment (PPE), and R&D expenses, which provided the inputs for constructing all dependent, independent, and control variables.

To strengthen reliability and coverage, these primary data were supplemented and validated with figures from TradingView, MarketScreener, and Morningstar, which offer standardized historical series and facilitate cross-company comparisons.

All monetary values were converted to euros to guarantee homogeneity across firms headquartered in different countries, using annual average exchange rates published by the European Central Bank (ECB).

The final dataset thus provides a robust and comparable panel, allowing for econometric analysis of the relationship between leverage and profitability in the European technology sector, while ensuring transparency in data construction and methodological rigor.

### ***3.5 Regression Model: Multiple Linear Regression***

Linear regression is a fundamental econometric technique used to quantify the relationship between a dependent variable and one or more explanatory variables. In its simplest form, the method assumes that the expected value of the dependent variable can be expressed as a linear combination of the independent variables plus an error term. Under the classical Gauss–Markov assumptions—linearity in parameters, independence of errors, homoscedasticity, and absence of perfect multicollinearity—OLS provides Best Linear Unbiased Estimators (BLUE). This ensures that the estimated coefficients are consistent, efficient, and suitable for statistical inference through t-tests and F-tests. The general specification for a multiple linear regression is:

$$Y = \alpha + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_k X_k + \varepsilon$$

Where  $Y$  is the dependent variable,  $X_k$  are the independent variables,  $\alpha$  is the intercept,  $\beta_k$  are the coefficients to be estimated, and  $\varepsilon$  represents the random disturbance capturing unobserved factors.

The coefficients  $\beta_k$  measure the marginal effect of each independent variable on  $Y$ , holding all other factors constant. Estimation typically relies on the Ordinary Least Squares (OLS) method, which chooses the coefficients that minimize the sum of squared residuals. The goodness of fit of the model is often evaluated through the R-squared statistic, which indicates the proportion of variance in the dependent variable explained by the regressors.

For the empirical analysis, a multiple linear regression model is applied in order to examine the relationship between financial leverage and profitability in European technology firms. The method

follows the Ordinary Least Squares (OLS) approach, which estimates the coefficients of the regression equation by minimising the sum of squared residuals. The general form of the model can be expressed as follows:

$$Y = \alpha + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_k X_k + \varepsilon$$

where  $Y$  represents the dependent variable (ROA or ROE),  $X_k$  are the explanatory variables (such as Debt/Equity, Debt/Assets, Short-Term Debt/Assets, Long-Term Debt/Assets, and the set of control variables Growth, Tangibility, Capital Intensity and R&D Intensity),  $\varepsilon$  is the intercept,  $\beta_k$  are the coefficients to be estimated, and  $\varepsilon$  is the error term.

The usefulness of multiple regression lies in its ability to isolate the effect of each independent variable while holding the others constant. For instance, it allows us to determine whether leverage has a negative or positive impact on profitability once firm-specific factors such as growth, tangibility, capital intensity and R&D intensity are controlled for. This ensures that the estimated coefficients are not biased by spurious correlations and provides a clearer picture of the true relationship between financial structure and performance. The interpretation of the results focuses on the sign, magnitude and statistical significance of the coefficients, which indicate both the direction and the strength of the relationship between leverage and profitability. In this way, the regression model becomes a powerful tool to connect theoretical predictions with empirical evidence in the context of European technology firms.

In this study, multiple linear regression was applied to a balanced panel of European technology firms using Excel's Data Analysis tool, which provides regression estimates and diagnostics. Before finalizing the models, several tests were conducted to verify the robustness and overall quality of the results, with particular attention to the R-squared values and the statistical significance of the coefficients.

The dataset is a balanced panel comprising 20 European technology firms observed annually from 2019 to 2023, yielding roughly one hundred firm-year observations. This design captures both cross-sectional heterogeneity and time-series variation, allowing the analysis to incorporate different macroeconomic phases—from pre-pandemic expansion to the post-2022 tightening cycle.

Following established corporate-finance literature (Rajan & Zingales, 1995; Booth et al., 2001; Frank & Goyal, 2009), the model controls for growth opportunities, asset composition, capital intensity, and R&D intensity to mitigate omitted-variable bias.

Two different models were estimated. The first used Return on Assets (ROA) as the dependent variable, combined with leverage ratios and control variables as predictors. However, this specification produced relatively weak explanatory power, with low R-squared values and

coefficients that were generally not statistically significant, suggesting that ROA—being independent of capital structure—captures only limited variation linked to leverage.

The second model adopted Return on Equity (ROE) as the dependent variable. In this case, the results were considerably stronger: the R-squared values improved markedly, the estimated coefficients showed higher statistical significance, and the relationship between leverage and profitability appeared more robust. This outcome is consistent with theoretical expectations, since ROE is directly affected by capital structure decisions and therefore more sensitive to the impact of financial leverage.

Overall, the use of multiple regression allowed to systematically test the link between leverage and profitability in the European tech sector, highlighting that ROE provides a more meaningful and theoretically coherent measure of firm performance when evaluating the effects of financial structure.

### ***3.6 Model Hypotheses and Statistical Tests***

To assess model adequacy, several goodness-of-fit and significance measures were employed.

The R-squared and adjusted R-squared statistics quantify the proportion of variation in firm profitability (measured by ROA or ROE) explained by the set of leverage ratios and control variables. The F-test evaluates the joint null hypothesis that all slope coefficients are equal to zero, testing whether the regressors collectively improve the explanatory power of the model. For each independent variable, t-tests examine whether the estimated coefficient differs significantly from zero, providing insight into the direction and magnitude of each factor's impact on profitability.

Given the exploratory character of the research and the moderate sample size (about one hundred firm-year observations), formal diagnostic tests for residual normality or heteroskedasticity (such as the Breusch–Pagan or Shapiro–Wilk tests) were not implemented. Instead, the analysis relied on a careful inspection of the coefficient signs and their economic plausibility, as well as on the relative explanatory power of alternative specifications. Correlation checks among leverage ratios were also reviewed to limit potential multicollinearity, allowing a clearer interpretation of the direction and magnitude of each factor's impact on profitability.

These diagnostic steps are directly linked to the research objective: understanding how capital structure affects profitability in European technology firms. The dataset spans 20 listed tech companies over 2019–2023, a period encompassing both pandemic-driven expansion and the post-2022 monetary tightening, making it essential to ensure unbiased and efficient estimates to capture the changing macro-financial environment.

The balanced panel structure, with 20 European technology firms observed annually across this five-year window, captures both cross-sectional heterogeneity and time-series dynamics. This design

is particularly relevant because it reflects the contrasting macroeconomic phases that directly influenced corporate financing choices and profitability patterns. By emphasizing economic interpretation over purely statistical refinement, the analysis remains focused on its core aim: assessing how financial leverage shapes firm performance in a rapidly evolving macro-financial landscape.

This framework supports the core objective of the study: to identify how different dimensions of financial leverage—Debt/Equity, Debt/Assets, Short-Term Debt/Assets, and Long-Term Debt/Assets—affect profitability while controlling for firm growth, tangibility, capital intensity, and R&D intensity.

The comparison between the ROA and ROE specifications confirmed theoretical expectations: ROE, which directly reflects equity holders' returns, shows a stronger and more statistically significant relationship with leverage than ROA, which is largely independent of financing mix.

Comparing models with ROA and ROE as dependent variables further clarifies how the sensitivity of profitability to leverage varies according to the chosen performance metric, reinforcing the stronger theoretical link between capital structure and ROE. Overall, the results provide credible empirical evidence that variations in financial leverage help explain profitability differences across European technology firms, validating the use of multiple linear regression as an appropriate tool for linking capital structure decisions to firm performance in this sector.

## **Chapter 4 – Analysis of Data and Results**

### ***4.1 Regression Results***

The quality of the model was assessed primarily through the R-squared statistic, which measures the proportion of variation in firm profitability explained by the leverage ratios and control variables. Regarding statistical significance, individual coefficients are evaluated using a 5 % significance threshold ( $p < 0.05$ ). In the ROE model, several independent variables exhibit p-values below this threshold, confirming their explanatory power. In the ROA model, however, most variables are not significant, reinforcing the conclusion that leverage measures have a weaker relationship with ROA.

For the regression using ROE as the dependent variable, the R-squared is approximately 60 %, indicating that the leverage ratios and control variables explain a substantial portion of the variation in equity return. This suggests that the ROE specification provides a satisfactory fit to the data and that the chosen explanatory variables capture key drivers of equity returns.

OUTPUT RIEPILOGO								
<i>Statistica della regressione</i>								
R multiplo	0,779359047							
R al quadrato	0,607400524							
R al quadrato corretto	0,572886284							
Errore standard	0,146649194							
Osservazioni	100							
ANALISI VARIANZA								
	<i>gdl</i>	<i>SQ</i>	<i>MQ</i>	<i>F</i>	<i>Significatività F</i>			
Regressione	8	3,027793126	0,378474141	17,59854859	1,39668E-15			
Residuo	91	1,957044733	0,021505986					
Totale	99	4,984837859						
	<i>Coefficienti</i>	<i>Errore standard</i>	<i>Stat t</i>	<i>Valore di significatività</i>	<i>Inferiore 95%</i>	<i>Superiore 95%</i>	<i>Inferiore 95,0%</i>	<i>Superiore 95,0%</i>
Intercetta	0,178703086	0,043554864	4,102942124	8,87353E-05	0,092186699	0,265219473	0,092186699	0,265219473
D/E	0,178951957	0,021247561	8,422235294	5,0835E-13	0,136746287	0,221157626	0,136746287	0,221157626
D/A	-0,494203431	0,270232098	-1,828810993	0,070703553	-1,030986296	0,042579434	-1,030986296	0,042579434
STD/A	-1,073387246	0,654907726	-1,638990049	0,104668273	-2,374280991	0,2275065	-2,374280991	0,2275065
LTD/A	0,218941946	0,269023095	0,813840708	0,417860674	-0,315439383	0,753323275	-0,315439383	0,753323275
Growth	0,138721868	0,069907891	1,984352065	0,050229128	-0,00014157	0,277585306	-0,00014157	0,277585306
Tangibility	0,406385224	0,353808252	1,148603011	0,253729972	-0,296411405	1,109181853	-0,296411405	1,109181853
Capital Intensity	-0,346658961	0,159306617	-2,176048721	0,032141797	-0,663101986	-0,030215936	-0,663101986	-0,030215936
R&D Intensity	-0,128495905	0,205501958	-0,625278251	0,533353363	-0,536700299	0,279708489	-0,536700299	0,279708489

The first model I estimated, which included all the independent variables, produced an R-squared of about 0.60, indicating a reasonably good fit.

However, not all the independent variables showed p-values below the conventional 0.05 threshold for statistical significance.

To strengthen the model, I gradually refined the specification by removing the least significant variables one at a time while checking how each change affected the overall fit.

I began by eliminating R&D Intensity, which had the highest p-value, followed by Long-Term Debt/Assets, and finally Tangibility, re-estimating the regression after each adjustment.

Through this iterative process, the final ROE model maintained an R-squared close to 0.60 but achieved p-values below 0.05 for all remaining predictors, resulting in a more parsimonious and statistically robust specification with stronger test statistics.

OUTPUT RIEPILOGO								
<i>Statistica della regressione</i>								
R multiplo	0,774173567							
R al quadrato	0,599344711							
R al quadrato corretto	0,57803326							
Errore standard	0,145762911							
Osservazioni	100							
ANALISI VARIANZA								
	<i>gdl</i>	<i>SQ</i>	<i>MQ</i>	<i>F</i>	<i>Significatività F</i>			
Regressione	5	2,987636207	0,597527241	28,12312951	2,55494E-17			
Residuo	94	1,997201652	0,021246826					
Totale	99	4,984837859						
	<i>Coefficienti</i>	<i>Errore standard</i>	<i>Statt</i>	<i>Valore di significatività</i>	<i>Inferiore 95%</i>	<i>Superiore 95%</i>	<i>Inferiore 95,0%</i>	<i>Superiore 95,0%</i>
Intercetta	0,186564229	0,028803181	6,477209252	4,24097E-09	0,129374838	0,24375362	0,129374838	0,24375362
D/E	0,180436872	0,021023607	8,582584049	1,8878E-13	0,138694008	0,222179736	0,138694008	0,222179736
D/A	-0,346719591	0,156649407	-2,213347609	0,029293283	-0,657750662	-0,035688521	-0,657750662	-0,035688521
STD/A	-1,291972768	0,620764171	-2,08126182	0,040128822	-2,524514581	-0,059430955	-2,524514581	-0,059430955
Growth	0,156872944	0,065752995	2,385791604	0,019047494	0,026318831	0,287427058	0,026318831	0,287427058
Capital Intensity	-0,168045215	0,04320347	-3,88962313	0,000187256	-0,253826717	-0,082263713	-0,253826717	-0,082263713

By contrast, the regression with ROA as the dependent variable produced a much lower R-squared of about 30 %. This implies that the same set of independent variables is less effective in explaining variation in ROA, which is consistent with the fact that ROA is largely independent of capital-structure decisions. By contrast, replicating the refinement strategy on the ROA regression led to a noticeably different outcome. Even after removing variables with the highest p-values, the R-squared did not improve and the significance of the coefficients remained weak.

This suggested that the chosen independent variables simply did not explain ROA as effectively as they explained ROE.

After careful analysis and multiple regression runs, I therefore decided to keep the full specification for the ROA model, acknowledging its limited explanatory power but preserving the integrity of the dataset.

OUTPUT RIEPILOGO		ROA							
<i>Statistica della regressione</i>									
R multiplo	0,574300575								
R al quadrato	0,32982115								
R al quadrato corretto	0,270904328								
Errore standard	0,061327584								
Osservazioni	100								
<b>ANALISI VARIANZA</b>									
	<i>gdl</i>	<i>SQ</i>	<i>MQ</i>	<i>F</i>	<i>Significatività F</i>				
Regressione	8	0,168438313	0,021054789	5,598081146	9,04092E-06				
Residuo	91	0,342257598	0,003761073						
Totale	99	0,51069591							
	<i>Coefficienti</i>	<i>Errore standard</i>	<i>Statt</i>	<i>Valore di significatività</i>	<i>Inferiore 95%</i>	<i>Superiore 95%</i>	<i>Inferiore 95,0%</i>	<i>Superiore 95,0%</i>	
Intercetta	0,067761393	0,018214315	3,72022741	0,000344086	0,031580894	0,103941891	0,031580894	0,103941891	
D/E	-0,005368417	0,008885569	-0,604172583	0,547232229	-0,023018509	0,012281674	-0,023018509	0,012281674	
D/A	0,064769827	0,113009019	0,573138569	0,567964475	-0,159708706	0,289248361	-0,159708706	0,289248361	
STD/A	-0,416306083	0,273877457	-1,520045089	0,131966687	-0,960330007	0,12771784	-0,960330007	0,12771784	
LTD/A	0,064746535	0,112503423	0,575507242	0,566368704	-0,158727695	0,288220764	-0,158727695	0,288220764	
Growth	0,070817261	0,029234951	2,422349219	0,01740211	0,012745622	0,1288889	0,012745622	0,1288889	
Tangibility	0,221021823	0,147959935	1,493795086	0,13868859	-0,072882411	0,514926057	-0,072882411	0,514926057	
Capital Intensity	-0,167504238	0,066620822	-2,514292558	0,013684044	-0,299838317	-0,035170158	-0,299838317	-0,035170158	
R&D Intensity	-0,01552852	0,085939364	-0,180691588	0,857011472	-0,18623651	0,155179469	-0,18623651	0,155179469	

These findings carry clear implications.

They indicate that financial leverage plays a far more decisive role in determining returns to equity holders (ROE) than in shaping overall asset profitability (ROA).

In practical terms, the results validate the decision to focus on ROE as the primary measure of profitability when examining the influence of capital structure in European technology firms, while recognizing that ROA reflects operational efficiency rather than financing choices.

## 4.2 Interpretation of the Coefficients

The beta coefficients ( $\beta$ ) measure how the dependent variable changes when an independent variable increases by one unit, holding all other variables constant.

A positive  $\beta$  means that a one-unit increase in the independent variable leads to an increase in the dependent variable of the same magnitude.

A negative  $\beta$  indicates an inverse relationship: a one-unit increase in the independent variable leads to a decrease in the dependent variable equal to the absolute value of  $\beta$ .

For example, if the coefficient for the Debt/Equity (D/E) ratio is positive, a one-unit rise in D/E increases ROE by  $\beta$  units, all else being equal.

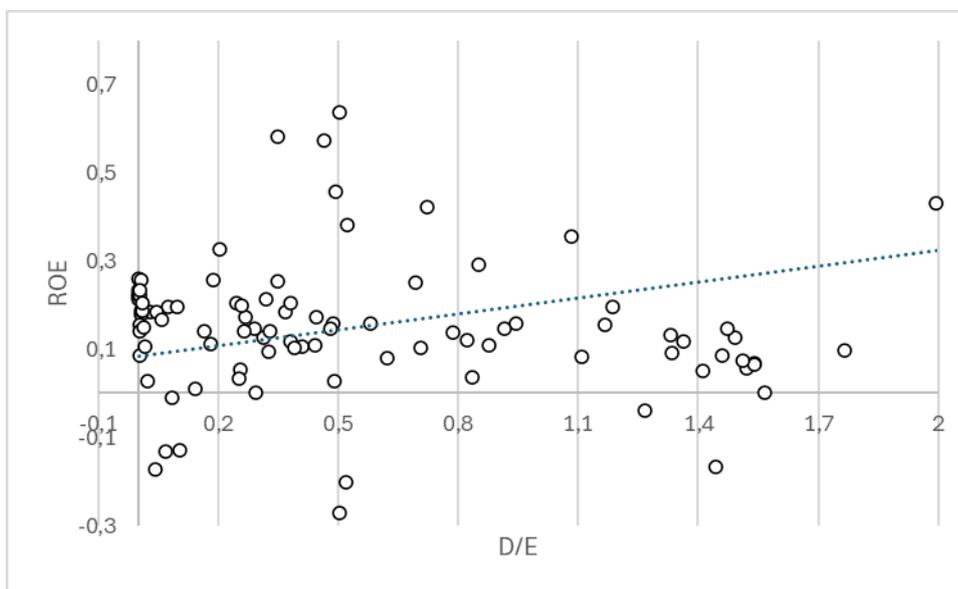
Conversely, if the coefficient for Debt/Assets (D/A) is negative, a one-unit increase in D/A corresponds to a  $\beta$ -unit decline in ROE, reflecting the negative impact of higher leverage on equity profitability.

	<i>Coefficienti</i>	<i>Errore standard</i>	<i>Stat t</i>
Intercetta	0,186564229	0,028803181	6,477209252
D/E	0,180436872	0,021023607	8,582584049
D/A	-0,346719591	0,156649407	-2,213347609
STD/A	-1,291972768	0,620764171	-2,08126182
Growth	0,156872944	0,065752995	2,385791604
Capital Intensity	-0,168045215	0,04320347	-3,88962313

The ROE regression results highlight two key explanatory variables, Debt/Equity (D/E) and Growth, that merit particular attention. The coefficient on D/E captures how changes in a firm's financial leverage influence its Return on Equity (ROE). A positive and significant estimate would indicate that higher leverage amplifies equity returns, consistent with traditional capital-structure theory, while a negative value would imply that excessive debt erodes profitability.

Similarly, the Growth coefficient measures the impact of a firm's expansion rate on ROE, revealing whether companies experiencing stronger sales or asset growth tend to deliver higher returns to shareholders.

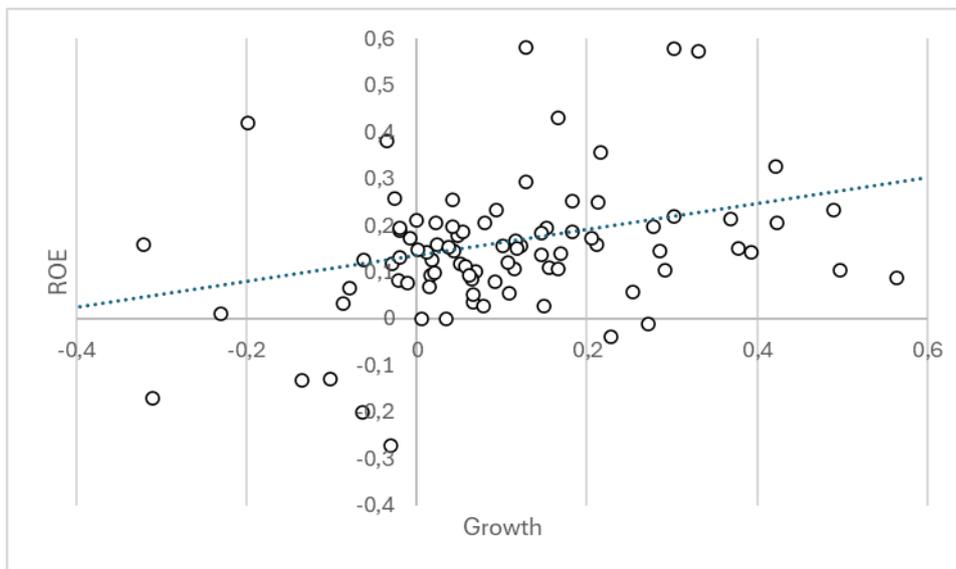
Examining the sign, magnitude, and significance of these two coefficients provides insight into the relative importance of financial structure and growth opportunities in shaping profitability within Europe's technology sector.



The scatter plot displays the relationship between Return on Equity (ROE) and the Debt-to-Equity (D/E) ratio. The fitted regression line has a slightly positive slope, suggesting that, on average, firms with higher financial leverage tend to achieve higher equity returns. However, the data points are widely dispersed around the line: many firms show very different ROE values

despite similar D/E ratios, and some highly leveraged observations record both high profits and losses.

This indicates that leverage, while positively associated with ROE, does not by itself explain equity profitability; other factors such as cost structure, macroeconomic conditions, or managerial decisions clearly play an important role. This visual evidence is consistent with the regression results, where D/E is statistically significant but with only a moderate impact.



The second plot illustrates the relationship between ROE and firm Growth. The trend line again slopes upward, indicating that companies with higher growth rates tend to deliver stronger equity returns. Compared with the D/E–ROE chart, the points appear slightly more concentrated along the regression line, suggesting a more stable relationship between growth and equity profitability. This supports the econometric findings, where the Growth variable shows a positive and significant coefficient, confirming that expansion opportunities are a key driver of equity returns.

### ***4.3 Discussion of the Results in Light of the Literature***

The empirical evidence of this study indicates that financial leverage, particularly the Debt/Equity (D/E) ratio, has a positive and statistically significant association with Return on Equity (ROE), whereas its relationship with Return on Assets (ROA) is weak and largely insignificant.

This pattern aligns closely with classic capital-structure theory.

The seminal work of Modigliani and Miller (1963) highlights that, when corporate taxes are considered, debt financing can enhance equity returns by providing an interest-tax shield, as long as the probability of financial distress remains moderate.

More recent corporate-finance surveys (e.g., Myers, 2001; Frank & Goyal, 2009) confirm that leverage amplifies the returns to equity holders - precisely the mechanism captured in the higher explanatory power ( $R^2 \approx 0.60$ ) of the ROE model relative to the ROA model in this research.

Empirical cross-country analyses support these findings.

Rajan and Zingales (1995) and Booth et al. (2001) document a positive relation between leverage and equity returns across developed and emerging markets, while also noting that asset-based measures of profitability such as ROA are less sensitive to financing structure.

This is echoed by Fama and French (1998), who show that leverage's primary impact is on the cost of equity rather than on overall asset productivity, explaining why ROE rather than ROA captures the influence of debt decisions.

Focusing on the technology sector, several studies reinforce the conclusions of this thesis.

For example, Balakrishnan and Fox (2021) find that U.S. high-tech firms with stronger intellectual-property portfolios employ moderate leverage to magnify shareholder returns without impairing innovation.

Similarly, Eriotis et al. (2011), analyzing European IT firms, report a positive association between leverage and ROE but a negligible effect on ROA, attributing this to the high proportion of intangible assets and the relatively low collateral value of physical capital.

In a panel of European ICT companies, Ghosh and Jain (2017) observe that financial leverage enhances market-adjusted equity returns, provided that R&D intensity is accompanied by stable cash flows.

These sector-specific findings parallel the present results: the European technology firms examined here display a capital structure where debt, when prudently managed, acts as a lever on equity performance but does little to alter asset-level profitability.

The positive and significant influence of Growth on profitability in this study also resonates with prior work.

Research by McConnell and Servaes (1995) and Anderson & Reeb (2003) suggests that firms with strong growth opportunities can both sustain higher leverage and generate superior returns, a pattern observed across innovative industries.

Likewise, Hall and Lerner (2010) emphasize that technology companies, dominated by intangible assets and R&D investment, depend more on future growth potential than on tangible collateral for financing—explaining why traditional variables such as Tangibility or even R&D

Intensity show weaker direct effects on profitability.

Taken together, these results underscore that capital-structure choices exert their greatest influence when performance is measured from the shareholders' perspective.

ROE, by construction, reflects the leverage-driven magnification of equity returns, whereas ROA is largely independent of financing mix and thus a less sensitive indicator of the debt–profitability channel.

The evidence presented here therefore strengthens the theoretical prediction that in sectors rich in intangible assets and rapid innovation - such as European technology - moderate financial leverage can be an effective tool for enhancing shareholder value.

This study thus contributes to the broader capital-structure literature by supplying updated, Europe-focused evidence that complements the predominantly U.S.-based findings, and by highlighting the sector-specific dynamics of leverage and profitability in technology markets.

## **Conclusions**

This thesis investigated the impact of financial leverage on the profitability of European technology firms over the five-year period 2019–2023, combining theoretical insights from capital-structure literature with empirical analysis of a balanced panel of 20 listed companies. Using multiple linear regression, the study tested whether leverage ratios—including Debt/Equity, Debt/Assets, and the maturity composition of debt—affect profitability when controlling for growth, tangibility, capital intensity, and R&D intensity.

The findings provide several key insights. First, the regression using ROE as the dependent variable reveals a clear and statistically significant positive association between financial leverage and shareholder returns. The model explains roughly 60 % of the variation in ROE, indicating that capital-structure decisions are an important driver of equity profitability in European technology firms. By contrast, the ROA model achieves an R-squared of only about 30 % and shows limited statistical significance, suggesting that leverage plays a smaller role in shaping operating efficiency independent of financing mix. This contrast aligns with theoretical expectations: ROE, by construction, captures the amplification effect of debt on equity, whereas ROA is largely neutral to capital structure.

Second, the stepwise refinement of the ROE model—eliminating variables with high p-values while monitoring explanatory power—produced a parsimonious yet robust specification, reinforcing the conclusion that the positive leverage–profitability relationship is not an artefact of model complexity. In the ROA model, however, similar refinements failed to improve fit or significance, underscoring the weaker link between leverage and asset-based profitability.

These results resonate with and extend prior literature. Consistent with trade-off theory, they show that moderate leverage can enhance equity returns when managed prudently. At the same time, the relatively low overall debt levels observed across the sample echo the pecking-order prediction that profitable technology firms often prefer internal financing, especially in periods of macroeconomic uncertainty and high intangible intensity. Compared with earlier studies of global or U.S. technology companies, the European evidence highlights the combined effect of structural features—intangible assets, volatile cash flows—and macro-financial shocks, from the pandemic boom to the post-2022 tightening cycle.

Managerially, the findings suggest that European technology firms can use leverage strategically to enhance shareholder returns, provided they maintain financial flexibility and avoid excessive short-term debt that could amplify refinancing risk. For investors, the evidence supports focusing on capital-structure quality—particularly the balance between short- and long-term debt—when

assessing profitability potential. From a policy perspective, the results underline the importance of well-functioning capital markets that allow technology firms to access stable financing while encouraging sustainable growth.

In sum, this research demonstrates that financial leverage remains a powerful yet nuanced determinant of profitability in the European technology sector. By revealing a robust positive relationship with ROE but not with ROA, it underscores that the benefits of debt are realized primarily through equity returns rather than operational efficiency. As the European tech ecosystem continues to mature and confront new challenges—from artificial intelligence adoption to geopolitical uncertainty—understanding this leverage–profitability dynamic will remain essential for corporate strategists, investors, and policymakers seeking to foster resilient, innovative, and competitive firms.

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