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M&A Trends in the Pharmaceutical Industry: The Relationship between Financial Performance and Valuation Multiples in the EU, UK and US Markets

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ABSTRACT

Objective – Previous academic literature focused on pharmaceutical M&A drivers, pre-deal and post-deal perfomance comparison and M&As' effect on financial and innovation outcomes. Little is known, however, about the determinants of M&A valuations in the industry, especially the ones related to the targets' financials. This paper examines the relationship between the pre-deal financial performance of pharmaceutical target firms and the valuation multiples.

Methods – Orbis and Orbis M&A were screened to obtain a sample of 276 majority stake acquisitions and acquisitions with a majority stake increase occurred between 2000 and 2025, involving EU, UK and US targets identified as manufacturers of basic pharmaceutical products and pharmaceutical preparations (NACE code: 21). Four econometric models with a total of sixteen linear regressions with errors clustered by deal year have been carried out through Stata. The financial performance indicators utilized as explanatory variables are EPS, ROA and R&D/Revenues. The valuation multiples used are EV/Revenues, EV/EBITDA, EV/EBIT and the Tobin's Q, considered here as a variant of an equity multiple. Apart from R&D/Revenues, all these variables have been winsorized at the 5th and at the 95th percentile.

Results – EPS presents negative coefficients when EV/Revenues is regressed, and positive estimates when the EBITDA and EBIT multiples are regressed. While in the first model all coefficients are significant, except in the case Tobin's Q is the dependent variable, in the last model the estimate is statistically significant only when EV/EBITDA is regressed (p-value < 10%). Apart from a negative coefficient in the fourth model with the EBITDA multiple as dependent variable, probably due to the error's dimension, ROA shows all positive estimates. Furthermore, it has a significant positive impact on EV/Revenues in the last model (p-value < 10%). R&D/Revenues always yields negative coefficients with enterprise value multiples as dependent variables, and positive ones when Tobin's Q is regressed. However, none of them reach statistical significance.

Conclusions – ROA has a positive relationship with valuation multiples. Acquirers are found to be willing to pay more for a pharmaceutical firm with a high return on assets as they appreciate a company with an elevated operational efficiency. The results on EPS require greater caution. Indeed, spurious correlations stemming from the influence of the EV multiples' denominators on the explanatory variable are detected. No significant association is observed between R&D/Revenues and the multiples.

Keywords – M&A · Pharmaceutical industry · Financial performance · Valuation multiples

INTRODUCTION

The pharmaceutical sector represents one of the most important industries in the economy. Through the production of medicines, indeed, companies satisfy a primary need, i.e. curing human health.
The world is plenty of multinational and smaller firms involved in extraordinary finance processes every year, such as mergers and acquisitions (commonly called M&A). These events have the power to change the

fate of a sector, with companies enhancing their market share and exploiting operating and financial synergies. These actions are difficult to implement and not always bring to the desired success. Hence, firms must carefully evaluate which would be the best business to acquire or to merge with. A common practice is, for istance, to assess the financial performance the target firm had prior to the time of the acquisition.

Various academic articles studied the topic of pharmaceutical M&As, especially in the last two decades. However, they mainly concentrated on understanding why firms exploit them, comparing the performance of companies before and after a deal, and analyzing the M&As' influence on financial results and innovation. Insufficient consideration has been given, instead, to the impact that target company attributes have on M&A valuations. Michaeli et al. (2022), for example, investigates when buyers are willing to pay more for a firm, but it only evaluates characteristics regarding the deal and the products offered rather than the financial traits belonging to the target.

Therefore, this paper analyzes the transactions occurred in the pharmaceutical industry and examines if there are financial metrics of the target company that acquirers consider relevant to determine its attractiveness. Hence, the research question can be formulated as follows: does the financial performance of pharmaceutical target firms have a significant impact on the valuation multiples paid in M&A transactions? This work conducts a study on deals involving companies belonging to the pharmaceutical sector with headquarters in the European Union (exception made for Austria, Cyprus, Estonia, Latvia and Malta due to lack of data), United Kingdom and United States of America. The sample is analyzed in a period with an inferior limit coincident with the beginning of 2000s, with the rationale of considering the transactions occurred in the new millennium. The inputs of the study are extracted from Orbis and Orbis M&A databases, processed through Microsoft Excel, and then imported into the software Stata to carry out linear regressions. Four models with valuation multiples as dependent variables and financial performance indicators as explanatory variables are implemented. As a result, sixteen regressions are used to study the relationship between them.

The paper is divided into three chapters. In chapter one, a holistic outlook on the M&A phenomenon and the pharmaceutical sector will be provided, as well as a view of the background literature to assess what academics found thus far. Chapter two gives details about the sample, the variables and the regression models chosen for the analysis, in order to demonstrate why they will help answering the research question. In chapter three, the evidence coming from the empirical analysis will be presented, leaving then space to the conclusions.

CHAPTER 1: A GENERAL PICTURE ABOUT M&A AND THE PHARMACEUTICAL SECTOR

THE M&A PHENOMENON

Mergers and Acquisitions represent the main example of inorganic growth[1] strategies that companies implement when they focus on expanding their business externally, through extraordinary transactions, rather than internally. In these transactions the ownership of companies or of their operating units are transferred or consolidated with other entities, allowing enterprises to grow, change the nature of their business or their competitive position.

The first aspect that needs to be outlined is the difference between a merger and an acquisition[2]. From a legal point of view, a merger involves the consolidation of two entities into one. It occurs when two companies combine to form a completely new enterprise, such that neither of the previous companies remains independently. An acquisition, instead, is the purchase of one business or company by another one. It occurs when one entity takes ownership of another entity's stock or assets.

There could be several strategic objectives behind pursuing an M&A transaction[3]. Under certain circumstances, it allows to achieve lower average manufacturing costs or to eliminate redundancies in the organization, hence reaching economies of scale. It may help achieving higher efficiency through economies of scope. Apart from creating operating synergies, it can also be carried out to implement diversification and decrease consequently the corporate risk profile and the cost of capital through positioning the firm in higher-growth products or markets. An M&A may be used to replace managers not acting in the best interests of the owners with new figures that will enhance the value of the acquired business. Moreover, sometimes a company decides to acquire another to optimize their supply chain and enhance or preserve their contractual power: on one hand, buying a supplier can reduce the risk of dependence on an outside supplier while on the other hand, buying a customer brings closer to end users enabling customer retention[4]. Finally, a relevant motivation derives from the so-called "hubris hypothesis"[5]. According to this theory, "If there actually are no aggregate gains in takeover, the phenomenon depends on the overbearing presumption of bidders that their valuations are correct.", meaning that managers may decide to acquire a company because of their overconfident belief that the market does not reflect the correct value of the combined firm.

M&As are mainly defined either by functional roles in the market or by business outcome. When distinguishing by the first categorization, transactions can be divided into horizontal mergers, vertical mergers, concentric M&As and conglomerate M&As[6]. A horizontal merger takes place when the two

[1] https://www.forbes.com/councils/forbesbusinesscouncil/2022/04/01/understanding-the-crux-of-organic-and-inorganic-growth/
[2] https://www.investopedia.com/terms/m/mergersandacquisitions.asp
[3] DePamphilis, D. (2011). Mergers, Acquisitions and other Restructuring Activities. 6th edition.
[4] https://www.investopedia.com/ask/answers/012715/when-does-it-makes-sense-company-pursue-vertical-integration.asp
[5] Roll, R. (1986). The Hubris Hypothesis of Corporate Takeovers. The Journal of Business, 59(2), 197-216.
[6] https://datarooms.org.uk/mergers-acquisitions/ma-strategy

companies involved are competitors in the same product/geographical markets. In this case, synergies can be obtained through increased market share, cost savings and new market opportunities. A vertical merger occurs, instead, between firms that do not operate at the same level of the production. An example could be a company acquiring one of its suppliers. The vertical buying is aimed at reducing overhead costs of operations and gaining economies of scale. In a concentric M&A, the target and the buyer do not operate in the same industry but in two industries which are related between them. Through such transaction, the merged firm can establish cross-selling income by offering complementary products and services to both customer bases. A conglomerate M&A entails the merger between two irrelevant, strategically unrelated firms, where the objective is usually diversification of goods and services. When analyzing transactions by their business outcome[7], one can distinguish between statutory and consolidated mergers. A statutory merger makes the target company dissolve with the purpose of transferring its assets and capital into the acquiring firm. The result of a consolidated merger is, instead, the creation of an entirely new legal company through the combination of the target and acquirer, which are both dissolved in the process. Speaking of further definitions, a strategic merger usually refers to the long-strategic holding of a target firm. Being the creation of synergies in the long run the aim of this M&A process, a strategic buyer may also be willing to pay a premium in the outlook of the post-acquisition value created. Moreover, in the recent years it has become common in the technology industry to use talent acquisition to add workforce expertise. This kind of acquisition, where the acquiring firm seeks to obtain the target's talent rather than its products, which are often discontinued during the process, is called by the term "acqui-hire"[8]. Finally, a merger of equals[9] refers to the combination of companies with similar size. Some of the largest ones took place during the dot.com bubble of the late 1990s and in 2000[7], such as the merger between AOL and Time Warner, a deal valued at 350 billion dollars[10].

When a company's owner decides to sell the business, he can choose between typically four sale process options[11]. One way is engaging in a one-step negotiation, where the process is carried on with one selected buyer and the price is negotiated and agreed shortly after the end of the due diligence, a risk management device which serves to confirm all material facts regarding a sale. This kind of deal-making provides a faster execution speed and a higher level of confidentiality, with the timing of the transaction remaining usually between four and six weeks and a lower profitability of leaks. On the other side, however, the involvement of only one buyer reduces bargaining power once the process is underway and eliminates price upside potential due to the lack of competition. Another possibility is to go for a controlled auction, approaching a broader but still very focused list of potential buyers. This option is characterized by a first

[7] https://en.wikipedia.org/wiki/Mergers_and_acquisitions
[8] https://www.forbes.com/sites/roberthof/2013/12/04/attention-startups-heres-how-to-get-acqui-hired-by-google-yahoo-or-twitter/
[9] https://www.investopedia.com/terms/m/merger_of_equals.asp
[10] https://www.nytimes.com/2010/01/11/business/media/11merger.html
[11] De Vecchi, L. (2024). M&A and Investment Banking; Sell-Side M&A (Lecture notes). Libera Università Internazionale degli Studi Sociali Guido Carli (LUISS).

phase, where indicative bids are submitted, and a second phase, where a detailed due diligence for investor selected in the precedent phase is conducted. The main advantage is the maximization of competition and consequently of the final price, even though, relatively to the negotiated process, the deal requires four weeks more circa to be sealed and it has a lower level of confidentiality. A comparable option in terms of form and execution is the broad auction, whose principal feature is that all potentially interested buyers are contacted, giving life to the broadest possible approach. This could generate an even greater competition, facilitating valuation upside, at the cost of a slower process and the highest level of confidentiality risk. Lastly, the target's owner could choose a so-called "non-auction", initiating parallel bilateral discussions with the identified buyers, to whom has not been explicitly told they are involved in a competitive process. Indeed, the existence of additional buyers is communicated only in the second round. The perceived absence of competition could encourage a higher number of potential bidders to participate, along with reducing confidentiality risk respect to the controlled and broad auctions. Notwithstanding that, this perception can lead to the loss of competitive tension. Moreover, on one hand, there is the difficulty in synchronising different buyers on the same timetable while, on the other hand, bidders might ask exclusivity as pre-requisite to continue the process.

The M&A process is structured as follows. It consists of a preparation phase, a first and second round, and an execution phase.

From the sell-side perspective, the preparation phase is divided into three parts. During the initiation phase, the sale objectives are agreed, the advisors are appointed and timing is decided. In the due diligence phase, the company's financial and operating performance are analyzed and the information memorandum is prepared, which describes the company in detail and will be usually given to the buyer once a non-disclosure agreement is signed[12]. The final preparation phase is used to finalise the information memorandum and prepare the prospective buyer list, the data room, which is a secure archive where documents regarding the transaction are available[13], and the vendor due diligence. From the buy-side perspective[14], instead, the preparation phase is made for reviewing the competitive landscape, selecting advisors and considering pre-emptive bids or potential partnerships.

The round one phase is characterized by non-binding indicative offers. The seller starts distributing the information memorandum and the initial bid procedures letter, which solicits buyers to make an offer[15]. Moreover, the legal agreements are prepared, data room and vendor due diligence are finalised, and non-binding offers are evaluated in order to select round two participants. At the same time, the buyer sends the preliminary expression of interest, reviews the information memorandum, identifies key due diligence items

[12] https://www.exitstrategiesgroup.com/ma-glossary-confidential-information-memorandum
[13] https://corporatefinanceinstitute.com/resources/business-intelligence/data-room/
[14] De Vecchi, L. (2024). M&A and Investment Banking; Buy-Side M&A (Lecture notes). Libera Università Internazionale degli Studi Sociali Guido Carli (LUISS).
[15] Rosenbaum, J. and Pearl, J. (2009). Investment banking: Valuation, Leveraged Buyouts, and Mergers & Acquisitions. John Wiley & Sons, Inc., Ch. 2, 6.

and assesses a preliminary valuation range before sending the non-binding offer.
Round two occurs when, instead, site visits are made and binding final offers are received. The seller distributes both the final bid procedures letter, inviting successful bidders to the second round and establishing the final offer's requisites and deadline[15], and the external due diligence reports. The buyer, after reviewing the vendor due diligence and either confirming or refining the preliminary valuation range, must make a binding offer.
Finally, during the execution phase final negotiations take place and definitive agreements are signed in order to announce the transaction. Then, regulatory approval represents the last step before the deal arrives to the closing. Indeed, filing requirements under the antitrust laws may be triggered by the size of the transaction[16]. Furthermore, the deal may need the government approval, which is usually called "golden power". For istance, golden power rules in the European Union were expanded during COVID crisis to shield companies deemed as strategic when valuations steeply declined[17].

When contemplating about entering in an acquisition, a buyer must reflect on the so-called purchase consideration[15], which refers to the mix of cash, stock and other securities that the buyer offers to the target's shareholders. Infact, there can be three different scenarios. In the case of an all-cash transaction, all or a portion of the target's shares are purchased in exchange of cash. Although cash gives liquidity, the receipt of such consideration triggers a taxable event. In a stock-for-stock transaction, instead, the exchange is not taxable until the shares are eventually sold. The equity value calculation is here based on either a fixed or floating exchange ratio, computed as the offer price per share (also called value to target) divided by the acquirer's share price. In a fixed exchange ratio structure, the amount of acquirer's shares given in exchange for each target's shares is put constant, such that the value to target moves in line with the buyer's share price. It is more commonly used because both the buyer and the seller share the risk (or opportunity) from share price movements between the signing and the closing. In a floating exchange ratio structure, the value to target, hence the price the acquirer has agreed to pay for each share of the target, is set while the number of stocks exchanged fluctuates in line with the acquirer share price's movements. In this case, target shareholders have higher certainty in terms of value received while the buyer assumes the full risk of a decline in its stock price. This structure, infact, is usually implemented when the acquirer is so large compared to the target that the risk-sharing coming from the fixed structure would not be sustainable for the seller. The buyer can finally opt for a cash and stock transaction, where the cash portion of the offer is based on a fixed value per share whereas the stock portion can be set according to either a fixed or floating exchange ratio.

[16] Edwin, L., Miller, J. (2008). Mergers and acquisitions: A step-by-step legal and practical guide. John Wiley & Sons, Inc., Ch. 1.
[17] https://www.reuters.com/markets/europe/italy-open-reviewing-golden-power-rules-ma-cut-red-tape-2025-03-04/

An additional transaction categorization consists of whether an acquisition is friendly or hostile[18]. Indeed, before the aforementioned regulatory approval, an acquisition needs to be approved first by the board of directors and then at the shareholder general meeting. The core of a hostile M&A involves making an offer to public shareholders that bypasses the target's management or board. Even though there are opportunities to exert pressure on a seller in a private sale process, truly hostile bid tactics are only possible in public M&A situations. Analyzing the pros and cons, it can help acquiring a target against the management's wishes but, on the other hand, it is characterized by a higher uncertainty and a possible reputational damage to the offeror. In addition, there is neither due diligence access nor co-operation with respect to regulatory issues and the target is incentivised to seek alternative solutions to repel the hostile bidder's move. Going for a friendly approach has, instead, the advantages of both a higher probability of closing the deal and a shorter bid timetable, due to the management co-operation and reduced likelihood of counter bids. Notwithstanding that, a friendly M&A is not free of disadvantages. Indeed, the board recommendation and support come at a cost and the risk of a leak cannot be ruled out.

Most of the time, before going hostile the bidder makes an unsolicited offer to a public company at a premium to the market share price. This strategy signals the buyer's commitment to acquire the target and can create a sense of emergency because of the fiduciary duty to act in the best interests of shareholders, thus intensifying pressure on the board of directors and increasing stockholders' engagement. This is the reason why the so-called "Bear hug" represents the precursor of a hostile bid[19].

In the case of a hostile M&A, the seller can defend himself thanks to both preemptive and reactive tactics[20]. Preemptive defense tactics are used to prevent the phenomenon. For istance, the anti-takeover amendments, also called "Shark repellents", aim at limiting the bidder's ability to get the target's control. They are namely the use of staggered boards, where directors are elected for different time lenghts, fair price and supermajority provisions, and dual class recapitalization, which implies reorganizing the capital structure by issuing shares with enhanced voting powers to friendly shareholders or to the board. Another typology of preemptive tactics are golden parachutes, provisions that give top managers generous compensations in case they are fired after a change in the company's control. When union representatives are part of the board of directors, labor agreements can be helpful given that labor representatives are likely to oppose a hostile takeover since it tipically results in downsizing the target. The use of poison pills is widely considered as the most effective defence. They are based on the issuance of securities to make control gain difficult and costly, and they are usually adopted with the intention of not implementing them like a "nuclear weapon", as stated by Bruner (2004). Lastly, poison puts are covenants that, in case of a change in control, grant bondholders the right to sell target bonds at par or even above par. It is when the hostile bid has already been launched

[18] De Vecchi, L. (2024). M&A and Investment Banking; Mergers & Acquisitions (Lecture notes). Libera Università Internazionale degli Studi Sociali Guido Carli (LUISS).
[19] https://dealroom.net/faq/bear-hug
[20] Iannotta, G. (2010). Investment Banking: A Guide to Underwriting and Advisory Services. Springer-Verlag Berlin Heidelberg.

that, instead, reactive defense tactics come in help. Restructuring, such as selling the target's segments in which the buyer is most interested (i.e. the "crown jewels"), acquiring undesirable assets or increasing the target's leverage to intolerable levels may lead the bidder to leave the deal. Also, the target could implement a greenmail, repurchasing its shares from the bidder at premium in exchange for an agreement stating a time span over which the bidder cannot make another hostile bid. Through the so-called "Pac-Man" strategy, the target may even launch a counter bid on the acquiror. Finally, it may seek help from either a white knight or a white squire. The former is a friendly bidder contrasting the hostile bid, while the latter is a friendly third-party investor, which is not a buyer but rather a strategic ally, brought in to help fend off the hostile bidder by purchasing a block and agreeing to vote in alignment with the target's management.

A famous example of hostile M&A is the Olivetti's takeover of Telecom Italia in 1999[21]. A peculiarity of this deal is that the target company was more than five times the size of the acquirer. Defense tactics were a failure, indeed the defense plan was not approved at the shareholders meeting and even the exploitation of a white knight, such as Deutsche Telekom, was unsuccessful. Infact, the italian government didn't want the german government to have a large stake in the italian company and threatened to exert its golden power to put a veto on the deal. Hence, Olivetti ultimately acquired 52% of Telecom Italia's voting shares at a cost of 31 billion euros.

It is also important to mention how law intersects with M&A processes. Regarding the geographic areas that are part of this study's sample, European Union, United Kingdom and United States present reasonable similarities in corporate disclosure obligations and shareholder rights[22]. Despite that, there are three aspects with notable differences. About employee rights, for istance, european law stipulates that employees retain protections against layoffs and restructurings, whereas few such protections are provided by the american law. Moreover, while in the US the standard practice of a two-step transaction, in which the buyer acquires voting control and then completes a full merger, is commonly accepted, such strategy is prohibited in the EU and UK where a full mandatory bid which leaves no minority is required. A different approach is finally adopted for takeover defense measures. The target in the United States is permitted a wide range of evasive maneuvers including asset sales, recapitalization and restructuring, whereas in the EU and UK the target may take no other actions than seeking alternative bids from other firms to fend off the hostile bidder.

Another crucial theme is the bond between mergers and competition law. According to european law[23], the article 102 of the Treaty on the Functioning of the European Union (i.e. TFUE) gives the European Commission the power to regulate the behaviour of companies it claims to be abusing their dominant position. The Commission must consider first if the company under analysis holds a dominant position and

[21] Kruse, T. A. (2005). Ownership, Control and Shareholder Value in Italy: Olivetti's Hostile Takeover of Telecom Italia. ECGI, Finance Working Paper 83.
[22] Bruner, R. F. (2004). Applied mergers & acquisitions. John Wiley & Sons, Inc., Ch. 27.
[23] https://competition-policy.ec.europa.eu/antitrust-and-cartels/procedures/article-102-investigations_en

then if its behaviour is abusive or not. The investigative powers the Commission possess to enforce this article are listed in the Regulation 1/2003, and it can require the undertakings to provide all necessary information to assess whether there has been a breach or not. Mergers that have a "Community dimension", meaning they have a noticeable impact both within the EU and globally in terms of aggregate turnover, are governed by the Merger Regulation No. 139/2004[24]. Article 2 says that for a merger to be declared compatible, it must not create or strenghten a dominant position where it would, if it went ahead, "significantly impede effective competition". In the US, the law that rules such matter is the Hart-Scott-Rodino Antitrust Improvements Act of 1976 (HSR Act)[25]. It requires companies to file premerger notifications with both the Federal Trade Commission and the Antitrust Division of the Department of Justice in order to establish whether the proposed transaction lessen competition in violation with Section 7 of the Clayton Act.

After having discussed deeply about M&As, do they actually bring to success? According to literature, several profitability drivers can be outlined. For istance, it seems that diversification destroys value rather than conserving it. Indeed, Berger and Ofek (1995) found an average loss in value from diversification between 13% and 15%, and the degree of relatedness between the businesses of the buyer and seller mitigates this effect. In addition, Maquieira et al. (1998) conclude that there are economically and statistically significant gains for firms involved in non-conglomerate mergers whereas conglomerate mergers present no statistically significant gains. Consequently, diversifying mergers tend to be associated with worse performance than related mergers. Another aspect that needs attention is that value acquiring pays whereas glamour acquiring does not. Rau and Vermaelen (1998) found that low book-to-market glamour acquirers significantly underperform after the merger, in contrast with high book-to-market value bidders, in both cash-financed and equity-financed deals. This paper's evidence "suggests that companies with low book-to-market ratios tend to make relatively poor acquisition decisions, in general". Even though one of the consequences of an acquisition is the enhancement of market position, studies shows that M&As carried out to build market power do not pay off. Mueller (1985) discovered that acquired firms do not perform better, if not even worse at times, than non-acquired ones, consequently stating that mergers decrease the merging companies' profitability. Regarding the method of payment, literature demonstrates that stock offers are not as attractive as cash offers. Huang and Walkling (1987) report that at deal announcements, abnormal returns associated with cash-based deals are higher than the ones associated with stock-based deals. Travlos (1987) found that shareholders experience even significant losses in the case of pure stock exchange bidding, while they earn normal returns when a cash-financing bidding takes place. Thus, announcing a stock payment could be taken as a signal that managers believe the company's shares are overpriced, consistently with the signalling hypothesis. Indeed, studying a sample of stock for stock mergers completed between 1985 and 1990, Erickson and Wang (1999) found that acquirors exploit manipulative accounting procedures to

[24] https://eur-lex.europa.eu/eli/reg/2004/139
[25] https://www.ftc.gov/legal-library/browse/statutes/hart-scott-rodino-antitrust-improvements-act-1976

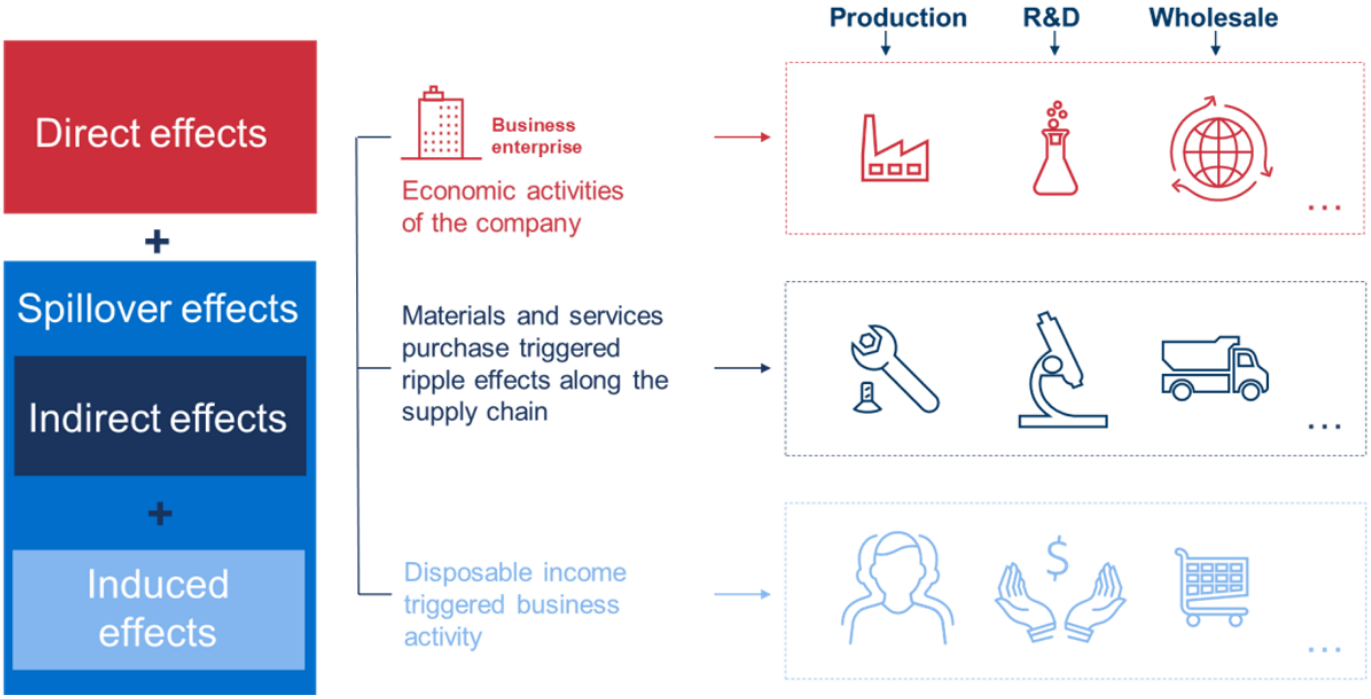
manage earnings upwards in the period before the merger agreement. Lastly, an important M&A profitability driver is the commitment of the buyer's management. Infact, Healy et al. (1997) concluded that "the transaction characteristics that were under management control substantially influenced the ultimate payoffs from takeovers.", suggesting that when managers have more at stake, more value is created.

THE PHARMACEUTICAL SECTOR

The pharmaceutical industry can be defined as an important component of the healthcare system. It consists of public and private businesses that discover, develop, manufacture and commercialize drugs for human and animal health[26]. Its strategic relevance derives not only from contribution to patients' well-being, preventing and treating diseases. Indeed, it also highly contributes to the global economy through value enhancement and job creation. A 2022 study from the International Federation of Pharmaceutical Manufacturers & Associations (IFPMA)[27] outlines medicines' contribution to the healthcare systems' sustainability through the generation of savings mainly from cost reduction in different areas, such as hospital stays and long-term care costs. Moreover, a research report from the WifOR Institute[28] found that the pharmaceutical sector adds value to the economy in terms of GDP contribution and employment both directly and indirecly through cross-sectional industry spillover effects (see Figure 1).

[26] https://iloencyclopaedia.org/part-xii-57503/pharmaceutical-industry/item/385-pharmaceutical-industry
[27] IFPMA. The Pharmaceutical Industry and Global health: Facts and Figures 2022. pp. 12.
[28] Juneja, M., Mai, L. and Albu, N. (2024). The economic impact of the global pharmaceutical industry: Measurement of the economic impact relating to the pharmaceutical industry's global economic and R&D activities. WifOR Institute Research Report, November 2024.

Figure 1: Diagram of the economic impact analysis: direct, indirect and induced effects triggered through economic activities of the global pharmaceutical industry.[28]

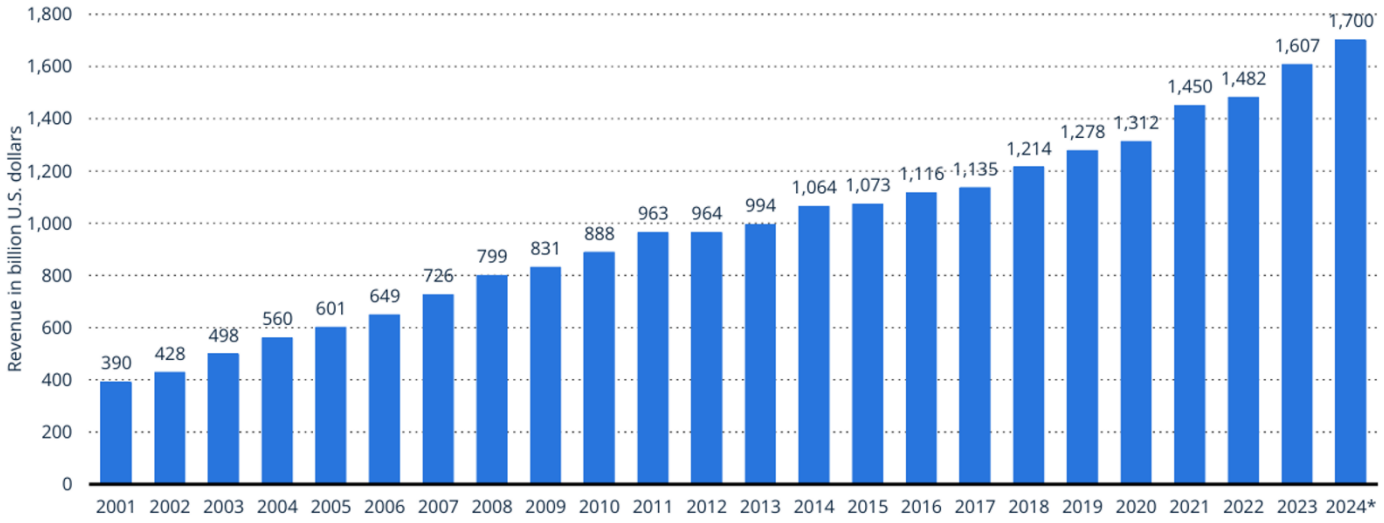


Indeed, the direct effects generated by the industry come from pharmaceuticals' production and R&D (i.e. research and development) investments, but additional value is created through indirect and induced effects dependant on global supply chains. Indirect effects derive from purchases made by a business to procure goods and services. For istance, the demand for chemicals from a pharmaceutical firm triggers economic activity at the chemical supplier and its suppliers, producing an indirect impact on the company. Induced effects, instead, develop due to the expenditure of disposable income by employees — both those of the company and those in the supply chain. The so-called spillover effects represent the combination between indirect and induced effects.

The global market value of the pharmaceutical industry experienced significant growth during the 21st century[29], with worldwide revenues passing from 390 billion dollars in 2001 to an estimated value of 1,700 in 2024 (see Figure 2) and a consequent CAGR[30] (i.e. compounded average growth rate) of 6.61%.

[29] Statista. Industries and Markets: Pharmaceutical market worldwide. November 2024.
[30] https://www.borsaitaliana.it/notizie/sotto-la-lente/cagr-259.htm

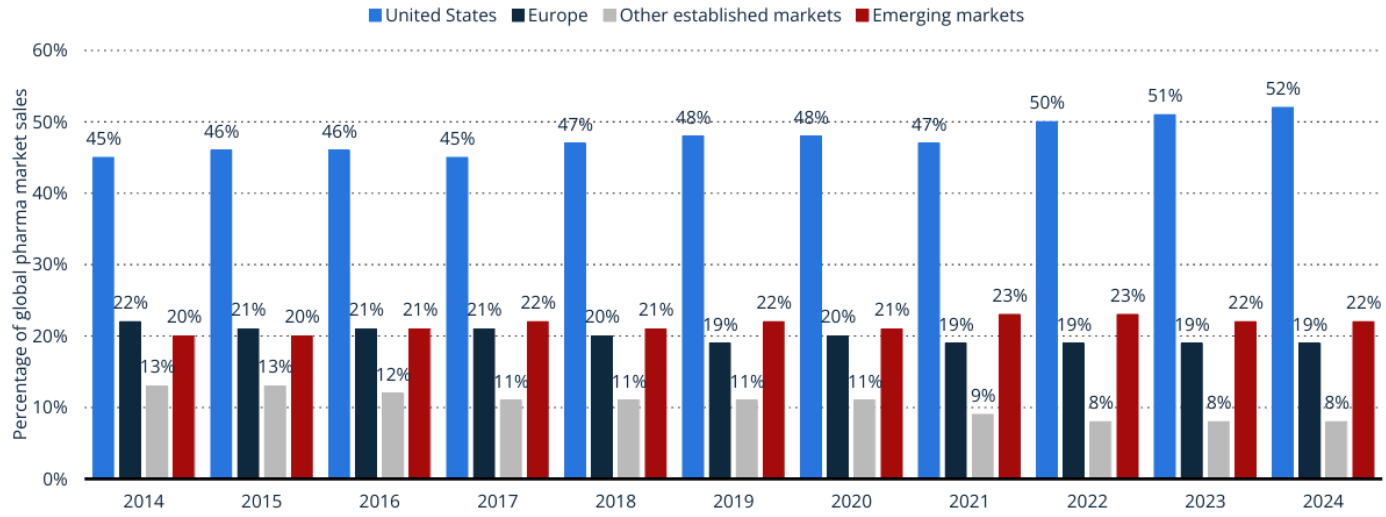
Figure 2: Revenue of the worldwide pharmaceutical market from 2001 to 2024 (in billion U.S. dollars)[29]



*For 2024, the total global pharmaceutical market was estimated at around 1.7 trillion U.S. dollars.

Throughout the last decade, the market has seen the predominance of the United States as the sector's leader, maintaining a market share in terms of sales between 45% and 52% and leaving Europe behind with a stake around 20% (see Figure 3). Germany, France and Italy have been the top three european players in 2024, with revenues of 69.8, 49.1 and 44.4 billion dollars, respectively. United Kingdom has ranked just after them, with revenues totaling 42.1 billion dollars.

Figure 3: Distribution of the total global pharmaceutical market sales from 2014 to 2024, by submarket[29]



The competitive landscape of the pharmaceutical sector can be assessed through the five forces analysis[31] (see Figure 4).

The buyer power is overall perceived as moderate, as the influence of price sensitivity, product differentiation and product indispensability varies depending on product categories. For istance, while for generic products buyers are highly responsive to price changes, buyer power on life-saving and specialty drugs is lower given that the critical nature of these products decreases price sensitivity. Moreover, even though the lack of differentiation in the generic drug segment increases buyer power, given that these products contain the same active ingredients regardless of the manufacturer, differentiation is instead substantial for patented and branded drugs, reducing buyer power. Finally, buyers have no other options but to bend to the seller's demands when purchasing essential medicines, whereas they have the chance to negotiate the price or to switch suppliers when dealing with drugs which are not largely indispensable.

Supplier power is moderate as well. Despite the wide network of suppliers globally, their concentration in critical or specialized segments, such as high-quality APIs (i.e. active pharmaceutical ingredients), can enhance their bargaining power. Indeed, pharmaceutical companies risk incurring in high switching costs given that APIs are supplied on a contractual basis. Notwithstanding that, many leading pharmaceutical companies possess a certain level of self-sufficiency due to their major investments in fine chemical manufacturing, reducing their dependence on suppliers. In addition, another way by which market players tend to diminish their reliance on other companies is by purchasing raw materials, such as laboratory equipment and chemicals, from different suppliers. However, there are istances where the need for specialized facilities limits the degree of choice, such as the sterile processing of biological materials, thereby making supplier power stronger. Lastly, pharmaceutical firms commonly outsource drug testing to third parties and given the trials' importance for regulatory approvals, companies are dependent on these test service providers.

The threat of new entrants is relatively weak. Indeed, the complex regulatory environment and its restrictive requirements represent the biggest barriers to entry. Beyond being time consuming, complying with regulations, establishing manufacturing facilities and conducting clinical trials all imply significant upfront investments. Along with the additional investments in quality assurance systems and distribution networks, these initial outlays generate particularly high fixed costs. However, while companies seeking to enter in the market through innovative products face higher R&D and differentiation costs, there are lower barriers in the generics market due to their undifferentiated nature. Despite that, new entrants in this sector must compete with well-established firms benefiting from economies of scale.

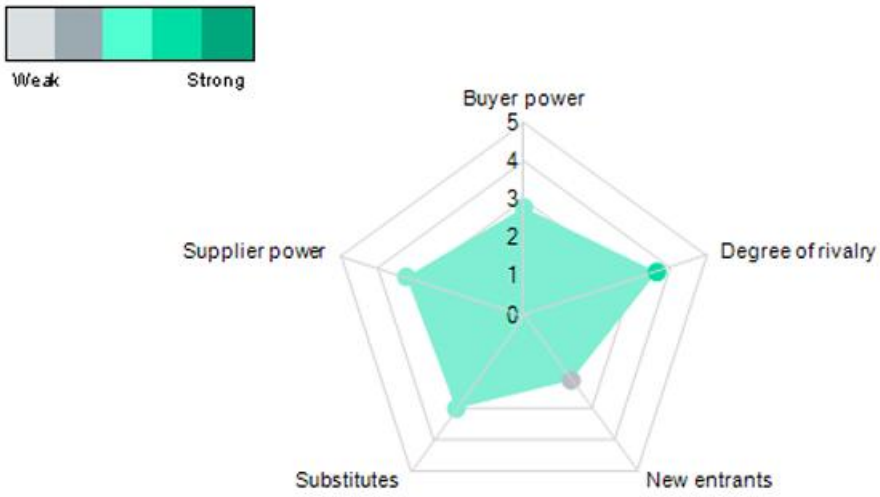
The threat of substitutes is, instead, moderate. Switching costs for patients are relatively low due to the presence of generics and biosimilars, which can be purchased at a lower price. Moreover, although conventional medicine is growing, the increasing demand for treatments such as herbal medicines and

[31] MarketLine. MarketLine Industry Profile: Global Pharmaceuticals. September 2024.

alternative drugs is expected to offer new opportunities for substitute products. Alternative medicines are mainly prescribed because of their effectiveness as placebo therapy, as prescribing a "pure" placebo is considered unethical by most medical practitioners.

Finally, there is a strong degree of rivarly in the market. Major multinational corporations dominate the industry and create a highly competitive environment because of their extensive product pipelines, R&D investments and significant financial resources. The engagement in strategic partnerships, mergers, and acquisitions represents a common strategy among pharmaceutical firms trying to enhance their market position, access new technologies and expand their product lines. The relatively low switching costs, aside from increasing buyer power, put competitive pressure on market players. In addition, competition tends to be even higher for undifferentiated pharmaceuticals, such as generics, due to their high interchangeability. Regarding exit opportunities, instead, it is moderately easy for a pharmaceutical company to sell its assets. Infact, many of them are intangible, such as patents and trademarks, and most of the production facilities and equipment have uses outside pharmaceutical research or manufacture, hence making it simpler for the firm to exit the market.

Figure 4: Forces driving competition in the global pharmaceuticals market, 2023[31]

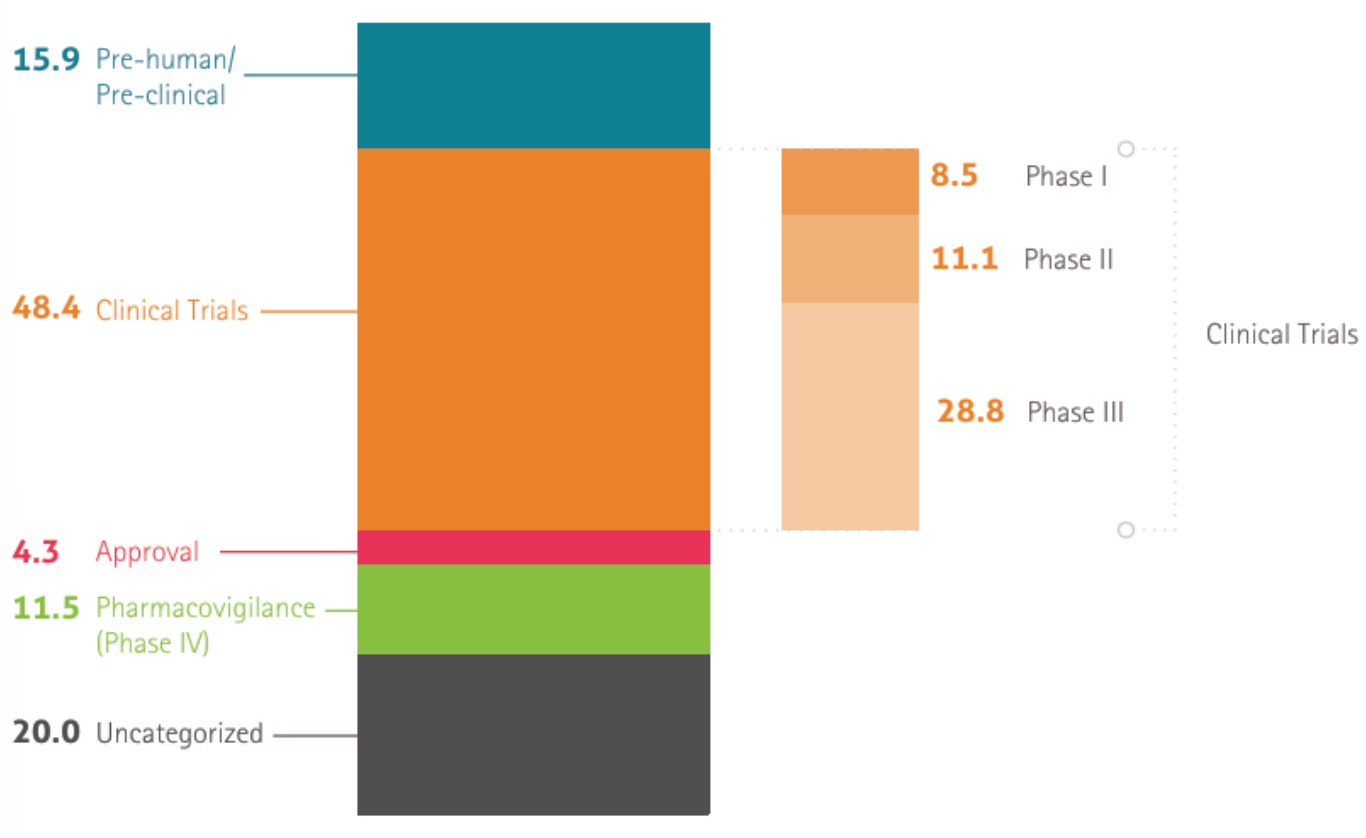


Furthermore, this sector is a driver of medical innovation thanks to R&D investments[32], which represent one of the main causes of the previously covered direct effects of this industry on economic value creation. It can take ten to fifteen years to bring a pharmaceutical to market[31]. The process begins[33] with tests of molecular compounds through which researchers attempt to discover and identify a promising candidate for development as a medical treatment. Then, pre-clinical research is carried out with both *in vitro* and *in vivo* studies before the drug can be tested on humans. At this juncture, four phases characterize clinical trials[34]. Phase I studies have the intent of identifying side effects and evaluating a safe dosage range

[32] Danzon, P. M. (2006). Economics of the Pharmaceutical Industry. NBER Reporter Fall 2006, 14-17.
[33] https://www.fda.gov/patients/learn-about-drug-and-device-approvals/drug-development-process
[34] https://www.who.int/health-topics/clinical-trials

by testing new drugs in a small group of people. The treatments considered safe are then tested on a larger group during phase II, in order to monitor for any adverse effects. Phase III usually represents the step before the treatments' approval, where studies are conducted in different regions and countries. Once the new drug is approved, phase IV takes place, during which further tests in a wide population are made over a longer timeframe. Having said that, according to the Pharmaceutical Research and Manufacturers of America (PhRMA)[31], out of 5,000 to 10,000 screened compounds, only 250 manage to enter preclinical testing, of which just five go towards clinical trials, with only one that will finally be approved. Hence, the probability of a successful outcome is particularly low. The rigorous standards enforced by the competent agencies, along with the substantial capital needed, surely don't make it easier. Infact, authorities such as the US Food and Drug Administration (FDA) and the European Medicines Agency (EMA) require comprehensive clinical trial data as well as the adherence to Good Manufacturing Practices (GMP) and quality control measures. Moreover, evidence shows that the biggest component of R&D expenses is allocated on clinical trials[35] (see Figure 5).

Figure 5: Allocation of R&D investments by function (%)[35]

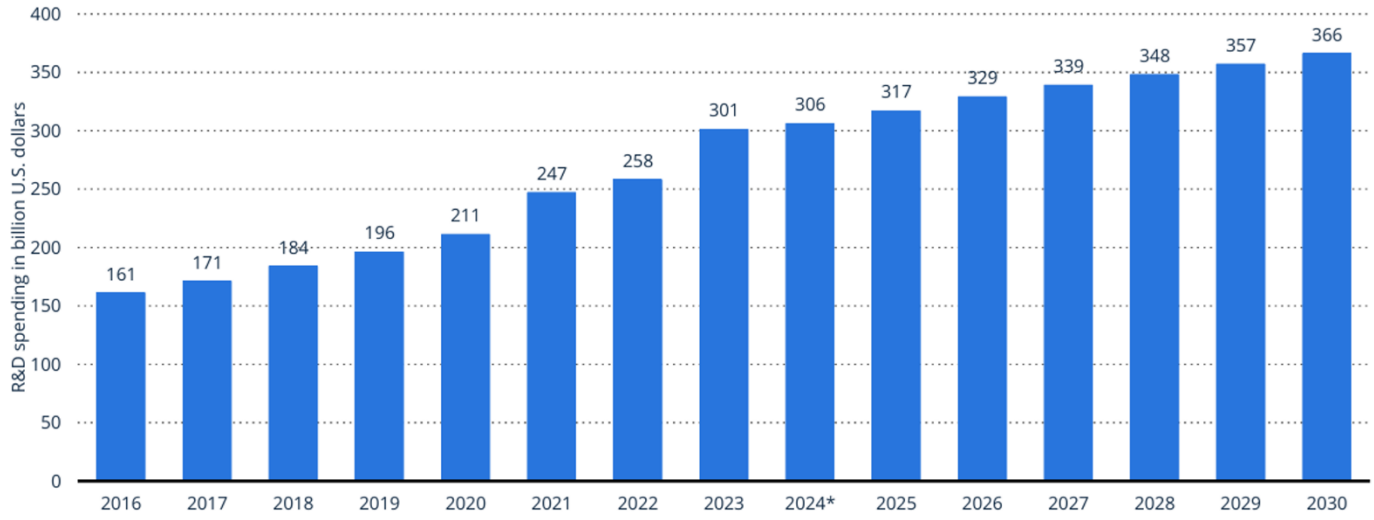


Despite these challenges, pharmaceutical firms highly invest in R&D because thanks to product innovation and differentiation they could achieve a competitive advantage. As a matter of fact[29] (see Figure 6), global

[35] EFPIA. The Pharmaceutical Industry in Figures: Key Data 2024.

R&D expenses in the industry almost doubled between 2016 and 2023, increasing from 161 to 301 billion dollars. In addition, the value is forecasted to enhance in the next years up to 366 billion dollars in 2030.

Figure 6: Total global spending on pharmaceutical research and development from 2016 to 2030 (in billion U.S. dollars)[29]



*All values are projected from 2023 on.

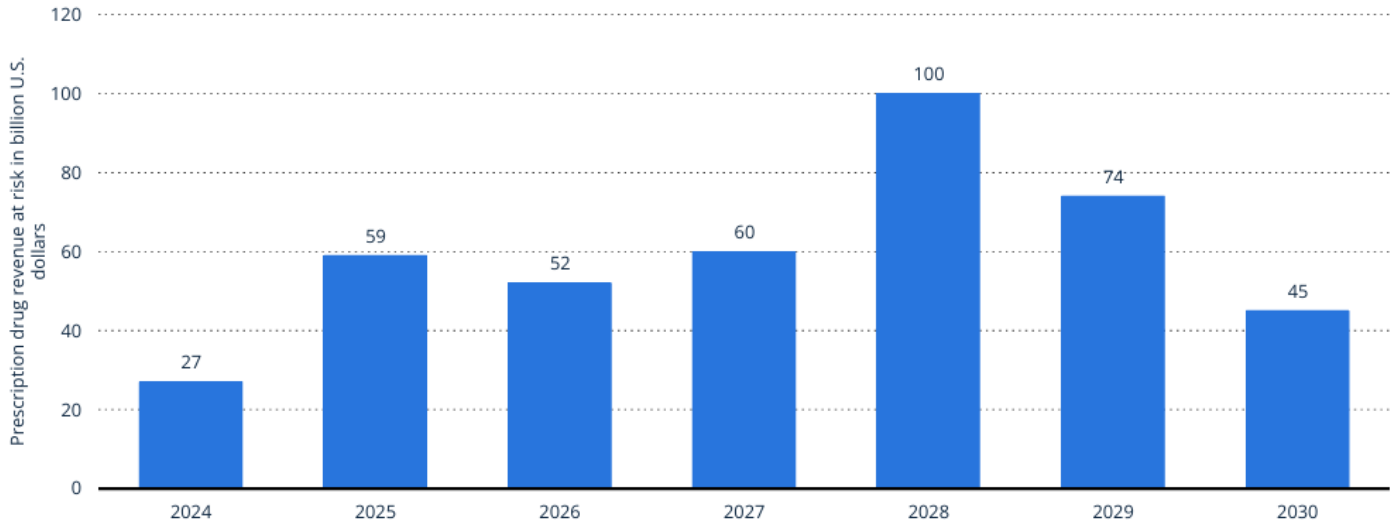
In this context, patents play a significant role because they protect R&D investments for new drug development, ensuring that they are not undertaken in vain.

The World Trade Organization's agreement on Trade-Related aspects of Intellectual Property Rights (i.e. TRIPS), negotiated during the 1986-94 Uruguay Round[36], introduced several provisions regarding the standards of patent protection[37]. In order for pharmaceutical inventions to be patentable under the TRIPS Agreement, they must meet the three standard substantive criteria for patentability, which are namely novelty, inventive step and industrial applicability. Moreover, members of the WTO must make an adeguate disclosure of the invention such that it will truly fall into the public domain once the patent term is expired. The minimum rights a patent confers to its owner are to prevent unauthorized persons from both using the patented process and selling or importing the patented product. Starting from the date of filing the patent application, the protection will last at least for a twenty-year term. However, the effective period is significantly lower because a large part of the term of protection will have expired before the approval from the regulatory bodies is obtained. Hence, many developed countries have introduced systems offering prolonged periods to partially compensate for this time loss, even though the TRIPS does not provide for it. Patent expiration represents, consequently, a big concern for firms producing branded pharmaceuticals. Indeed, once the patent expires generic drugs enter in the market, sharing the same active ingredient and costing less than the brand-name counterparts due to cost-savings deriving from not repeating animal and

[36] https://www.wto.org/english/thewto_e/whatis_e/tif_e/agrm7_e.htm
[37] https://www.wto.org/english/tratop_e/trips_e/pharma_ato186_e.htm

clinical studies[38]. Thus, as patent protection comes to an end, it poses a significant threat to the revenues of these companies. According to Statista[29], with respect to 2024 estimates, the expected value of worldwide prescription drug revenue at risk from patent expiration will experience growth, reaching its peak in 2028 with a notable amount of 100 billion dollars (see Figure 7).

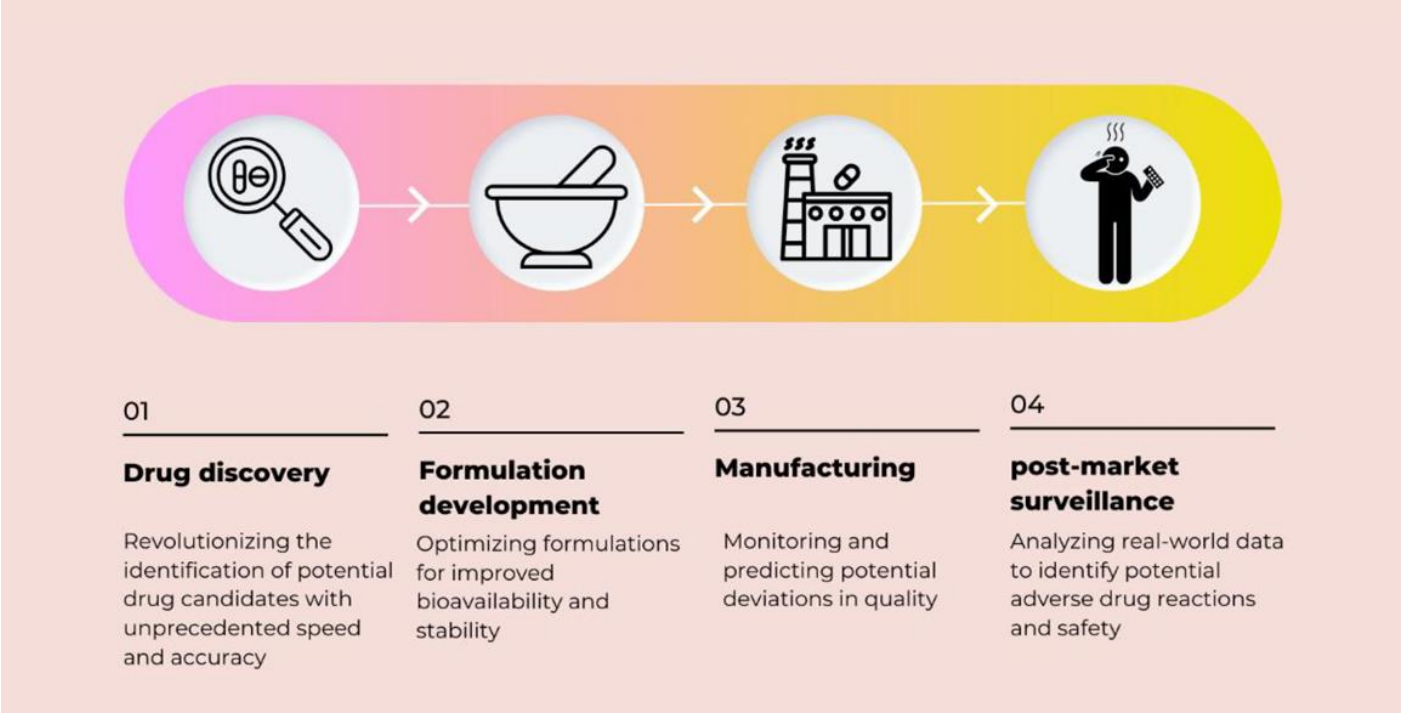
Figure 7: Forecast of total prescription drug revenue at risk worldwide from patent expiration from 2024 to 2030 (in billion U.S. dollars)[29]



It is worth mentioning, finally, how the industry is facing the advent of AI (i.e. Artificial Intelligence). Thousands of articles and reviews on the use of AI in pharmaceutical applications have been published in the last years, according to Huanbutta et al. (2024). This paper illustrates AI's potential to foster progress toward a personalized, effective, and accessible healthcare system. Thanks to their ability to analyze large amounts of data, AI algorithms can be implemented to identify potential drug targets and accelerate the discovery process. Furthermore, AI-driven tools can be used to apply a more efficient and precise approach to pharmaceutical formulation development as well as to facilitate cost-effective clinical trials. In addition, the incorporation of AI has not only hastened quality control procedures and minimized errors, but also offered innovative solutions to optimize supply chain management and post-market surveillance (see Figure 8). Hence, this suggests that pharmaceutical firms that rapidly transition to AI adoption could gain a significant competitive advantage over competitors in the long term.

[38] https://www.fda.gov/drugs/frequently-asked-questions-popular-topics/generic-drugs-questions-answers#q1

Figure 8: Application of artificial intelligence in enhancing the drug development and distribution life cycle[39]



To sum up, the global pharmaceutical industry is characterized by a strong degree of rivarly, relatively high barriers of entry and low switching costs for customers due to the presence of generics. The sector has grown considerably in the last decades, with the United States remaining the undiscussed leaders in terms of market share. The sector contributes to the economy's GDP and employment through cross-sectional spillover effects and direct effects, deriving for istance by R&D expenditures. These investments are considered fundamental to achieving innovation, and since it takes time to bring a pharmaceutical to market due to the required drug testing, patent protection represents a crucial mechanism to safeguard them. Finally, artificial intelligence tools have the ability to provide several benefits that could substantially help pharmaceutical companies to increase their efficiency and achieve significant advantages.

LITERATURE BACKGROUD

Several academic studies have covered mergers and acquisitions in the pharmaceutical sector, trying to analyze different topics ranging from M&A drivers to mergers' impact on company performance.

Ravenscraft and Long (2000) studied a sample of sixtyfive transactions in the industry occurred between 1985 and 1996 and found that the average abnormal returns of both the target and the bidder were statistically significant, whereas the return of the combined firm was not. However, while the one for the targets was positive, the return for the bidders was negative, implying that "the target shareholders gain and

[39] Huanbutta, K., Burapapadh, K., Kraisit, P., Sriamornsak, P., Ganokratanaa, T., Suwanpitak, K. and Sangnim, T. (2024). Artificial intelligence-driven pharmaceutical industry: A paradigm shift in drug discovery, formulation development, manufacturing, quality control, and post-market surveillance. European Journal of Pharmaceutical Sciences, 203.

the bidder shareholders lose in the typical pharmaceutical deal". A regression of the abnormal stock market returns on deal characteristics has been implemented afterwards. Large horizontal mergers generated positive and statistically significant returns for the target, bidder and combined companies, and the same results have been observed for cross-border deals, exception made for the target return which was not reported as statistically significant. Furthermore, on one hand, hostile and vertical acquisitions are reported to pay high target premiums while, on the other hand, partial and smaller takeovers pay relatively low premiums. Despite that, these features do not present statistically significant effects on the bidder and combined shareholders. Regarding horizontal mergers, the paper also revealed that in the eighteen months prior to becoming targeted, the acquired firms underperformed and lost on average 22% of their value. The article concludes that the rapidly changing conditions of the pharmaceutical sector generate excess capacity that mergers can help to reduce. Moreover, it asserts that large pharmaceutical mergers lead to R&D cutbacks which stem from pharmaceutical economics' changes that enhance the attractiveness of external alliance projects to the detriment of internal ones. Lastly, in order to explain the reason behind the bidder's value decline upon the merger's announcement, the study affirms that bidders are challenged by the coverage of competitive premiums and post-merger integration costs.

Schweizer (2002) aimed at answering two research questions regarding the drivers of M&As in the pharmaceutical and biotechnological industries and the ways to successfully manage the post-deal integration. To do this, a literature review, an empirical analysis and two M&A case studies are implemented. What has been found is that the gap the top ten pharmaceutical firms have with respect to the other companies in terms of market capitalization has increased steadily during the 1990s. The analysis on pharma-to-pharma deals supports the belief that US firms are on average more performing than the european peers even though the predominance in american pharmaceutical companies acquiring european competitors is absent. About pharma-to-biotech deals, instead, the study found that as the mid-1990s over-inflated valuations of biotech targets adjusted downwards, these companies regained attractiveness, bringing M&A activities to a steady increase. After confronting theoretical and empirical considerations, the paper states that the two main reasons for M&As in the industry are the financial need for pharmaceutical firms to maintain high profitability margins and the acquisition of knowledge through the possession of promising compounds that ensure competitiveness. Furthermore, unlike in biotech firms, interpersonal communication does not represent a part of all-day work in big pharmaceutical companies but it is, however, fundamental to achieve success in the integration process as well as having an efficient integration manager.

Danzon et al. (2004) analyzes the M&A activity in the pharmaceutical and biotech industries between 1988 and 2001. It first examines the reasons behind these deals and it then studies the merger's impact on cost categories such as employment and R&D. The study is conducted on two sub-samples, one comprising large firms and the remaining one with small firms, where the size criteria used are sales and enterprise value. Regarding the first stage of the analysis, various hypotheses are tested. The excess capacity hypothesis, for istance, which states that a firm which faces patent expirations and pipeline gaps might

consider to engage in an acquisition, in particular in the case cost reduction has not been effective in maintaining revenue growth. Economies of scale are also evaluated, as smaller firms would be expected to be more active as acquirers if achieving them was a primary determinant of mergers. In addition, the corporate control hypothesis asserts that firms having high operating expenses growth rates and low sales growth rates are more likely to be acquired. Interpreting these variables as alternative measures of managerial performance, this would imply that M&As "transfer assets from ineffective to effective managers". The paper then investigates if foreign companies tend to merge to improve their access to the US market, as it would be a way to acquire specific assets. The article finds that excess capacity represents an important motive for large pharmaceutical firms to engage in M&As, as well as the perception of economies of scale. Indeed, contrary to expectations, high enterprise value companies are found to be more involved in merger activities. Furthermore, firms with low Tobin's q have emerged as more likely to be acquired, consistently with the corporate control hypothesis and the concept of acquisitions as a mean to transfer assets to effective managers. Regarding the specific assets acquisition motive, the non-significant coefficient for foreign firms suggests that entering the US market does not constitute for these companies a reason to merge. The main reason for small firms to merge appears, instead, to be exiting from financial trouble and, coherently, financially strong firms are found to be less likely to engage in M&As. The results about the mergers' impact on a companies' subsequent performance shows that small and large firms with high propensity scores experienced slower sales, employees and R&D growth. Moreover, the third year after a merger is found to be characterized by a low growth in large firms' operating profit. In contrast, small firms had a slower growth in operating profit the year after the merger but, compared to companies that did not merge, no significant difference was observed in the subsequent years. The paper consequently suggests that post-merger integration is easier for small firms. Finally, the study concludes that in small firms resources may be diverted from R&D after a deal.

Koening and Mezick (2004) compares two waves of pharmaceutical M&As occurred between the 1980s and the 1990s with a sample of non-merged companies using drug and patent data. An index of pharmaceutical research productivity has also been created consisting of the number of FDA drug approvals or patents obtained per dollar expended. The first (1989) and second wave of mergers (1994-1996) were studied analyzing both the pre-merger and the post-merger performance. The second wave companies performed better than the non-merged firms whereas the first wave companies presented a worse performance with respect to the the non-merged ones when assessing patent data. The paper hence concludes that the second wave was more successful. The hypothesis, instead, that the first wave resulted from necessity and that the second one comprised firms trying to exploit market opportunities is neither rejected nor confirmed. Finally, while data show short-term performance improvements after M&A deals, there is absence of evidence revealing long-term utility.

Demirbag et al. (2007) adopts a survey approach to investigate the pre-deal (1995-1999) and post-deal (2000-2004) performance of pharmaceutical companies involved in three selected M&A deals along

with three pharmaceutical non-M&A firms. These six case studies are analyzed based on three firm performance variables, namely research productivity, return on investment and profit margin. The first variable has been measured using the ratio between the number of NMEs (i.e. new molecular entities) developed and R&D expenditures. Providing a comparative analysis of average performance values, different results have been found for the variables implemented. Indeed, the three M&A cases presented after the merger lower research productivity than that of both pre-merger and non-merged firms. Moreover, the post-M&A return on investment was worse than the one of the companies before the transaction, but better than the one of the non-M&A firms. Regarding profit margin, firms involved in M&As experienced a better performance post-deal and a similar performance with respect to the non-merged peers. The article concludes that the sample deals did not generate any value creation in terms of firm performance.

Hassan et al. (2007) performs a study over the 405 pharmaceutical M&A transactions belonging to the 1981-2004 period. The majority of the sample deals, specifically 78%, are characterized by a US target. Furthermore, 64% of them are mergers with the remaining 36% consisting of acquisitions. The paper exploits three different methods to implement short-term and long-term analyses. For the short-term event study, it uses the Fama-French three factor model with the value weighted market portfolio to estimate the cumulative abnormal returns. For the long-term analysis on stock performance, instead, the Fama-French Calendar Time Portfolio model is complemented by an accounting performance study. The former estimates alphas while the latter tests if the differences between pre-deal and post-deal profitability and operational efficiency are statistically significant. The article does not find abnormal returns from mergers for acquirors. Indeed, even though the acquiring firms present improvements in cash flow and ROA, the ROE does not improve. On the other hand, acquisitions show statistically significant positive abnormal returns for acquirors both in the short and the long run. The accounting performance measures indicate that higher profitability and efficiency are easier to be achieved through acquisitions rather than through mergers. Moreover, US M&As with local targets are found more likely to be successful than transactions involving foreign targets. The authors suggest that the reason behind these findings is that acquisitions are simpler and easier to manage, reducing the time to completion which is considered fundamental due to the limited patent protection characterizing the industry. The paper then states that further work is needed to explain why the sector presents a higher number of mergers even though acquisitions appear to be more profitable.

Rossi et al. (2015) is a descriptive paper investigating M&As in high-tech sectors focusing on the biotechnological one, with data mainly covering the 2005-2011 period. It states that pharmaceutical companies faced tight cost pressure due to changing patent and regulatory laws as well as difficulties in refilling the product pipeline, making M&A a strategy to overcome these challenges. Indeed, during those years a trend was observed that traditional pharma firms with sufficient cash deriving from the pre-existing sales, but struggling with a dried-out product and patent pipeline, were acquiring innovative but cash-poor biotech companies. According to the study, in intersector activities (i.e. pharma-to-biotech deals) the pharmaceutical firm adds new technologies in a more cost-effective way and decreases its vulnerability to

patent expiration as generics companies encounter a higher difficulty in reproducing biotech products. In turn, the financial and marketing strenght of the pharmaceutical company, as well as its greater experience in developing drugs through trials, generate a substantial benefit for the biotech firm. This doesn't mean that the integration is always easy because their R&D expertise may be not compatible, given that a pharmaceutical firm mainly develops small-molecule drugs whereas a biotech firm deals principally with large-molecule ones. Notwithstanding that, this issue should resolve itself as their therapeutic platforms gradually converge. In the years covered by the analysis, large pharma companies have been the most important acquirers of both US and european biopharma targets. However, they have become more selective and try to implement staged deals in order to offload some of the risks to the sellers. A last significant finding is that, coherently with Danzon et al. (2004), while for large firms M&As are used to solve product pipeline's gaps and an excess capacity deriving from anticipated patent expirations, smaller companies engage in M&A processes as a strategy to exit from financial distress.

Richman et al. (2017) mainly investigates two concerns that have risen regarding the consequences of M&A transactions in the pharmaceutical sector. One is focused on the upstream end of the industry and it is based on the fear that, when involving large R&D operations, mergers can reduce competition and decrease the number of new discoveries. On the downstream end instead, the fear is that M&A deals might enhance the bargaining power of few pharmaceutical manufacturers and undermine downstream competition, leading to reduced pricing pressures and higher distribution barriers to innovators. Through the review of theory and evidence regarding M&A activity in the sector, the paper states that this kind of transactions does not possess a relevant role in pricing controversies. Moreover, the article concludes that the two aforementioned concerns do not seem to be justified. Indeed, it is asserted that these mergers could invigorate the marketplace for discovery rather than threaten it. Also, the development of a mechanism to spread pharmaceutical information should mitigate the competition concern at the downstream level. Nevertheless, it is found that market concentration at the regulatory approval stage presents some potential dangers.

Fernald et al. (2017) collects data regarding incumbent pharmaceutical companies, referred to as Big Pharma, to analyze the impact acquisitions and alliances have on their innovation performance. The study covers the period between January 1990 and December 2013, with a total time frame of 24 years. To investigate the main effects, a regression without firm dummies and another one including them are utilized. Subsequently, a new regression which included interactions of absortive capacity with the variables related to acquisitions and alliances was implemented. This has been used to assess the role of absortive capacity, computed as R&D intensity with respect to sales. The dependent variable, thus the innovation performance of Big Pharma, has been measured by the total number of NMEs and BLAs (i.e. Biologic License Applications). The findings regarding the first regression without dummies support the innovation paradox, for which a significant enhancement of R&D investments does not augment a firm's innovation performance. From the regression where dummies are included, the main effects of acquisitions have a negative influence on innovation performance whereas the ones of alliances positively affect it. What

emerges from the last regression of the analysis is that the absortive capacity predominantly moderates the effects of related acquisitions and negatively moderates the alliances positive effect. The article concludes that Big Pharma relied on the acquired biotech firms underestimating the importance of internal R&D, absortive capacity and post-deal integration, leading them to their current innovation deficits.

Mihaiu et al. (2021) is a paper based on a sample of 100 pharmaceutical firms involved in 492 M&A deals occurred during the 2011-2020 period. It exploits a Z-score function to measure the company's performance and investigate its evolution considering both financial and non-financial data. Financial variables are defined as ratios belonging to four different groups, namely profitability, market value, liquidity and solvency, and assets and debt management. The ESG score is, instead, used to measure non-financial performance. The study found that, while some variables have a strong positive impact on the evolution of a pharmaceutical firm's performance, with ROA, profit margin and ESG score being in the top three, market value indeces such as Tobin's Q have a still positive but weak association with perfomance evolution. The conclusion of this work is that M&A transactions and sustainability positively affect the performance of pharmaceutical firms.

Michaeli et al. (2022) studies the relationship between transaction value and variables categorized as lead product, further product and deal characteristics through five multivariate regression models. A total of 311 majority acquisitions involving US and EU biopharma targets that develop NMEs for human prescription use are included in the sample analyzed, with a 2005-2020 period covered. In particular, transactions worth less than ten million dollars were excluded as well as deals where the target had a portfolio with more than ten NMEs. From the regression models, the number of further products, target companies headquartered in the US, market conditions and the buyer's market capitalization appear to positively influence valuations. When firms developing orphan and non-orphan lead drugs are compared, instead, no significant valuation difference is found. Furthermore, acquisition value seems to be positively correlated with the target's drug portfolio size. Finally, as higher valuations are found for firms with biologics or gene therapeutics rather than small-molecule lead products, the authors suggests that strategic buyers are willing to pay a premium for these companies.

Wajid et al. (2022) tries to answer three different research questions, using literature review to justify the answers to the first two and implementing an empirical study to answer the last one. Through the first question, the authors want to investigate whether in the pharmaceutical industry M&A transactions enhance innovations, and they assert no agreement in literature is revealed. The second question aims at understanding in which ways do pharmaceutical firms exploit M&As to augment innovation. It seems that integration process, previous experience and complimentary knowledge are some of the factors companies should bear in mind in that sense. Lastly, the third question seeks to study the relationship between R&D investments and innovation outcome. The paper does it by carrying out a Pearson correlation analysis on six indian pharmaceutical companies observed from 2010 to 2018. Using patent applications as the base for measuring innovation, in line with Koening and Mezick (2004), it has a significant association with R&D

expenditures in three of the six considered firms, while in the others it presents a positive but not significant relationship. Hence, the study concludes that an association between R&D and innovation is found.

The most recent article of this literature review is Büssgen and Stargardt (2024), which examines M&As impact on the success of pharmaceutical firms. To measure it, twelve success factors are implemented and divided into four categories. For istance, revenues, R&D costs, ROA and market capitalization are among the variables used to indicate the areas of success relative to market size, innovation, profit and shareholder value, respectively. The sample is composed by 81 transactions between 2000 and 2020, involving the thirty pharmaceutical companies with the highest revenues in 2020. Twelve DiD models (i.e. Difference-in-Difference models) are utilized where the dependent variable is always one of the corporate success factors. To make comparisons between organic growth and M&A, a premerger period consisting of the two years before the deal's year is defined as well as a postmerger period which comprises the three years following the transaction. The paper finds that revenues, number of employees, gross profit, net profit and ROA experienced a significant enhancement after the deal. Instead, the indicators of both innovation and shareholder value seem to be not affected, as they did not increase significantly. Overall, this work finds that M&As have a positive impact on a pharmaceutical company's success.

What emerges from previous literature is that large pharmaceutical firms mainly engage in M&As to solve pipeline gaps and patent expirations while small firms carry out them to exit from a situation of financial difficulty. However, there is no unanimous agreement on the positive impact of M&A on company performance. It appears crucial for companies not to underestimate the relevance of post-merger integration. Beyond these literature findings, academic studies on pharmaceutical M&As mainly focused on the reasons behind them, the comparison between pre-deal and post-deal performance, and the impact of M&A activities on the subsequent financial and innovation outcomes. They paid little attention, instead, to the impact that the financial results of the target firm have on M&A valuations. Even though Michaeli et al. (2022) examines when acquirers are willing to pay more for a business, as it is done in this study, it analyzes deal and product features rather than target financials. Hence, this paper's aim is to evaluate if there are financial characteristics of the target company that significantly influence valuation multiples.

CHAPTER 2: RESEARCH METHODOLOGY

DATA

A specific dataset on pharmaceutical M&As has been built to perform the analysis of this paper. The sample is mainly based on Orbis and Orbis M&A data for the 2000-2025 period. It focuses on deals involving EU, UK and US targets belonging to the pharmaceutical industry, identified with NACE code 21 (i.e. "Manufacture of basic pharmaceutical products and pharmaceutical preparations"). In addition, the study concentrates on majority stake acquisitions and acquisitions where the majority stake has been

increased. The rationale is that the inclusion of deals where only a minority stake has been acquired, for which no control premium has been paid, could have biased the dataset. The use of these criteria led to a total of 2,257 transactions, but the ones which had a disclosed deal value, considered of core importance for this study, were only 916. This is not the number of acquisitions analyzed yet. The sample consists of pre-deal data, which have been preferred to post-deal data because the study wants to assess values that the buyer may have exploited to formulate the acquisition price. For this reason, all transactions where the pre-deal data of the target and/or of the acquirer where more than one year older than the acquisition's year were excluded from the sample. The final dataset is thus left with a total of 276 deals, covering 26 years and 24 countries out of 29, as it no more comprises transactions with a target from Austria, Cyprus, Estonia, Latvia and Malta.

Several variables are used in the regressions implemented by this study.

Three EV (i.e. enterprise value) multiples are included to represent company valuation measures. They consist in a ratio between the firm's value and a metric of the firm's financial performance. Given that the enterprise value measures the value of the entire business before the debt is paid, the multiple's denominator should be a metric of earnings before the interest payments are made[40]. Hence, we opted for mutiples on revenues, EBITDA (i.e. earnings before interest, taxes, depreciation and amortization) and EBIT (i.e. earnings before interest and taxes). Regarding these data, due to their low availability and in order to obtain more observations to implement the regressions, several enterprise values have been constructed summing the market capitalization with the net debt, value extrapolated from the firms' balance sheets. Indeed, 39 additional data have been built and the EV is computed as[40]:

$$Enterprise\ Value = Market\ Value\ of\ Equity + Debt - Cash$$

where the market value of equity coincides with the market capitalization and the value of total debt net of cash corresponds to the net debt.

Together with these three enterprise value multiples, an additional measure, which has been several times implemented in previous academic articles (Danzon et al., 2004; Sivakumar et al., 2011; Mihaiu et al., 2021), is used to investigate the impact financial performance has on it. The tobin's Q is a metric indicating how much a company is worth with respect to the value of its assets. It is calculated dividing the market capitalization by total assets and it should theoretically be around one with the premise that a firm's market value should be in line with how much its assets are worth[41]. As its numerator corresponds to the market value of equity, it is here considered as a variant of the equity value multiples commonly used, compensating for the presence of EV multiples in this study.

[40] Berk, J. and DeMarzo, P. (2024). Corporate Finance. Pearson, sixth edition.

[41] https://information.moodysanalytics.com/000000BYZUSR2CYCJ/data-guide/stock-and-earnings-estimates-guide/annual-stock-valuation-guide

Because of their wide use in prior literature (Shortridge, 2004; Hassan et al., 2007; Nord, 2011; Fernald et al., 2017; Mihaiu et al., 2021; Büssgen et al., 2024), three performance measures are also employed to understand their relationships with the multiples. The EPS (i.e. earnings per share) is a typical measure of company's profitability and it consists of the ratio between the net income, thus the total of shareholders' earnings, and the number of shares outstanding[40]. The ROA (i.e. return on assets) is an operating measure comparing a firm's profitability, hence the net income, with the assets it holds. Consequently, having a high ROA means that the company is efficient in managing economic resources[42]. Finally, given the important role R&D has in the pharmaceutical industry, a ratio is included showing the amount of R&D expenditures a company incurs with respect to the revenues it generates.

Given the presence of extreme values, the winsorizing technique has been implemented on both the multiples and the performance variables. The metric R&D/Revenues represents the only exception due to the fact that it does not illustrate any outliers. Winsorizing permits to define un upper percentile bound and a lower percentile bound[43] and to replace the values exceeding these bounds with the value associated to the percentile exceeded[44]. In our case, the EV multiples, Tobin's Q, EPS and ROA have been winsorized at the 5th and at the 95th percentile. Hence, six new variables have been created representing the winsorized form of each metric. To give an example, here is shown how the multiple EV/Revenues is indicated in the analyses run through Stata, both in its pure form and in its winsorized version:

$$ev\_revenues \longrightarrow w\_ev\_revenues$$

Some additional variables, such as the deal value and the revenues of both the target and the acquirer are used as controls. In particular, they have been exploited utilizing their logaritmic version in order to obtain more uniformed quantities. However, given the presence of revenues equal to zero for some targets and some buyers, they have been transformed into the logaritm of their values plus one. To give an example, here is shown how target revenues are defined in the models' regressions:

$$ln\_target\_revenues = ln(1 + target\_revenues)$$

To maintain coherence, the same transformation has been done also on deal value even though there was no null value. Apart from data regarding the year of the deal and the target's country, other two set of parameters are included as control variables but their definition will be discussed in the next section.

[42] https://corporatefinanceinstitute.com/resources/accounting/return-on-assets-roa-formula/
[43] Wicker, T. (2025). Winsorizing and Trimming with Subgroups. CentER Discussion Paper, 7, 1-48.
[44] https://www.sciencedirect.com/topics/mathematics/winsorization

EMPIRICAL MODELS

A total of sixteen regressions is implemented for the purpose of this study. It is worth to restate that the goal of this paper is to investigate if and how a target's performance influences its multiples and consequently to understand how the targets' metrics here included are used by acquirers to determine a firm's attractiveness when they pursue an M&A in the pharmaceutical sector.

With regard to the details, four different regression models are utilized in this article. Each of them is composed by four regressions with respectively EV/Revenues, EV/EBITDA, EV/EBIT and Tobin's Q in their winsorized form as the dependent variable. Nevertheless, the models have several common features. Indeed, they are based on linear regressions with one-way clustered errors to take into account differences between the years of the sample inside the error term. The initial idea was to use a two-ways clustered error to consider also the differences between countries, but the low number of clusters generated by Stata due to the characteristics of the sample made not possible to carry out the regressions. Furthermore, they share the same control variables, which do not act as the parameters of main interest for the study but they account for factors that could generate an omitted variables bias in case they were neglected[45]. Beyond ln_deal_value, $ln\_target\_revenues$ and $ln\_buyer\_revenues$, which are already mentioned in the previous section, four additional parameters are used as dummies. A dummy is a variable which can either assume a value of 1 or 0. The year of the deal and the country of the target are the only categorical variables of this paper's models and are indicated by their set of dummies, 26 for the years (y_1, …, y_{26}) and 24 for the countries (C_1, …, C_{24}), in order to account for differences between years and countries. The other two dummy variables included to control for further deal's characteristics are $share\_payment$ and $prior\_ma\_buyer$. The former is equal to 1 when the acquisition has been made, at least partially, through a share payment, 0 otherwise. The latter, instead, tracks precedent activities done by the acquirer and has a value of 1 if the buyer has been involved in other M&As in the three years prior to the deal observed, 0 otherwise.

Having said that, the difference between the four models employed is the change in the independent variables used. As already mentioned, the article evaluates three explanatory variables: w_eps, w_roa and $rd\_revenues$. In order to have a holistic assessment of their impact on valuation multiples, they are first tested alone and then simultaneously.

The first model seeks to determine the relationship between w_eps and the multiples. It can be visualized as follows:

$$(1)\ multiple_i = \beta_1 w\_eps_i + \beta_2 ln\_deal\_value_i + \beta_3 ln\_target\_revenues_i + \beta_4 ln\_buyer\_revenues_i + \beta_5 share\_payment_i + \beta_6 prior\_ma\_buyer_i + \gamma_1 C_1 + \cdots + \gamma_{24} C_{24} + \delta_1 y_1 + \cdots + \delta_{26} y_{26} + \varepsilon_y$$

[45] Stock, J. H. and Watson, M. W. (2020). Introduzione all'econometria. Pearson, fifth edition.

where the observations of the model are expressed by i and the one-way clustered error is indicated by ε_y. The left-hand side variable $multiple$ will assume the form of $w\_ev\_revenues$, w_ev_ebitda, w_ev_ebit and w_tobin_q. In this case, the usage of a profitability measure (i.e. w_eps) as explanatory variable allows these set of regressions to assess how a pharmaceutical company's ability to generate income is associated with multiples.

The second model, as reported below, implements w_roa as the independent parameter and, thus, it studies the relationship between multiples and the operational efficiency of a pharmaceutical firm:

$$(2)\ multiple_i = \beta_1 w\_roa_i + \beta_2 ln\_deal\_value_i + \beta_3 ln\_target\_revenues_i + \beta_4 ln\_buyer\_revenues_i + \beta_5 share\_payment_i + \beta_6 prior\_ma\_buyer_i + \gamma_1 C_1 + \cdots + \gamma_{24} C_{24} + \delta_1 y_1 + \cdots + \delta_{26} y_{26} + \varepsilon_y$$

If the $\widehat{\beta_1}$ resulting from this model's regressions, which is the estimated value of the coefficient β_1, is found to be positive and statistically significant, it could imply that pharmaceutical acquirers are willing to pay more a business with a higher return on assets.

The third model is the last one which tests one single explanatory variable, namely $rd\_revenues$. The typology of regressions belonging to it is illustrated below:

$$(3)\ multiple_i = \beta_1 rd\_revenues_i + \beta_2 ln\_deal\_value_i + \beta_3 ln\_target\_revenues_i + \beta_4 ln\_buyer\_revenues_i + \beta_5 share\_payment_i + \beta_6 prior\_ma\_buyer_i + \gamma_1 C_1 + \cdots + \gamma_{24} C_{24} + \delta_1 y_1 + \cdots + \delta_{26} y_{26} + \varepsilon_y$$

As already mentioned, $rd\_revenues$ is the only independent variable which has not been subject to winsorizing due to the absence of outliers.

Finally, the fourth model can be considered the most important among the ones used in this study as it evaluates simultaneously all the independent variables implemented in the three previous analyses. Hence, it investigates the impact of each explanatory variable on the valuation multiples, while taking into account the influence of all the other independent variables on them. Model (4) is reported below:

$$(4)\ multiple_i = \beta_1 w\_eps_i + \beta_2 w\_roa_i + \beta_3 rd\_revenues_i + \beta_4 ln\_deal\_value_i + \beta_5 ln\_target\_revenues_i + \beta_6 ln\_buyer\_revenues_i + \beta_7 share\_payment_i + \beta_8 prior\_ma\_buyer_i + \gamma_1 C_1 + \cdots + \gamma_{24} C_{24} + \delta_1 y_1 + \cdots + \delta_{26} y_{26} + \varepsilon_y$$

To sum up, while in the first part of the analysis (1), (2) and (3) are exploited to test respectively w_eps, w_roa and $rd\_revenues$ separately, (4) tests these variables together in order to obtain a comprehensive study of the effect they have on the multiples deriving from pharmaceutical M&As.

CHAPTER 3: EVIDENCE FROM M&As IN THE PHARMACEUTICAL SECTOR

The findings from Model (1), where the multiples are regressed on w_eps, are shown in Table 1. In this case, the coefficients interpretation doesn't turn out to be particularly intuitive. Indeed, when w_ev_ebitda and w_ev_ebit are used as the dependent variable, they are positive and statistically significant at the 10% and 5% levels, respectively. Thus, this suggests that earnings per share have a positive association with both the EBITDA and EBIT multiples. However, when w_eps is utilized to predict $w\_ev\_revenues$ as in regression (1.1), its coefficient is negative and statistically significant at the 10% level. Hence, one could assert then that the high profitability of the targets increases their firm value but not when compared to revenues. A possible reason could be that the sample consists of companies in which the presence of high (low) income depends mainly on a greater (smaller) sales volume rather than on a higher (lower) efficiency in managing operating costs. Notwithstanding that, given that usually the EPS increases when EBITDA and EBIT rise in value, spurious correlations triggered by the EV multiples' denominator may lie behind these results. Regarding regression (1.4), the coefficient is negative but not statistically significant when regressing w_tobin_q. Thus, the potential negative relationship w_eps has with it is not backed by statistical relevance. A further check on Model (4) is needed.

Table 1: Results from Model (1) regressions

Model (1)

	(1.1) w_ev_revenues	(1.2) w_ev_ebitda	(1.3) w_ev_ebit	(1.4) w_tobin_q
w_eps	-8.549*	6.847*	7.558**	-0.111
	(4.170)	(3.133)	(2.760)	(0.126)
ln_deal_value	49.52**	0.300	4.439	0.260
	(17.37)	(3.589)	(4.312)	(0.296)
ln_target_revenues	-47.36***	-4.147***	-3.974**	0.0302
	(9.391)	(1.283)	(1.501)	(0.173)
ln_buyer_revenues	-0.658	2.615	-0.0232	0.308
	(8.865)	(3.430)	(3.337)	(0.229)
share_payment	6.424	0.154	8.161	0.0163
	(46.94)	(12.23)	(14.98)	(0.892)
prior_ma_buyer	-26.88	-4.843	11.11	-1.939**
	(24.68)	(12.82)	(17.78)	(0.853)
Constant	-77.85*	6.490	-25.26	-5.113
	(40.72)	(19.24)	(30.75)	(2.981)
Observations	39	41	41	43
R-squared	0.851	0.562	0.509	0.522

Standard errors in parentheses
* p<0.10, ** p<0.05, *** p<0.01

Sample: United Kingdom, United States of America and European Union countries except for Austria, Cyprus, Estonia, Latvia and Malta (24 countries).

Period: 2000-2025.

Source: Computations made through the software Stata using Orbis and Orbis M&A data.

Table 2 illustrates the regressions belonging to the model where w_roa is the explanatory variable, hence Model (2). Analyzing regressions (2.1), (2.2), (2.3) and (2.4) the ROA's coefficient is always positive. This could indicate that buyers look favorably upon a target's high return on assets because, coherently with Mihaiu et al. (2021), it has a positive impact on the evolution of a firm's performance. Indeed, the operational efficiency of a company relative to its assets should be positively acknowledged by buyers during the valuation phase. Analyzing the p-values, the coefficients deriving from the regressions with $w\_ev\_revenues$, w_ev_ebit and w_tobin_q as dependent variables do not reach any significance level, while when regressing w_ev_ebitda, the coefficient is statistically significant at the 10% level. While they don't seem to have a strong base from a statistical point of view, at least when one regresses only on w_roa, these results indicate a positive relationship, especially between return on assets and the EBITDA multiple. Surely, it will be helpful to find out if also (4) yields similar results.

Table 2: Results from Model (2) regressions

Model (2)

	(2.1) w_ev_revenues	(2.2) w_ev_ebitda	(2.3) w_ev_ebit	(2.4) w_tobin_q
w_roa	45.34	26.47*	24.30	0.761
	(37.10)	(12.75)	(14.63)	(0.805)
ln_deal_value	55.47***	-4.440	-0.469	0.233
	(16.90)	(5.515)	(5.678)	(0.306)
ln_target_revenues	-61.13***	-2.316**	-1.395	-0.0489
	(13.34)	(1.017)	(1.569)	(0.224)
ln_buyer_revenues	-2.699	2.977	-0.161	0.382
	(6.484)	(4.775)	(4.611)	(0.249)
share_payment	-33.73	6.320	16.73	-0.0887
	(40.70)	(18.24)	(17.34)	(0.946)
prior_ma_buyer	1.203	-0.954	13.99	-2.006*
	(24.25)	(16.57)	(19.41)	(0.921)
Constant	37.91	48.68	18.69	-4.829
	(66.53)	(39.75)	(38.25)	(3.718)
Observations	38	40	40	40
R-squared	0.855	0.327	0.310	0.463

Standard errors in parentheses
* p<0.10, ** p<0.05, *** p<0.01

Sample: United Kingdom, United States of America and European Union countries except for Austria, Cyprus, Estonia, Latvia and Malta (24 countries).

Period: 2000-2025.

Source: Computations made through the software Stata using Orbis and Orbis M&A data.

The results Table 3 displays regard analyses belonging to (3), model studying the impact $rd\_revenues$ has on the multiples. In this case, its coefficients are negative in all the regressions except in (3.4), suggesting R&D/Revenues has a negative relationship with EV/Revenues, EV/EBITDA and EV/EBIT, and a positive relationship with Tobin's Q. As already stated, investments in research and development cover a fundamental role in the pharmaceutical industry because they can give birth to new drugs that, if well protected through patents, could generate a new source of revenues and, as found by Nord (2011), increase the market value of a company. However, three aspects that can make the negative association with the EV multiples understandable must be considered. First, R&D costs do not guarantee any return in exchange for the upfront investment made. Consequently, acquirers could decide not to reward them as they are not considered drivers of immediate value. Second, a negative association between $rd\_revenues$ and EV multiples could be explained, in accordance with what King et al. (2008) found in high-technology industries, by a counterproductive effect that surplus target R&D resources may have on firm performance. Third, the explanatory variable consists of the weight that these investments have on the target's revenues. Hence, having a high proportion of R&D expenditures could be perceived as a sign of inefficiency in distributing business costs fairly, risking the disregard of other operating activities. Indeed, as

the income flows of a pharmaceutical firm are based on R&D activities, an optimal value should be foreseen by the market beyond which this kind of investments ceases to enhance value. Consequently, one could expect that R&D/Revenues has a quadratic curvilinear relationship with enterprise value multiples, where the coefficient of its squared term is negative. However, the statistical weakness of the estimates here is more amplified compared to Table 2 results. Indeed, none of the coefficients of $rd\_revenues$ appear to be statistically significant, installing doubts on the validity of the interpretation here given of regressions (3.1), (3.2) and (3.3) as well as on the positive association with w_tobin_q in (3.4).

Table 3: Results from Model (3) regressions

Model (3)

	(3.1) w_ev_revenues	(3.2) w_ev_ebitda	(3.3) w_ev_ebit	(3.4) w_tobin_q
rd_revenues	-2.699	-22.53	-45.69	0.456
	(2.721)	(57.05)	(41.66)	(1.461)
ln_deal_value	6.236***	-15.01	-15.35	1.650**
	(1.482)	(20.53)	(16.94)	(0.553)
ln_target_revenues	-6.137***	12.31	20.82	-1.975***
	(1.049)	(16.17)	(14.06)	(0.504)
ln_buyer_revenues	-0.645	5.310	2.399	0.113
	(0.505)	(7.365)	(5.854)	(0.172)
share_payment	-2.396	-3.331	4.822	0.521
	(1.492)	(40.83)	(40.03)	(0.582)
prior_ma_buyer	0.634	-3.617	8.377	-0.887*
	(1.140)	(16.73)	(22.40)	(0.427)
Constant	5.266	-5.812	-73.21	2.371
	(7.044)	(51.42)	(50.88)	(2.058)
Observations	26	26	26	28
R-squared	0.801	0.391	0.442	0.817

Standard errors in parentheses
* p<0.10, ** p<0.05, *** p<0.01

Sample: United Kingdom, United States of America and European Union countries except for Austria, Cyprus, Estonia, Latvia and Malta (24 countries).

Period: 2000-2025.

Source: Computations made through the software Stata using Orbis and Orbis M&A data.

Table 4 shows the findings of the last model exploited in the empirical analysis of this paper. Model (4), as stated in the previous chapter, is fundamental to investigate thoroughly the impact that financial performance has on valuation multiples. Infact, having together w_eps, w_roa and $rd\_revenues$ as independent variables enables to observe the effect of each one on $w\_ev\_revenues$, w_ev_ebitda, w_ev_ebit and w_tobin_q while accounting, at the same time, for the influence the others have. This is the

main reason why this article first regresses on these parameters singularly and then regresses on all of them at once.

Having said that, it is better to assess the variables' coefficients in order. Analyzing the EV multiples as the dependent variables, the signs of the coefficients referring to w_eps in this model are consistent with the ones that were noticed in (1). Indeed, when regressing the EBITDA and EBIT multiples, coherently with Shortridge (2004), a higher EPS appears to make a firm more valuable. When regressing the revenue multiple, instead, the coefficient is negative. The difference in outputs between (4) and (1) lies in their statistical significance. On one hand, the EPS coefficients are no more statistically significant in (4.1) and (4.3) while, on the other hand, the one in (4.2) maintains the same level of significance as in (1.2), with a p-value < 10%. Thus, these results could depend on the EV multiples' denominator rather than on their numerator. Infact, as aforementioned, the enhancement in EBITDA and EBIT should determine an increase in EPS, hence leading to the spurious correlations found. When w_tobin_q is regressed, the coefficient changes sign with respect to (1.4), where it was negative. This could be due to an omitted variables bias. Nonetheless, the estimate is still not statistically significant, meaning an actual relationship between these metrics is not found. Therefore, even though the EBITDA multiple appears to be positively impacted, the findings on EPS probably need a greater prudence. In this model, w_roa has almost all positive coefficients as in the regressions belonging to (2). The only exception is in (4.2), where the EV/EBITDA is the dependent variable. Regarding p-values, the main distinction is that in the second model the estimate was significant only when regressing w_ev_ebitda, whereas in (4) the coefficient is statistically significant, at the 10% level, only when $w\_ev\_revenues$ is regressed. The analyses of this model seem to confirm the belief that the operational efficiency of a pharmaceutical firm is a factor that buyers appreciate. However, the coefficients' change in both sign and significance when w_ev_ebitda is regressed remains ambiguous. Nevertheless, the big dimension of the estimate's error in (4.2) is probably the explanation for this misleading coefficient. Regarding $rd\_revenues$, this model remains coherent with the third model. Indeed, the coefficients are always negative when the enterprise value multiples are regressed. High R&D resources could be counterproductive, in line with King et al. (2008), and the market might have foreseen an optimal amount indicating a threshold pharmaceutical companies must not cross in order to benefit from them. When the Tobin's Q is the dependent variable, instead, the estimate is positive. This goes against Sivakumar et al. (2011), which found that R&D intensity, despite being used as a control variable, was negatively associated with Tobin's Q. However, accordingly with Nord (2011), R&D expenses appear to positively impact market capitalization. Consistently with regressions belonging to (3), however, all the coefficients do not reach any significance level. As a consequence, the considerations listed so far about the negative relationship R&D/Revenues has with EV multiples and its positive relationship with Tobin's Q turn out to be not founded because of the absence of statistical significance.

Table 4: Results from Model (4) regressions

Model (4)

	(4.1) w_ev_revenues	(4.2) w_ev_ebitda	(4.3) w_ev_ebit	(4.4) w_tobin_q
w_eps	-1.214	11.40*	8.898	0.0639
	(0.783)	(5.702)	(5.071)	(0.302)
w_roa	15.60*	-3.805	54.82	2.626
	(7.074)	(94.87)	(104.3)	(2.006)
rd_revenues	-1.608	-39.00	-61.08	0.543
	(2.070)	(31.65)	(55.39)	(1.015)
ln_deal_value	5.653***	2.743	3.475	1.920***
	(1.395)	(15.08)	(22.97)	(0.486)
ln_target_revenues	-5.757***	-8.934	-2.928	-2.389***
	(1.282)	(15.54)	(22.96)	(0.437)
ln_buyer_revenues	-0.198	2.533	0.803	0.138
	(0.401)	(6.036)	(5.517)	(0.152)
share_payment	-2.563*	-11.00	-4.912	0.510
	(1.208)	(25.72)	(35.83)	(0.410)
prior_ma_buyer	-1.453	3.892	9.341	-1.091**
	(1.395)	(14.50)	(27.94)	(0.459)
Constant	3.376	52.84	-10.85	3.518
	(7.290)	(62.02)	(68.98)	(2.928)
Observations	26	26	26	28
R-squared	0.858	0.585	0.639	0.859

Standard errors in parentheses
* p<0.10, ** p<0.05, *** p<0.01

Sample: United Kingdom, United States of America and European Union countries except for Austria, Cyprus, Estonia, Latvia and Malta (24 countries).

Period: 2000-2025.

Source: Computations made through the software Stata using Orbis and Orbis M&A data.

To summarize, the EPS presents the least intuitive findings. One could argue that, overall, the earnings per share have a positive effect on valuation multiples, as the only significant estimate in the final model is positive. Nevertheless, the influence that the denominator of the EV multiples has on the regressions generates the spurious correlations observed. Hence, the results involving w_eps as the explanatory variable require more caution. Regarding ROA, it can be concluded that a positive relationship is found. Apart from the one in (4.2) that is probably due to the error's dimension, all the estimates are positive, and the impact is significant on EV/EBITDA in (2) and on EV/Revenues in (4). Thus, these regressions confirm that pharmaceutical acquirers consider more valuable a firm with a notable operational efficiency. Finally, the coefficients of R&D/Revenues are negative when regressing EV multiples and positive, instead, when regressing Tobin's Q. These estimates could indicate that an optimal level of R&D investments is foreseen by the market and that, consequently, there is a curvilinear quadratic relationship

with the multiples. However, there is no statistical significance to justify the considerations about $rd\_revenues$. The outputs of this study are synthesized in Table 5.

Table 5: Summary table of the empirical analysis results

Model	Explanatory Variable	$w\_ev\_revenues$	w_ev_ebitda	w_ev_ebit	w_tobin_q
(1)	w_eps	-8.549*	+6.847*	+7.558**	-0.111
(2)	w_roa	+45.34	+26.47*	+24.30	+0.761
(3)	$rd\_revenues$	-2.699	-22.53	-45.69	+0.456
(4)	w_eps	-1.214	+11.40*	+8.898	+0.0639
(4)	w_roa	+15.60*	-3.805	+54.82	+2.626
(4)	$rd\_revenues$	-1.608	-39.00	-61.08	+0.543

Note: *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels, respectively.

Sample: United Kingdom, United States of America and European Union countries except for Austria, Cyprus, Estonia, Latvia and Malta (24 countries).

Period: 2000-2025.

Source: Computations made through the software Stata using Orbis and Orbis M&A data.

CONCLUSIONS

This paper examines the relationship between the financial performance and the valuation multiples of pharmaceutical target firms. Given the limited attention in prior literature to the factors affecting M&A valuations, the intent is to provide empirical evidence about whether buyers utilize targets' financial data to evaluate their business appeal and how they exploit them to formulate the acquisition price, thus influencing the multiples paid.

Four econometric models have been implemented on a final sample of 276 M&A deals involving targets belonging to the pharmaceutical sector, covering 24 different countries and a time span of 26 years. The nations under analysis are European Union countries — except for Austria, Cyprus, Estonia, Latvia and Malta — United Kingdom and United States of America. The reference time frame coincides with the 2000-2025 period, so that transactions from the new millennium are studied. The variables included are based on Orbis and Orbis M&A pre-deal data and they are used in a total of sixteen linear regressions with one-way clustered errors by deal year. The multiples utilized as dependent variables are four, namely $w\_ev\_revenues$, w_ev_ebitda, w_ev_ebit and w_tobin_q. They are the winsorized version of EV/Revenues, EV/EBITDA, EV/EBIT and Tobin's Q, respectively. The first three are the enterprise value multiples predominantly used in valuations, whereas the fourth is here considered as a variant of an equity multiple, given that it is computed with the market capitalization at the numerator[41]. The independent variables measuring the financial performance of the target are w_eps, w_roa and $rd\_revenues$. The first

two, hence EPS and ROA, are winsorized at the 5th and at the 95th percentile, such as the valuation multiples. The last one, representing the ratio between R&D expenditures and revenues, is instead included in its pure form, as it had no outliers to exclude. In this article, the four dependent variables are first regressed on each of the three explanatory variables, thus EPS, ROA and R&D/Revenues, in models (1), (2) and (3), respectively. Then, all the independent variables are implemented together in model (4), in order to observe the effect each of them has while accounting also for the influence of the others.

From the findings of the empirical analysis, it can be concluded that the ROA has a positive relationship with the multiples. It suggests that acquirers positively acknowledge the operational efficiency relative to the assets of a pharmaceutical target and, hence, that they would be willing to pay a higher multiple for a firm with a high return on assets. This could be explained by the fact that, coherently with Mihaiu et al. (2021), it has a positive influence on the evolution of a company's performance. It can be asserted, then, that the ROA is a key factor in shaping valuation multiples. The results regarding EPS are the least intuitive, as it presents positive coefficients when the EBITDA and EBIT multiples are regressed, and negative estimates when the revenue multiple is the dependent variable. On one hand, this could indicate that, for the firms in the sample, a high income is mainly determined by a high sales volume rather than by a better optimization of operating costs. On the other hand, given that the only significant coefficient in (4) is positive, this could denote, coherently with Shortridge (2004), that a high EPS adds value to a company. The reality is that this study finds spurious correlations that are due to the influence of the EV multiples' denominators, as usually the EPS augments when EBITDA and EBIT rise in value. Consequently, the findings about EPS require a greater prudence. R&D/Revenues, instead, doesn't seem to have a significant association with the multiples. When the enterprise value multiples are used as the dependent variable, it presents negative estimates while, when the Tobin's Q is regressed, positive coefficients are found. None of the estimates are, however, backed by statistical significance, meaning that an actual relationship between R&D/Revenues and the valuation multiples is not found. Notwithstanding that, as the R&D activities of a pharmaceutical firm typically represent one of the main determinants of its income flows, an optimal value should be foreseen by the market. Hence, a curvilinear quadratic relationship where the squared term of $rd\_revenues$ has a negative coefficient is expected.

As a final remark, this paper brings new insights about the M&A phenomenon in the pharmaceutical sector, studying whether financial performance indicators act as drivers of valuation multiples and, by extension, of a target firm's attractiveness. Nevertheless, given the presence of some inconclusive results from the empirical analysis, especially with regard to EPS and R&D/Revenues, the answer to the research question of this study can only be partially affirmative. Therefore, future research should further investigate this topic.

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