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# Predicting the Reputation of Pharmaceutical Firms with Financing and Geographical Location Data

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**Abstract:** Reputation is a strategic asset for firms, but has been poorly studied in the pharmaceutical industry, particularly in relation to their financial and stock-market performance. This work aimed to predict the probability of a firm being included in a pharmaceutical reputation index (Merco and PatientView), and the position it occupies, according to its economic–financial and stock-market outcomes and its geographical location. Fifty firms with excellent sales in 2019 and their rankings in 2017–2019 were employed. The methodology followed was logistic regression. Their research and development (R&D) expenditures and dividends strongly influenced them being included in both rankings. Non-Asian pharmaceutical companies were more likely to belong to the two reputation indices than Asian ones, and to occupy the best positions in the Merco ranking. Although no large differences appeared in the firms in both indices, differences were found in the position that pharmaceutical companies occupied in rankings and in the variables that contribute to them occupying these positions. Being in PatientView influenced dividends, sales, and income, while appearing in Merco showed accounting aspects like value in books and debt ratio.



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## 1. Introduction

The corporate reputation concept dates back to 1958 when [1] the ‘brand image’ concept was extended to the ‘corporate image’, and so it was that a broader concept was created, one that integrated the perspectives of all the relevant groups for a firm’s survival (shareholders, consumers, potential consumers, employees). However, it was not until the 1990s when the interest shown in this term grew and was studied by many researchers [2–5]. Indeed, it peaked after some severe reputational crises, which allowed world leaders to understand that a bad reputation can lead to a firm’s bankruptcy [6]. Consequently, organizations started to understand that business success lay in the hands of their groups of interest (stakeholders), and that the new role of both firms and institutions was to be at their service.

Therefore, it can be stated that corporate reputation is an intangible asset that is difficult to imitate, complex, and multidimensional, that needs time to be generated, and is specific and hard to manipulate by firms whose use has no limits, and it never depreciates with use [7,8]. It can be specifically understood as “knowledge about a firm’s true characteristics and the emotions that its stakeholders or groups of interest feel about it” [9]. Therefore, it is the result of the “firm’s representative perception based on its past action and on its future projection” [10].

Nowadays, reputation is a strategic asset for firms. Businesses with a good reputation show a differentiating capacity to attract investments and to maintain clients and employees, and to, in turn, build higher levels of satisfaction and reliability with their products and brands [11]. Therefore for firms, being able to measure their reputation has become a

key element. What is more, corporate reputation is one of the most popular non-financial indicators in the world of public and private organizations. For all these reasons, different corporate reputation metrics have been developed in recent years. The most well-known and widely used reputation indices in the literature are those devised by Fortune Magazine and by the consulting firm Reputation Institute. Others also exist, like Reputation Quotient, devised by Harris and Fombrun, and published by the Wall Street Journal, or the index devised by Monitor Español de Reputación Corporativa (Merco) [12].

The pharmaceutical industry is essential for improving citizens' health and moves huge quantities of money every year. This market has substantially grown in the last two decades, was valued at 357.9 billion USD \$ in 2020 (market size), and its global growth is expected to continue at a rate of 12.8% until 2030 [13]. Some of the drivers behind this sector's possible growth are a growing and aging population, significant economic growth in emerging markets, the increasing prevalence of diseases, infrastructure investments, technological advancements, evolving care models, and global health insurance reforms [14,15]. Evidently, with the COVID-19 pandemic, governments and companies have made major investments in this sector [16].

The pharmaceutical industry is characterized by being innovative and intense in knowledge terms [17–19]. It generally has a long return period from the research and development (R&D) stage to the final product launch, but the successful development of new drugs usually implies huge profits for investors [20].

For all these reasons, its activity may lead the population feeling distrust, especially in the present-day with the coronavirus pandemic. On the one hand, it is considered a service that provides basic benefits of vital importance for citizens insofar as monitoring the compliance of sustainability development goals (SDG) in this sector is fundamental for improving the population's trust [21]. On the other hand, we ought not to forget that its main objective is to make profits, just like any other industry. Hence, controversy exists between the industry's commercial interests and those of the public sector or the general population, caused by the industry's objectives, being more interested in generating patents and exploiting them than in patients themselves [22,23].

Given the pharmaceutical industry's importance and the scarce literature about it as regards its economic–financial domain, particularly about the study of reputation in this sector, the objective of the present work is to analyze how pharmaceutical reputation indices are conditioned by the economic–financial and stock-market attributes of the world's main pharmaceutical firms, and to what extent, and to know if geographical location is another influential factor.

Thus, the present research work has two objectives:

- Objective 1: Predicting a firm being included in a reputation index (RI) according to its economic–financial/stock-market outcomes and its geographical location.
- Objective 2: Predicting firms' positions in the quartiles of a RI according to their economic–financial/stock-market outcome and its geographical location.

This study was conducted over the 2017/2019 study period for the pharmaceutical sector and it intends to determine the economic–financial and stock-market variables that impact the probability of considering a pharmaceutical firm to be a reputable one. This study analyzes reputational bias based on firms' geographical location, and represents an advance in modeling and quantifying the variables that influence the pharmaceutical industry's reputation, which is believed to be one of the most important intangible assets.

This study is arranged as follows. Section 2 is a literature review. Section 3 defines the materials and methods employed in this study. Section 4 presents the results of the performed analyses. Finally, Section 5 concludes with a discussion.

## 2. Literature Review

### 2.1. Corporate Reputation Metrics

The importance of corporate reputation metrics lies in two main aspects. The first is the need for firms and professionals to be able to value organizations' non-financial aspects

using a robust quality indicator, and to also count on a benchmark to share and measure the firms in this area, which could become a world standard to measure and manage corporate reputation. The second aspect comes about from the fact that no regulation or standard exists to measure and value reputation, unlike other intangible assets like brand or corporate social responsibility (CSR), for which measuring standards exist, e.g., Standard UNE 418001: 2015 Brand Valuation [24] and the Global Reporting Initiative Standard for measuring economic, environmental, and social performance following the guidelines of international standard ISO 26000, the Social Responsibility Guidance Standard [25], respectively. These facts mean that many metrics and methodologies appear for measuring corporate reputation.

Indices or monitors, which are commonly known as rankings, value reputation, are generally published on an annual basis and are linked with consulting firms and the mass media. They are also recognized by the business community as tools that have a certain influence on business strategies. The first reputation ranking was published in 1982 by the North American magazine *Fortune* with a list of the most admired companies in the world. Since then, it has continued to generate much expectation in the business community when it publishes its ranking every year. In the 21st century, other reputation rankings have come about and today the most well-known ones worldwide are: Global RepTrak™ Pulse of the Reputation Institute, the World's Most Admired Companies of *Fortune's Magazine* and, in Spain and Latin American countries, the Merco ranking. They all consider different variables that can be grouped into six categories of attributes: economic outcomes, CSR, commercial quality, occupational quality, innovation, internationalization, and ethics [26], which denote the interrelation that links a firms' reputation, CSR, and its economic impact. Despite these rankings analyzing similar attributes, their outcomes differ [27].

Simultaneously in the academic field, measuring reputation has been the object of many studies in recent decades, which has led to different methodological proposals being developed [28–31]. Some of these methodologies have even served as the basis of prestigious institutions that produce rankings, such as the Reputation Quotient tool developed by Fombrun et al. (2000) [29], which was later improved and was launched by the above-cited Global RepTrak™ Pulse Ranking.

All these rankings annually publish the list of world companies with the best reputation from all sectors and, generally, only the Top 100. However, there are two exclusive reputation rankings in the pharmaceutical sector: the Health Reputation Monitor devised by the Spanish research company Merco and the Corporate Reputation of Pharma by the UK consulting firm PatientView.

Some researchers [32–34] have employed the rankings published by Merco in their works, especially the Business Reputation Monitor, whose objectives are, among others, to analyze differences among rankings and their attributes, relate the labor reputation to corporate financial performance (CFP) or to study the social reports of Merco Spanish firms. However, the Health Reputation Monitor has not been used to date. Likewise, the ranking by PatientView [35] barely appears in the literature [36–38] and has never been related to economic–financial variables. For all these reasons, this work is pioneering insofar as it uses and analyzes both these rankings from the pharmaceutical sector.

## 2.2. Corporate Reputation and Corporate Financial Performance (CFP)

From the corporate reputation perspective, business success must be measured as the capacity of knowing how to read the social context better than one's competitors, making a sustainable differentiation in time and reinforcing relationships with key groups of interest. In fact reputation, along with brand and CSR, are considered the intangible assets with the best strategic value for firms and capable of creating a real value in firms [39,40].

The literature has widely studied the relation between corporate reputation and CFP by concluding that a positive relation exists between both. In fact, a good reputation is understood to act as a source of financial performance and differentiation for firms [41–43]. Roberts and Dowling [44] confirm its strategic importance by stating that it improves

a firm's capacity to continue with better financial performance over time. This better performance is due mostly to: increased product prices, reduced transaction costs, favorable access to the capitals market, hiring better-trained workers with better cost terms, a greater possibility of diversifying, creating barriers to entry for competitors, reducing data assymetry [40,41], greater employee and customer loyalty, sales and assets growth [44,45], a higher share market price [46,47], or a positive relation with the dividend policy [48]. To sum up, a firm's financial outcomes (stock-market value and accountancy outcomes) affect its reputation [41,49], and vice versa [50–52].

### 2.3. Pharmaceutical Sector, Corporate Financial Performance (CFP) and Corporate Reputation

Knowing the effect that economic–financial variables have on a firm's performance in any sector is essential for managers of companies and other interested parties. However, the literature has not broadly studied the relation of CFP in the pharmaceutical sector. Annabi et al. (2015) [53] used econometric methods to study current production compared to the potential one in the Iranian pharmaceutical industry between 2008 and 2012, but did not relate it to CFP. In Europe, Fenyves et al. (2019) [54] demonstrated in Visegrad countries (Czech Republic, Hungary, Poland and Slovakia) for the 2014–2017 period that the more profitable pharmaceutical companies are able to utilize their assets more efficiently, and finance their operations with external capital to a lesser extent. More recently, the main works conducted in Asia, such as that by Dihn and Pham (2020) [55], studied the effect of capital's structure on the financial performance (ROE) of 30 pharmaceutical firms on the Stock Market of Vietnam between 2015 and 2019. They concluded that the leverage ratio, long-term asset ratio and debt to assets ratio are positively related to their financial profitability (ROE), while the self-financing ratio is negatively related. In the same year, Ge and Xu (2020) [56] studied the same relation. In this case, however, they measured firms' performance with earnings, profitability, corporate return, sales growth, productivity, and market value with a sample of 204 pharmaceutical firms on the stock market in China for the 2013–2018 study period. These authors also found a positive relation between all the variables and firms' performance, except for market value, which was negative, and sales growth had no impact. In 2020, Lim and Rokhim (2020) [57] investigated the factors that affect profitability of pharmaceutical firms from Indonesia after a national health policy was set up. They found a positive relation between liquidity and the sustainable growth rate with three profitability measures, while no significant relation appeared for sales growth and the asset turnover ratio. The scarce literature on this matter centers on studying Asian pharmaceutical firms. However, those pharmaceutical firms with a larger volume of world sales concentrate in Europe and the USA, and have not been the study object to date.

Studies have also been done about pharmaceutical firms' CSR, which is another component of reputation indices. Some employ a qualitative approach based on reviewing and analyzing CSR reports devised and published by pharmaceutical firms to know the degree of their transparency in CSR terms and the standards applied to collect and diffuse CSR data [58,59]. As pharmaceutical firms are well aware of the importance that their CSR data have for CFP [60,61], they publish this information to highlight their achievements to boost their image and reputation [58,59,62].

Corporate reputation has, however, rarely been studied in the pharmaceutical sector. Some works relate pharmaceutical firms' corporate reputation to brand differentiation [63], and also to managers setting up a brand image strategy [64]. Yoo and Park (2017) [65] work on building a reputation scale for pharmaceutical firms by determining that the three key factors of their reputation are corporate sustainability management, R&D leadership and patient centricity. Van de Bogaert et al. (2018) [66] examine the discourse employed by the Belgian pharmaceutical industry to fight against the bad reputation that this industry faces by prioritizing earnings rather than patients. Ion et al. (2020) [67] examine the effect of pharmaceutical firms' reputation on doctors' intention to prescribe medicines.

### 3. Materials and Methods

#### 3.1. Pharmaceutical Firms' Reputation Indices

As previously mentioned, pharmaceutical firms' only specific reputation rankings are those devised by PatientView and Merco.

PatientView has published since the Corporate Reputation of Pharma Ranking from the patient perspective, which publishes the Top 48 companies. PatientView includes the views of 1850 patient groups around the world about the reputation of the pharmaceutical industry and individual companies. Industry and companies are assessed for their performance with 12 indicators from the perspective of patient groups: patient centricity, patient information, patient safety, high-quality products, transparency: clinical trial data, funding of external stakeholders, pricing policies, integrity, quality of relationships with patient groups, provision of services 'beyond the pill', engaging patients in research and engaging patients in development. Surveys are completed by patient groups that are familiar with the company, and by patient groups that have partnered or worked with the company in the past five years. Pharmaceutical firms are scored with a value between 1 and 48 points from a better to a worse reputation.

The health reputation ranking by Merco has been published yearly in Spain and in eight other countries since 2014. It includes the Top 100 companies from 2018. Before in 2017, it published the Top 60, the Top 50 in 2014 and 2016, and the Top 45 in 2015.

Merco, a leading reputation monitor in Spain and Latin America, has become one of the world's reference monitors because it is the only reputation evaluation instrument that undergoes an independent evaluation process performed by the auditing network KPMG in line with Standard ISAE 3000, which confers it more objectiveness and reliability than most existing reputation metrics. On the one hand, it includes the perceptions obtained from thousands of surveys held with specialized doctors, hospital pharmacists, patient association representatives, health journalists, managers and directors of hospitals and pharmaceutical firms and health administration members. On the other hand, it analyzes the objective healthcare quality indicators and reputation merits that it collects from the following dimensions: economic–financial outcomes, commercial supply quality, talent, ethics and corporate responsibility, firms' international dimension, innovation and corporate reputation management. This second part is evaluated internally by technicians from the Analysis and Research Group who are in charge of Merco's fieldwork, and also by independent experts from each evaluated dimension. Finally, by following a typical criterion of weighting, pharmaceutical firms are scored with a value between 1 and 100 points from a better to a worse reputation.

Significant differences appear in the methodologies followed by both consulting firms. The methodology applied by PatientView is a less global one as it only includes patients' perceptions. The indicators that PatientView analyzes focus more on measuring pharmaceutical firms' activity in relation to either patients or the pharmaceutical product they administer, and also in relation to patient-centered activities, but do not analyze any other type of actions performed by pharmaceutical firms or from other stakeholders' perspective. In contrast, Merco includes data from several stakeholders (doctors, investors, investment portfolio managers, public administration) about pharmaceutical firms.

#### 3.2. Data

We initially employed the 50 firms from the pharmaceutical sector with more world sales in 2019, according to the PharmaExec Magazine [68]. This sales ranking has been used by other authors [69]. Of the 50 pharmaceutical firms, four were excluded for not being on the stock market. Therefore, all the pharmaceutical firms totalled 46: 16 from the USA, 13 in Europe, and 17 from Asia. In 2019, North American pharmaceutical firms' total sales were 12.66% higher than those of the European ones, and 363.93% higher than those from Asia (Table 1).



**Table 1.** The geographic distribution and sales of the 46 analyzed pharmaceutical firms.

USA	Europe	Asia
Johnson & Johnson (82,059)		Takeda (19,241)
Pfizer (51,750)		Teva Pharmaceutical Industries (16,887)
Merck & Co (46,840)	Roche (61,869)	Astellas (11,985)
Abbvie (33,266)	Bayer (48,675)	CSL (8538)
Bristol Myers Squibb (26,145)	Novartis (48,667)	Daiichi Sankyo (8529)
Abbot Laboratories (31,904)	GlaxoSmithKline (43,177)	Chugai Pharmaceutical (6295)
Amgen (23,362)	Sanofi (42,064)	Sumitomo Dainippon Pharma (4213)
Gilead Sciences (22,449)	Fresenius Kabi (39,581)	Sino Biopharmaceutical (3511)
Eli Lilly (22,319)	Astrazeneca (24,384)	Shanghai (2703)
Allergan (16,088)	Novo Nordisk (18,269)	Ono Pharmaceutical (2648)
Biogen (14,377)	Merck KGaA (18,055)	Otsuka Holdings (1281)
Mylan (11,500)	Grifols (5699)	Eisai (588)
Bausch Health Companies (8601)	UCB (5491)	Yunnan (429)
Regeneron Pharmaceuticals (7863)	Ipsen (3010)	Sun Pharmaceutical Industries (412)
Alexion (4991)	Endo International (2914)	Jiangsu (337)
Vertex Pharmaceuticals (4162)		Aurobindo Pharma (277)
407,676	361,855	87,874

Sales figures for 2019 are shown in brackets and expressed as millions of USD \$. The total sales figures (in millions of \$) in 2019 of pharmaceutical firms are shown per region in the last row.

### 3.3. Variables

First of all, in order to measure firms' reputation, the rankings that consulting firms PatientView and Merco prepared for the 2017–2019 period were employed. At the time this work was conducted, the 2020 rankings had still not been published. In all, 138 data about the ordinal variable reputation were obtained from these two international consultancy firms' websites.

Secondly, 12 economic–financial variables from the annual accounts of the pharmaceutical firms were selected for the 2017–2019 period: current assets, current liabilities, total assets, total liabilities, net result, operating income (OI), sales, number of employees, number of shares, dividends per share (DS), earnings per share (EPS). The monthly stock-market closing listing price was obtained from the Yahoo Finance platform, and then the average stock-market listing price for each year was calculated. All the data were converted into American dollars (USD \$). Thus, those economic variables expressed as millions of USD \$ (current assets, current liabilities, total assets, total liabilities, net result, OI, R&D, sales) were transformed logarithmically and to categorical variables according to their quartiles. Thus four dummy variables were obtained from each categorical variable.

With these 13 variables, a set of 11 ratios was calculated: price to earning (PER = price/earning); capital gains of the listing price of shares; profitability from dividends (dividend per share  $\times$  100/listing price); financial profitability (ROE = net result  $\times$  100/equity); economic profitability (ROA = EBIT  $\times$  100/Total assets); value in books (VB) or equity (Total assets – Total liabilities); debt ratio (Total liabilities  $\times$  100/Total assets); leverage (Total liabilities  $\times$  100/equity); self-financing (Equity  $\times$  100/assets); long-term assets (Non-current assets  $\times$  100/Total assets) and Fixed asset ratio (Non-current assets  $\times$  100/Equity).

### 3.4. Methodology

We first did a descriptive analysis with the selected variables.

Then, to measure Objective 1: to predict a firm being included in an RI according to its economic–financial/stock-market outcomes and its geographical location, a statistical analysis of the odds ratio (OR) is done to calculate the influence that a pharmaceutical firm's economic–financial/stock-market outcomes and the geographical location values might have on it being included in an RI.

This OR is a measurement of the association between belonging to an RI with these economic–financial/stock-market values, ratios and geographical location.

The OR of a pharmaceutical firm, in relation to its characteristic  $i$ , is calculated as the odds of belonging to an RI if it possesses this characteristic, divided by the odds of

belonging to the RI if it does not possess this characteristic. The mathematical expression of the OR is [70]:

$$OR = \frac{Odds_{YRI}}{Odds_{NRI}} \tag{1}$$

where:

$Odds_{YRI}$  = the odds of a pharmaceutical firm tha possesses a characteristic i belonging to an RI.

$Odds_{NRI}$  = the odds of a pharmaceutical firm that possesses a characteristic i not belonging to an RI.

An OR value of 1 indicates no association between belonging to an RI and characteristic i being present, whereas the higher this value is, the closer the relation between both factors. Values lower than 1 indicate a negative association between a given characteristic i and being included in an RI.

For each pharmaceutical firm,  $Odds_{RI}$  is calculated as the likelihood of being included in an RI divided by the likelihood of this not being the case, and is interpreted as ratios. That is to say, the number of times of a pharmaceutical firm being in an RI to the possibility of this not being the case. This is calculated by the mathematical expression shown below [71]:

$$Odds_{RI} = \frac{P_{YRI}}{P_{YNRI}} = \frac{N_{YRI}}{N - N_{YRI}} \tag{2}$$

where:

$P_{YRI}$  = likelihood of a pharmaceutical firm that possesses a characteristic i being included in an RI.

$P_{YNRI}$  = likelihood of a pharmaceutical firm that possess a characteristic i NOT being included in an RI.

$N_{YRI}$  = Number of pharmaceutical firms that possess a characteristic i and are included in an RI.

$N$  = total number of pharmaceutical firms that possess a characteristic i.

The OR values can be significantly contrasted by the logistic regression model [72–79]. This model is a generalization of the classic linear regression model for dichotomic categorical dependent variables [73]. Its advantage lies in it not requiring normality and homoscedasticity assumptions (variances equality) and allows non-linear effects to be included [78]. This model generally quantifies the joint influence of the explanatory variables (independent variables, regressors or covariables), their economic–financial and stock-market variables, ratios and their geographical location, which were considered predictive, on the likelihood: (1) of being included in an RI (dependent variable or regressor). If several explanatory variables are employed, and the qualitative dependent variable takes a value of 1 or 0, the mathematical expression of the binomial logistic regression is expressed as follows:

$$Ln \left\{ \frac{P(RI = 1/x_1, x_2, \dots, x_{27})}{P\left(RI = \frac{0}{x_1, x_2, \dots, x_{27}}\right)} \right\} = \alpha + \beta_1 * x_1 + \beta_2 * x_2 + \beta_3 * x_3 + \beta_4 * x_4 + \dots + \beta_{27} * x_{27} \tag{3}$$

where:

$RI$ : The endogenous dummy variable: pertenencia de la pharmaceutical firm a un RI. It takes a value of 1 if the pharmaceutical firm was included in the RI (PatientView or Merco) in each year (2017 to 2019), and 0 otherwise.

$\alpha$ : Constant term.

$\beta_1$ : Coefficient of the explanatory variable dummy  $X_1$  that takes a value of 1 if the pharmaceutical firm is located in the USA, and 0 otherwise.

$\beta_2$ : Coefficient of the explanatory variable dummy  $X_2$  that takes a value of 1 if the pharmaceutical firm is located in Europe, and 0 otherwise.

$\beta_3$ : Coefficient of the explanatory variable dummy  $X_3$  that takes a value of 1 if the pharmaceutical firm is located in Asia, and 0 otherwise.

$\beta_4, \dots, \beta_{27}$ : Coefficient of the explanatory economic–financial variable and its ratios  $X_4, \dots, X_{27}$ .

$\varepsilon$ : Random disturbance term.

According to (2) and (3), the  $Odds_{RI}$  is defined with binomial logistic regression as follows [71]:

$$Odds_{RI} = \frac{P(RI = 1/x_1, x_2, \dots, x_{27})}{P\left(RI = \frac{0}{x_1, x_2, \dots, x_{27}}\right)} = \frac{P(RI = 1/x_1, x_2, \dots, x_{27})}{1 - P\left(RI = \frac{1}{x_1, x_2, \dots, x_{27}}\right)} = e^{\alpha + \beta_1 * x_1 + \beta_2 * x_2 + \beta_3 * x_3 + \beta_4 * x_4 + \dots + \beta_{27} * x_{27}} \quad (4)$$

The odds coefficient in expression (4) indicates how many times it is more likely for a company to be in  $RI$  versus it not being included (likelihood of success vs. failure). The odds of each independent variable  $X_i$ , is  $e^{\beta_i}$ . When all the independent variables are  $X_i = 0$ , or are absent,  $Odds = e^\alpha$ .

By finding the unknown in Expression (4), we obtain the likelihood of a pharmaceutical firm with a given variable  $X_i$  value being included in an  $RI$  [79]:

$$P(RI = 1/x_1, x_2, \dots, x_{27}) = \frac{e^{\alpha + \beta_1 * X_1 + \beta_2 * X_2 + \beta_3 * X_3 + \beta_4 * X_4 + \dots + \beta_{27} * X_{27}}}{1 + e^{\alpha + \beta_1 * X_1 + \beta_2 * X_2 + \beta_3 * X_3 + \beta_4 * X_4 + \dots + \beta_{27} * X_{27}}} \quad (5)$$

$$= \frac{1}{1 + e^{-(\alpha + \beta_1 * X_1 + \beta_2 * X_2 + \beta_3 * X_3 + \beta_4 * X_4 + \dots + \beta_{27} * X_{27})}}$$

Therefore, the likelihood of a pharmaceutical firm with a given  $X_i$  value not being included in an  $RI$  would be:

$$P(RI = 0/x_1, x_2, \dots, x_{27}) = 1 - \frac{1}{1 + e^{-(\alpha + \beta_1 * X_1 + \beta_2 * X_2 + \beta_3 * X_3 + \beta_4 * X_4 + \dots + \beta_{27} * X_{27})}} \quad (6)$$

From Equations (4)–(6), we find [80]:

$$Odds_{RI} = \frac{P(RI = 1/x_1, x_2, \dots, x_{27})}{P\left(RI = \frac{0}{x_1, x_2, \dots, x_{27}}\right)} = \frac{\frac{1}{1 + e^{-(\alpha + \beta_1 * X_1 + \beta_2 * X_2 + \beta_3 * X_3 + \beta_4 * X_4 + \dots + \beta_{27} * X_{27})}}}{1 - \frac{1}{1 + e^{-(\alpha + \beta_1 * X_1 + \beta_2 * X_2 + \beta_3 * X_3 + \beta_4 * X_4 + \dots + \beta_{27} * X_{27})}}} \quad (7)$$

According to (1) and (7), the  $OR$  is the quotient between the  $Odds_{RI}$  with the presence of independent variables and the  $Odds_{RI}$  with the absence of independent variables [81]:

$$OR = \frac{\left(\frac{1}{1 + e^{-(\alpha + \beta_1 * X_1 + \dots + \beta_{27} * X_{27})}}\right) / \left(1 - \frac{1}{1 + e^{-(\alpha + \beta_1 * X_1 + \dots + \beta_{27} * X_{27})}}\right)}{\left(\frac{1}{1 + e^{-\alpha}}\right) / \left(1 - \frac{1}{1 + e^{-\alpha}}\right)} \quad (8)$$

Thus  $OR$  quantifies the magnitude of the association between being present in the  $RI$ , and the economic–financial variables, their ratios, and geographical location.

Estimators were calculated by a maximum likelihood calculation and the associated  $p$ -values were obtained for each one. Error levels were 0.5%, 1%, and 5%. The contrast over the overall model was performed with the likelihood ratio logarithm calculation (log-likelihood ratio), Hosmer–Lemeshow tests ( $\chi^2$ ) and Nagelkerke  $R^2$ .

Next to study the Objective 2: Predicting firms’ positions in the quartiles of a  $RI$  according to their economic–financial/stock-market outcome and its geographical location, multinomial logistic regression [82] was employed. In order to build each ranking’s multinomial dependent variable, a K-means cluster analysis [83,84] was applied for the set of the positions that the firm occupied in the three study years (2017–2019). Values of 1, 2, 3, and 4 were assigned to them for the companies located in the cluster groups, from positions: very high, high, medium, or low, respectively.

By taking the low position (value 4) as the reference position, the mathematical expression of the multinomial logistic regression to know the probability of the pharmaceutical



firms occupying another position (values 1, 2, 3) in any *RI*, according to their economic-financial and stock-market variables and geographical location, is:

$$\ln \left\{ \frac{P \left( RI = \frac{k}{x_1, x_2, \dots, x_{27}} \right)}{\left( RI = \frac{0}{x_1, x_2, \dots, x_{27}} \right)} \right\} = \alpha + \beta_1 * x_1 + \beta_2 * x_2 + \beta_3 * x_3 + \beta_4 * x_4 + \dots + \beta_{27} * x_{27} \quad (9)$$

where:

*k*: the positions that pharmaceutical firms occupy in an *RI*. It takes a value of 1 if it occupies a very high position, 2 for a high position and 3 for a medium position.

Goodness of fit was measured with Nagelkerke  $R^2$  and Pearson’s test ( $X^2$ ).

#### 4. Results

##### 4.1. Descriptive Analysis

As we can see in Table 2, the pharmaceutical firms analyzed for the set of the three study years takes a mean assets value of 43,773 million USD \$, a mean sales figure of around 18,000 million USD \$ and their mean R&D expenditure is 3000 million USD \$. The mean profitability of assets (ROA) is 10.48%. Therefore, these firms have a good capacity to make profits, while the mean financial profitability (ROE) is 14.55%, which indicates that they are also capable of generating value for their shareholders. The median PER in the sector is 17.8, which is suitable. The mean size is 43,000 employees, but there are firms with almost 300,000 employees, such as Fresenius Kabi, as opposed to others with around 2500, such as Alexion or Vertex Pharmaceutical.

**Table 2.** Descriptive statistics of the world’s pharmaceutical firms’ top sales.

	PER	ROA	ROE	Assets	Net Result	Sales	R&D	Employees
Mean	22.0	10.48%	14.55%	43,773,124	2,484,927	18,007,793	3,003,516	43,358
Median	17.8	8.83%	13.07%	21,404,973	1,219,431	11,754,888	1,795,000	23,350
Standar dev.	20.0	10.81%	57.24%	46,578,560	4,483,131	18,717,245	3,426,919	50,613
Range	137.1	93.26%	738.87%	171,546,921	37,832,000	82,020,237	11,766,764	291,834
Minimum	1.8	−24.82%	−419.78%	250,079	−16,525,000	38,763	0	2300
Maximum	138.9	68.44%	319.09%	171,797,000	21,307,000	82,059,000	11,766,764	294,134
Percentiles								
25	13.5	4.71%	7.06%	6,781,062	71,102	3,038,219	339,596	10,339
50	17.8	8.83%	13.07%	21,404,973	1,219,431	11,754,888	1,795,000	23,350
75	22.9	14.12%	21.38%	70,366,000	4,089,321	26,116,500	5,204,909	65,550

Data in thousands of USD \$, except for employees and the ROA, ROE and PER ratios.

In relation to the reputation data collected in the two cited rankings, we observed that of the 46 firms, 29 were present in PatientView and 33 in Merco. The 29 firms in the PatientView ranking remained in it for the three study years. The same occurred with the 33 companies included in the Merco, except for five of them which were not present in this ranking in 2017, possibly because this ranking only published its Top 60 that year and not its Top 100. All the companies in the PatientView ranking also appeared in Merco, except for the firm CSL. However, the positions they occupied in both rankings vastly differed. For example, in PatientView, the first positions in 2019 were occupied by Roche, followed by AbbVie, while the top Merco positions were occupied by Novartis and Pfizer.

##### 4.2. The Binomial Logistic Regression Results

Objective 1: Predicting a firm being included in a RI according to its economic-financial/stock-market outcomes and its geographical location

The results are shown in Table 3 by taking the presence or absence in the PatientView reputation ranking as the dependent variable by logarithmically using (Model 1) the variables expressed as millions of USD \$, and also categorically by quartiles (Model 2).

**Table 3.** The binomial logistic regression results for the PatientView pharmaceutical reputation ranking.

Variables	Model 1			Model 2		
	Sig.	OR	95%CI	Sig.	OR	95%CI
USA	0.013	6.090	(1.462–25.366)			
Europe				0.019	3.965	(1.252–15.556)
DS	0.000	5.963	(2.338–15.210)	0.000	4.516	(2.316–8.805)
logR&D	0.000	5.615	(2.521–12.509)			
logSales	0.011	0.391	(0.190–806)			
S2				0.000	18.793	(3.610–97.834)
Constant	0.004	0.000		0.000	181	
Pseudo R <sup>2</sup>		0.707			0.579	
Likelihood		81.770			106.42	
χ <sup>2</sup>		13.627			2.518	

DS: expressed as \$/share. S2: dummy variable, firms classified in the 2nd quartile per sales volume.

In Model 1, the OR of the variable USA indicates that a North American pharmaceutical firm has a six-fold higher probability than an Asian or European firm to be one of the 48 most reputable firms in the world according to the PatientView ranking. According to Model 2, a European pharmaceutical firm has a 3.9-fold higher probability than the rest. Model 1 also shows an increase in the DS of 1\$/share, the OR of belonging to the ranking increases 5.96-fold, which is a similar figure to that obtained in Model 2 (4.51). If the R&D expenditures logarithm increases by one unit, the probability of belonging to the reputation ranking increases 5.6-fold, but this variable does not appear in Model 2.

According to model 1, a negative association appears between pharmaceutical firms' sales and belonging to the reputation ranking (OR < 1). If logSales lowers by one unit, the OR of belonging to the ranking increases by 2.55-fold (1/0.39). However, in pharmaceutical firms with a level of sales 2 (S2) (Model 2), the OR of belonging to the ranking increases by 18.79-fold in relation to the firms in the other three quartiles.

Table 4 also includes the results when taking the inclusion or not in the Merco reputation ranking as the dependent variable.

**Table 4.** The binomial logistic regression results for the Merco pharmaceutical reputation ranking.

Variables	Model 1			Model 2		
	Sig.	OR	95%CI	Sig.	OR	95%CI
Asia	0.001	0.018	(0.002–0.203)			
USA				0.000	27.658	(5.473–139.770)
Europe				0.000	13.912	(3.613–53.563)
DS	0.004	16.072	(2.429–106.336)	0.001	3.964	(1.766–8.897)
List. Price	0.004	0.966	(0.943–0.989)	0.010	0.989	(0.981–0.997)
logR&D	0.002	7.774	(2.169–27.858)			
R&D2				0.003	12.680	(2.388–67.330)
logOI	0.037	0.341	(0.124–940)			
EPS	0.018	1.553	(1.078–2.235)			
Constant	0.041	0.000		0.000	0.167	
Pseudo R <sup>2</sup>		0.791			0.600	
Likelihood		54.299			95.544	
χ <sup>2</sup>		3.864			15.497	

DS, listing price and EPS: expressed as \$/share. R&D2: dummy variable, firms classified in the 2nd quartile per R&D volume.

According to Model 1, a non-Asian firm has a probability of belonging to the Merco ranking that is 55.55-fold (1/0.018) higher than Asian firms. In Model 2, a pharmaceutical firm from the USA has a 27.6-fold higher probability than the others of belonging to the ranking, and one of 13.91-fold if it is European.

With an increase in the DS of 1\$/share, the probability of belonging to the Merco ranking increases 16.07-fold according to Model 1, or by 3.96-fold according to Model 2. In both models, the influence that the listing price of shares has on the ranking is null because its OR practically equals 1.

In Model 1, if log R&D increases by one unit, the probability of belonging to the Merco ranking increases 7.77-fold. In Model 2, for the highest positioned pharmaceutical firms in the 2nd quartile of R&D2, the OR of belonging to the ranking increases 12.68-fold versus the other quartiles.

Moreover in Model 1, if EPS increases by 1\$/share, the OR of belonging to the ranking increases 1.55-fold. Finally, logOI is inversely related to belonging to the ranking. If logOI lowers by one unit, the OR of belonging to the ranking increases 2.93-fold on average (1/0.341). Conversely, these last two variables do not appear in Model 2.

Model 1 obtained better results in the two rankings than Model 2.

### 4.3. The Multinomial Logistic Regression Results

Objective 2: Predicting firms' positions in the quartiles of a RI according to their economic-financial/stock-market outcome and its geographical location.

Firms were grouped into four categories according to the cluster analysis results of the variable position occupied in rankings. In the PatientView ranking showing the Top 48, the category very high position includes the 10 first positions, the category high position goes from 11 to 19, the category medium position goes from 20 to 31, and the category low position goes from 32 to 48. In the Merco ranking that considers 100 positions, the category very high position corresponds to the first 17 positions, the category high position goes from positions 18 to 37, the category medium position from 38 to 64, and the category low position from 65 to 100.

Tables 5 and 6 respectively show the results by taking the position in the PatientView reputation ranking and the position in the Merco reputation ranking as the dependent variable.

**Table 5.** The multinomial logistic regression results for the pharmaceutical PatientView reputation ranking.

Category	Variables	Sig.	OR	95% CI
Very high	Intersection	0.125		
	DS	0.004	13.338	(2.271–78.333)
	logSales	0.189	0.234	(0.027–2.048)
	logOI	0.006	12.305	(2.042–74.145)
High	Intersection	0.720		
	DS	0.005	11.795	(2.069–67.249)
	logSales	0.100	0.193	(0.027–1.369)
	logOI	0.059	4.569	(0.942–22.152)
Medium	Intersection	0.129		
	DS	0.002	14.980	(2.639–85.052)
	logSales	0.023	0.108	(0.016–736)
	logOI	0.044	4.939	(1.046–23.312)

DS: expressed as \$/share. Nagelkerke R<sup>2</sup> = 0.471, Pearson's X<sup>2</sup> = 241.874.

The DS values allow which company is included in the ranking to be predicted (Tables 3 and 4), and to also determine its position (Table 5) in the PatientView ranking with a probability of 13.34—(very high position), 11.79—(high position) and 14.98—(medium position) fold higher than the low position. An increase in logOI by one unit increases the probability of belonging to the ranking by 12.35—(very high position), 4.5—(high position) and 4.9—(medium position) fold in relation to the low position. The negative relation between the best positions and the best sales is confirmed. By lowering logSales by one unit, the probability of occupying a position in the very high category vs. occupying a low category is 4.27—fold (1/0.23) higher, while the probability of occupying a position

in the high and medium categories is 5.18—(1/0.193) and 9.25—(1/0.108) fold higher, respectively, versus occupying a low category. Geographical location does not influence the PatientView positions.

**Table 6.** The multinomial logistic regression results for the pharmaceutical Merco reputation ranking.

Category	Variables	Sig.	OR	95%CI
Very high	Intersection	0.000		
	DebtRatio	0.000	1.219	(1.103–1.347)
	logVB	0.000	76.829	(11.667–505.912)
High	Intersection	0.006		
	DebtRatio	0.137	1.044	(0.986–1.105)
	logVB	0.006	5.953	(1.679–21.108)
	[asia = 0]	0.125	0.058	(0.001–2.218)
Medium	Intersection	0.060		
	DebtRatio	0.486	1.021	(0.962–1.084)
	logVB	0.038	3.764	(1.076–13.162)
	[asia = 0]	0.044	0.026	(0.001–0.908)

LogVB = value in books logarithm. Nagelkerke  $R^2 = 0.657$ , Pearson's  $\chi^2 = 170.640$ ,  $gl = 261$ .

The results show that geographical location in the Merco ranking influences positions, but only the high and medium ones, as opposed to the low position. Indeed a non-Asian firm has a probability of 17.24-fold (1/0.058) of occupying a high position, and one of 38.46-fold (1/0.026) of occupying a medium position, which are higher than they are for Asian firms. The most influential economic variable on pharmaceutical firms being included in the index's positions is the firm's VB. So, for each unit that logVB increases by, the probability of being classified in the ranking's very high position is 76.82-fold higher than the low position, 5.95-higher in the high position and 3.76-fold higher in the medium position. The DebtRatio relation to the Merco ranking position is practically null.

## 5. Discussion and Conclusions

Reputation along with brand and CSR are the intangible assets with the highest strategic value for firms, and they are also closely related. With a lack of a standardized methodology to measure, and even economic value, these intangible assets makes firms' decision making and their relationship with different stakeholders difficult [85].

Many studies can be found in the health field about the effect of drugs on diseases, but only a few appear about the firms that produce these drugs, their finances, and their reputation to understand the keys to their successful CFP in depth.

We also found that the pharmaceutical industry's reputation has barely been investigated despite being the main input to earn stakeholders' trust. Considerable controversy in this industry exists owing to patents allegedly prioritizing patients in firms' objectives, and one of the best means to settle this controversy is by earning a good business reputation. Hence the fundamental need to investigate reputation in the pharmaceutical sector, which is the object of the present work.

In other sectors, a good reputation implies improved CFP, and vice versa. Many authors [4,29,42–52] have verified the positive relation between a good reputation and CFP and its capacity toward achieving better financial performance. Nonetheless, reputation in the pharmaceutical industry has not been studied in the literature with its economic–financial component. Hence, this work helps to bridge this important gap by examining the economic–financial and stock-market variables that most affect pharmaceutical reputation rankings. This work also analyzes the world's pharmaceutical sector and not just Asian companies [55–57].

It is known that one of the attributes used to define reputation Merco index is economic results, whereas it is not considered in PatientView index. The present work was able to determine the economic–financial and stock-market variables that influence a company's

higher probability of being included in a pharmaceutical RI (PatientView or Merco), as well as its geographical location.

According to the obtained results, we can predict that non-Asian pharmaceutical firms are more likely to belong to one of these two rankings than non-Asian ones, especially in Merco. The economic–financial and stock-market variables that most influence the higher probability of belonging to either of these two ranking are R&D, DS, Sales, OI, and EPS, particularly the first two: DS and R&D. This positive relation has globally come over in previous works [48,86] and particularly in the pharmaceutical sector [65]. DS are most important for investors and R&D expenditure is fundamental because it allows the firm's future to improve, which the present work empirically demonstrates. Regarding sales, although other works have demonstrated a positive relation with business reputation [44,45], they do not influence the Merco ranking, while a negative relation is found in PatientView. However, when dealing with this variable in quartiles, the probability of belonging to this ranking is higher in the second group with the biggest sales volume.

This study corroborates a bias that favors firms' geographical location versus their sales volumes, which even shows a negative relation with the probability of including firms in rankings. This might be due to the commercialization and distribution of diverse drugs in international markets, which could vary in the future, along with the composition of these rankings.

In short, some differences appear in the PatientView and Merco rankings for economic–financial variables that they consider including.

For the positions occupied by pharmaceutical firms in reputation indices, major deficiencies appear in both rankings. Geographical location has not influence on the PatientView ranking. In the Merco ranking, the probability of being in a very high, high or medium position vs. a low position is higher for non-Asian firms. This is logical because, although Asian pharmaceutical firms rapidly grow, many of them still do not appear in the studied rankings, or when they do, they will not easily occupy top positions. The economic variables that impact a higher probability of occupying top positions are completely different in each ranking. In PatientView, they are DS, logSales, and logOI, but they are DebtRatio and log VB in Merco. These differences might be due to different circumstances, such as the various sizes of rankings' compositions (Top 100 in Merco versus Top 48 in PatientView), the methodology employed by each one to devise them, and indices only ordering, but not quantifying reputation. Therefore, this work also stresses the need to further investigate monetizing reputation as a firm's intangible asset, which also occurs with other intangible assets like brand [87].

Finally, this work indicates the importance of creating new pharmaceutical reputation indices after a better consensus has been reached about methodological criteria so that stakeholders have more tools for valuing pharmaceutical firms' non-financial aspects, and to also improve the transparency of existing metrics by defining the employed economic–financial and stock-market variables that confer indices greater objectiveness and quality, or by extending the number of firms in PatientView. What is more, the employed indices (PatientView and Merco) herein do not publish detailed information about the origin and type of the data collected about indicators, and the methodology they follow to quantify them is unknown. In fact, one of the variables considered in the Merco index composition is CSR, while PatientView relies on several indicators, such as the provision of services 'beyond the pill', integrity, and transparency, which might prove useful for measuring CSR.

One limitation here is that this study centered only on firms' economic dimension and its relation to firms' reputation in the selected indices, but other social and environmental variables were not considered [26] and they might influence how different stakeholders perceive a firm's reputation. Future studies could analyze this relation in the pharmaceutical sector, which has already been done in other sectors [88,89].



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