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RESEARCH ARTICLE

Risk analysis of Spanish companies

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Abstract

This paper aims to investigate the determinants of different types of market risk faced by Spanish firms from 2012 to 2019. Using Fama and French's (*Journal of Financial Economics*, 1993, 33, 3) three-factor model, we estimate total risk, diversifiable risk, and systematic or non-diversifiable risk in the three dimensions proposed by these authors: market risk, size risk, and valuation risk. Risk determinants are derived from a series of economic and financial variables obtained from the information contained in financial statements. This information is summarised using a factor analysis that aims to resolve the correlation issues between the proposed measures. The study demonstrates that the systematic risk factors proposed by Fama and French in their 1993 three-factor model incorporate dimensions of systematic risk that are relevant to investors and that the set of economic and financial variables proposed can explain these risks. Among these variables, profitability and the market to book ratio have the greatest impact in explaining company risk, while factors such as operating and financial leverage, growth, or company insolvency have a much smaller effect as explanatory factors for risk.

1 | INTRODUCTION

Our study examines the relationship between a company's different types of risk and the information contained in its financial statements. We identify the determinants of the main types of risk in the company and how a company's financial decision affect the risk perceived by the markets, using the traditional three-factor model by Fama and French (1993). We measure total risk, diversifiable risk, market risk, size risk, and value risk. We decompose systematic or non-diversifiable risk into market risk, size risk, and value risk.

Traditional valuation models are based on the mean variance preferences and diversification concept developed in the original proposal of Markowitz's Portfolio Theory (1952). It was Sharpe (1964), Lintner (1965) and Mossin (1966) who developed a simplified empirical estimation of Markowitz's model, which led to the formulation of the Capital Asset Pricing Model (CAPM). The CAPM is a single-factor model that explains the return on securities by the market return differential to the return on risk-free assets, stating that the returns on an asset are proportional to the returns on the market portfolio, with β being the factor that measures this proportionality. However, Alquist et al. (2020) argued that the CAPM is dead. As an improvement on single-factor models, Fama and French developed the so-called three-factor model in 1993 (Fama & French, 1993).[1] This model identifies three non-diversifiable risk factors: the market risk already reflected in the CAPM proposal, size risk, and value risk. The factors in the Fama and French model efficiently capture the effect of a set of variables which, in addition to being highly predictive of stock price evolution, faithfully reflect the policies and decisions adopted by companies and that constitute the essence of their fundamental risk (Li & Dempsey, 2018).

A later version by these authors (Fama & French, 2015) proposes an augmented version that adds two more factors as components of non-diversifiable risk: profitability and investment. Models have been developed which have added factors to the original three-factor model in order to study a wide range of financial asset price anomalies (Soebhag

et al., 2022), in what is known as the "factor zoo" (Cochrane, 2011). Increasing the number of divisions in systematic risk would mean that a correct interpretation in economic terms proves difficult. As a result, we focus on the market, size, and value factors as the most relevant in the literature.

Bali (2008) establishes that the risk premium associated with beta (market factor) is both pertinent and statistically significant. Additionally, González-Urteaga and Rubio (2016, 2021, 2022) corroborate the presence of empirical evidence indicating that exposure to the market volatility risk premium constitutes a key determinant of volatility risk premia. Market risk quantifies the volatility stemming from fluctuations in commodity prices, exchange rates, interest rates, and other factors, which investors cannot mitigate even through a perfectly diversified investment portfolio. In the context of Spain,[2] the research by Menéndez-Plans et al. (2012) furnishes empirical support for the relevance of accounting and macroeconomic measures in explaining market risk. For an international sample, León et al. (2007) estimate the coefficient of risk aversion when studying the intertemporal relationship between risk and expected return.

Asness et al. (2020) argue convincingly that a size factor can be highly informative for gaining insights into investor behaviour. Size risk – which is non-diversifiable – emerges from the variations in company sizes. This risk primarily arises due to the greater operational and financial risks typically associated with smaller firms, leading them to earn higher returns compared to their larger counterparts (Fama & French, 2015). Alquist et al. (2018) shed light on the idea that as long as size remains correlated with a fundamental source of risk, rational investors should be compensated for holding assets that exhibit greater exposure to this risk. In essence, size risk encapsulates a portion of a broader effect that can enhance value when considered alongside other risk factors. These authors provide evidence that the inclusion of the Fama and French factors significantly strengthens the impact of size risk. Consequently, if the aim is to comprehend investor behaviour, then incorporating a size factor proves to be highly beneficial. In conclusion, smaller firms respond differently to various phases of the business cycle when compared to their larger counterparts (Amel-Zadeh, 2011). This justification underscores the importance of including a factor that captures the distinct characteristics of smaller firms.

González-Sánchez et al. (2018, 2020) convincingly established that the value factor possesses robust economic foundations due to its association with uncertainty and risk aversion. Value risk arises from distinct corporate strategies: value-oriented versus growth-oriented. Value companies typically exhibit high book to market ratios (indicative of high value), whereas growth companies tend to have low book to market ratios (indicative of low value). Given the lower market valuation, it is common for markets to undervalue companies with high book to market ratios, in anticipation that these companies may subsequently improve their prices and deliver superior performance (Fama & French, 2006; Li & Dempsey, 2018). Consequently, the market tends to undervalue stocks with high book to market ratios, a metric linked to indicators such as earnings over price, cash flow over price, or sales over price. These indicators reflect an inherent undervaluation of these shares, potentially leading to positive abnormal returns in the future.

Policy Implications

- Any policy that favours higher growth opportunities will be associated with higher market risk.
- As companies increase their profitability, they increase their risk.
- Changes in operating and financial leverage are less relevant than growth opportunities in companies' risk.
- Policies that favour gains in solvency do not reduce substantially the company's market risk.

Although the study of accounting measures as determinants of firm risk receives little attention in contemporary finance research, the tradition has persisted in strategic management literature (Campbell et al., 2010). Chiou and Su (2007) compile the dual theoretical and empirical strands that have traditionally considered the determinants of risk in finance literature and which consider that the internal determinants of systematic risk are articulated around the degree of operating leverage and financial leverage – based on Hamada (1969, 1972). Analysis of these two major factors and their interaction suggests the emergence of certain other determinants, including earnings, sales, asset value, and dividend payout.

Campbell et al. (2010) analyse the determinants of stock performance and systematic risk by focusing on value and growth stocks. They conclude that the fundamentals related to the evolution of corporate cash flows are basic determinants of this dimension of non- diversifiable risk highlighted by Fama and French (1993) and mention classic variables such as volatility, profitability, and indebtedness. Fama and French (2000) link the risk associated with the book to market (BTM) factor to two basic concepts: earnings and financial insolvency.

From a more traditional perspective, Lee and Hooy (2012) attempt to analyse the systematic risk of air transport companies in different areas of the world, estimating an Intertemporal Asset Pricing Model (IAPM)

model and obtaining betas as an indicator of risk. In the second phase, they attempt to explore the determinants of systematic risk by proposing groups of variables in line with previous proposals, including size, liquidity, profitability, financial and operating leverage, and growth.

Following a somewhat different line of research, Jensen (2022) examines the relationship between subjective risk and investors' return expectations and realised returns. Jensen finds different premia depending on whether the dependent variable is required return (high premia) or realised return (low premia). The author concludes that investors suffer from over-optimism when estimating the cash flows of riskier companies, which leads them to overestimate the required return of these types of stocks and to engage in mispricing. Jensen (2022) looks at the behaviour of traditional models and asset pricing models and restates the idea of factors related to the behaviour of securities in terms of risk. In multifactor models, these factors are size, profitability, and the existence of solvency problems. The single-factor model contemplates a broad set of 119 factors, prominent amongst which are more specific factors such as stock quality, profitability, asset growth, earnings per share (EPS) growth, company age, duration, and book to market.

To systematise the choice of explanatory variables for the behaviour of Fama and French's essential risk factors, we note that new proposals revolve around dimensions which are very similar to those already considered in classical studies, such that we choose to follow the proposal of the initial work by Azofra Palenzuela et al. (1997), which allows us to group the factors of influence into three large groups of variables. The first of these represents financial risk and its main dimensions, debt capacity, financial leverage, and the company's bankruptcy probability. The second group represents operating risk, which is measured in two dimensions, operating leverage and the company's liquidity. Finally, the third group – other factors – includes various firm characteristics that cannot be included in either of the two previous groups, such as size, growth, or profitability.

In consequence, our research tests Spanish companies' risk determinants using accounting data from a panel from 2012 to 2019 and a robust methodology. The sample consists of listed Spanish companies but incorporates new measures of systematic risk based on the asset valuation model proposed by Fama and French (1993). Our paper contributes to the literature on the relevance of accounting measures as determinants of firm risks. It extends and updates previous results by Azofra Palenzuela et al. (1997) and provides evidence concerning the relevance of measuring company risk just after the financial crisis of 2007–2008.

The findings underscore the significance of growth opportunities and profitability in elucidating variations in company risk. As a company expands – augmenting its long term debt and decreasing its liquid assets – both total risk and diversifiable risk tend to increase. However, an upswing in operating leverage serves to diminish both total and diversifiable risks while amplifying market risk. A higher proportion of fixed assets (higher tangibility) diminishes the perception of risk for lenders but heightens concerns among market investors regarding elevated fixed costs. Notably, systematic risk demonstrates a decrease with an increase in the company's financial leverage. Lastly, as a company approaches insolvency, there is an observable escalation in both diversifiable and non-diversifiable risks.

The rest of the paper is structured as follows. Section 2 explains the sample, variables, empirical design, and methodology. Section 3 presents the results, while Section 4 discusses the main conclusions.

2 | METHODOLOGY AND DATA

A sample of listed Spanish companies – excluding financial companies – is used for the analysis. The study period spans from January 2012 to December 2019. The information is compiled from the Refinitiv Eikon database (companies' share prices), from Orbis (companies' financial statements), and from the Bank of Spain (risk-free yield). Data for 2020 and 2021 were excluded from the analysis as they are exceptional years due to the COVID pandemic.

The work is carried out in two stages. In the first stage, we apply the Fama and French three-factor model (1993), which allows us to estimate the three dimensions of non-diversifiable risk (market, size, and value). Together with diversifiable risk and total risk, these constitute the variables studied in the second stage. In this second stage – and with the economic and financial information available for Spanish listed companies – we select a series of ratios that are representative of a company's economic and financial situation. The foreseeable correlation between these variables makes it advisable to apply factor analysis to reduce its number and so extract the most important information from the ratios previously selected as potential determinants of risk.

2.1 | Estimation of the different types of risk

To calculate the five types of risk considered in the study, we start by estimating the three-factor model proposed by Fama and French (1993). According to this model, the expected return of any asset or portfolio is determined by three factors:

1. The excess return of the capital market to the risk-free asset.

2. The difference (SMB) in the return of the stocks of small market value companies (S) compared to the return of large market value (B) companies.
3. The difference (HML) in the return of stocks of value companies (high book to market = H) minus the return of growth companies (low book to market = L).

The mathematical formulation of the model corresponds to the following expression:

$$R_{i,t} - R_{F,t} = \beta_i * (R_{M,t} - R_{F,t}) + \gamma_i * (SMB_t) + \delta_i * (HML_t) + \varepsilon_{i,t} \quad (1)$$

where i: companies from 1 to 90. t: weeks from 1 to 52 for each year of the sample. $R_{i,t}$: the return on asset i in week t. $R_{F,t}$: the return on the risk-free asset in week t. $R_{M,t}$: the market return in week t. β_i: the sensitivity of the return on asset i to changes in the market premium return. γ_i: the sensitivity of asset i's return to changes in the size premium. δ_i: the sensitivity of asset i's return to changes in the valuation premium. $\varepsilon_{i,t}$: the error of the model to be used to estimate the own risk of asset i. SMB_t: difference between the average return of small market value companies and the average return of large market value companies in week t. HML_t: difference between the average return of value companies and the average return of growth companies in week t.

To estimate the model, we use data on the weekly stock returns of Spanish listed non-financial companies from 2012 to 2019. The initial sample includes 103 non-financial companies. However, we had to exclude those companies in which either some of the data required to construct the different accounting ratios were not available or where share price data were not available for at least 4 consecutive years, or when the company had no positive equity for 4 consecutive years. After applying these filters, the final sample is reduced to 90 companies. Not all of the 90 companies have data for all the years since, for example, some were listed after 2012, while others disappeared before the end of 2019. The sample is therefore an incomplete panel.

The risk-free asset return is the return on the Spanish Government's 10 year bond – data for which were extracted directly from the Bank of Spain's website. The market return is the return on the IBEX 35 index, which is our proxy for the market portfolio. The alternative could be the Madrid Stock Exchange General Index (IGBM). The correlation between the returns of these two indexes is very high, such that using one or the other does not change the results.[3] The following expression is used to calculate the return of the market portfolio:

$$R_{M,t} = \frac{P_{M,t} - P_{M,t-1}}{P_{M,t-1}} \quad (2)$$

where $P_{M,t}$: IBEX 35 quote at the end of week t. $P_{M,t-1}$: IBEX 35 quote at the end of week $t-1$.

To standardise the treatment given to dividends in the IBEX 35 index, stock dividends were not considered when calculating their weekly yield. The weekly return of each of the companies in the sample was obtained using the following expression:

$$R_{i,t} = \frac{P_{i,t} - P_{i,t-1}}{P_{i,t-1}} \quad (3)$$

where $P_{i,t}$: company i's quotation at the end of week t. $P_{i,t-1}$: company i's quotation at the end of week $t-1$.

Size and value risks are incorporated through two variables: SMB and HML. According to the proposal of Fama and French (1993), companies with small market value are expected to have a higher risk and, therefore, higher profitability than those with a greater market value. On the other hand, as the HML variable is constructed, value firms are a priori considered to have a higher risk (higher return) than growth firms.

To estimate the value of the SMB and HML variables, we classify companies each year, according to their size or book to market ratio, respectively. For the SMB variable, two groups of companies are created according to their market value in each period: small companies (S) and large companies (B), using the median market value as the cut-off point. Similarly – and based on the median book to market ratio – two groups of companies or portfolios are created each year: companies with the highest book to market ratio (H) and companies with the lowest book to market ratio (L). The market value and the book to market ratio vary from year to year, such that the number of companies and the companies that make up the groups each year also differ.

The following expression is used to calculate the returns of each group:

$$R_{G,t} = \sum_{i=1}^{n} W_{i,G,t} \bullet R_{i,G,t} \quad (4)$$

where $R_{G,t}$: average return of group G in week t. $W_{i,G,t}$: weighting coefficient of company i, which belongs to group G in week t. $R_{i,G,t}$: profitability of company i, which belongs to group G in week t.

In turn, we calculate the weighting coefficient with the following expression:

$$W_{i,G,t} = \frac{E_{i,G,t}}{E_{G,t}} = \frac{E_{i,G,t}}{\sum_{i=1}^{n} E_{i,G,t}} \quad (5)$$

where $W_{i,G,t}$: weighting coefficient. $E_{i,G,t}$: market value of company i, which belongs to group G in week t. $E_{G,t}$: sum of the market value of the companies belonging to group G in week t.

The return of each group is therefore the weighted average of the returns of the companies that make up the group, with the weighting coefficient being the ratio of the company's market value to the total market value of the group.

The variable SMB (S minus B) reflects the size risk factor and is the weekly difference between the average return of the group of small market value companies (smaller companies) and the average return of the group of large market value companies (larger companies).

$$SMB_t = S_t - B_t = R_{S,t} - R_{B,t} \quad (6)$$

where SMB_t: variable size at week t. $R_{S,t}$: average return of small firms in week t. $R_{B,t}$: average return of large firms in week t.

The variable HML (H minus L) reflects the value risk factor and is the weekly difference of the average return of value companies compared to the average return of growth companies.

$$HML_t = H_t - L_t = R_{H,t} - R_{L,t} \quad (7)$$

where HML_t: variable value in week t. $R_{H,t}$: average return of firms with the highest book to market ratio in week t. $R_{L,t}$: average return of companies with the lowest value of the book to market ratio in week t.

When performing the linear estimation of model coefficients proposed in Equation (1), the weekly data of each company are used to obtain the parameter estimates in each of the years (T) of the sample (2012–2019) and for each company (i).

$\beta_{i,T}$: coefficient representing the market risk of company i in year T. $\gamma_{i,T}$: coefficient representing the size risk of company i in year T. $\delta_{i,T}$: coefficient representing the value risk of company i in year T. $\sigma_{\varepsilon_{i,T}}$: company i's diversifiable risk in year T. $\sigma_{i,T}$: total risk of company i in year T.

As can be seen, the estimation of the model not only allows us to obtain the non-diversifiable risk in its triple dimension of market risk (β), size risk (γ), and value risk (δ) but also the diversifiable or idiosyncratic risk measured through the standard deviation of the residuals (σ_ϵ) for each year in the sample.

Finally, the standard deviation of firm return (σ) allows us to add the last type of risk to be analysed: total risk. The total risk of firm i in year T, $\sigma_{i,T}$, is thus calculated as the deviation of the total return of firm i in year T from the weekly data of firms' returns:

$$\sigma_{i,T} = \sqrt{52} \cdot \sqrt{\cdot \frac{SST}{N-1}} = \sqrt{52} \cdot \sqrt{\cdot \frac{SSR + SSE}{N-1}} \quad (8)$$

where SST: Sum of Squared Total. SSR: Sum of Squared Regression. SSE: Sum of Squared Error. N: number of measures used to perform the regression, i.e., the number of weeks in a year. $\sqrt{52}$ allows us to annualise the weekly data used and obtained in the calculation.

In order to calculate the diversifiable risk of company i in year T, $\sigma_{\varepsilon_{i,T}}$, the following expression is used:

$$\sigma_{\varepsilon_{i,T}} = \sqrt{52} \cdot \sqrt{\cdot \frac{SSE}{N-1}} \quad (9)$$

where SSE: Sum Squares of Errors. N: number of measures used to perform the regression.

Once we have the annualised estimates for each of the five risk measures, in the next section, we identify the explanatory factors of Spanish company risk based on their economic and financial characteristics.

2.2 | Economic and financial variables

We start from the proposals of Beaver et al. (1970) who indicate that certain characteristics of the economic and financial structure of the company determine its risk because there is a high degree of correlation between these variables and the risk of each company. Other authors – such as Leary and Roberts (2014) and more recently Baba-Yara et al. (2023) – argue that several factors capture the economic and financial characteristics of firms and that determine their risk taking and investment decision. These factors include profitability, indebtedness, market to book ratio, or liquidity. Along the same lines, the work of Azofra Palenzuela et al. (1997) allows these variables to be grouped into three large blocks: financial risk, operating risk, and other factors (see Table 1).

2.2.1 | Financial risk

The first block includes variables of the firm related to its financial risk. We thus consider ratios that measure indebtedness, financial leverage, and the firm's bankruptcy probability.

Indebtedness is an indicator of the maximum debt a company can assume before experiencing solvency problems. The higher a company's indebtedness, the greater the financial risk should be. The company's indebtedness is related to the financial leverage that allows a company to increase its investment capacity above its equity. As the company becomes more indebted, not only does its leverage increase but also its financial risk since while the remuneration to equity providers is concurrent with the results of the investments, the remuneration to creditors must be made periodically and punctually and is not directly linked to project maturities. In short, the greater a company's financial leverage, the greater its risk. In order to measure a company's indebtedness and financial leverage, we consider three ratios: D1, D2, and LAF (see Table 1).

A company approaches bankruptcy when it is unable to meet its financial obligations. The probability

TABLE 1 Economic and financial variable definitions.

Variable	Description
Financial risk	
Indebtedness and financial leverage	
D1	log(Debt/Equity)
D2	Long Term Debt/Total Assets
LAF	log(EBIT/(EBIT-Financial Expenses)
Bankruptcy	
Z''	$3.25 + 6.56 \bullet X_1 + 3.26 \bullet X_2 + 6.72 \bullet X_3 + 1.05 \bullet X_4$[a]
Operating risk	
Operating leverage	
LAO	log((Net Income + Fixed Expenses)/Net Income)
LAO1	log(Sales/EBIT)
Flexibility or assets liquidity	
LL1	log(Current Assets/Current Liabilities)
L2	Current assets/Total Assets
Other factors explaining corporate risk	
Size	
LT	log(Total Assets)
LV	log(Sales)
Growth	
CR	$(\text{Assets}_t - \text{Assets}_{t-1})/\text{Assets}_{t-1}$
Profitability	
R1	Earnings before interest after taxes/Equity
R2	Sales/Assets
R3	EBIT/Sales
R4	EBIT/Assets
R5	EBIT/Equity
R6	Cash Flow/Assets
Growth opportunities	
MTB	Equity Market Value/Equity Book Value

[a]From Altman et al. (2017), X_1 = Working Capital/Total Assets. X_2 = Retained Earnings/Total Assets. X_3 = Earnings Before Interest and Taxes/Total Assets. X_4 = Market value/Total Debt.

of financial insolvency is measured with the *Z*-Score proposed by Altman (1968), which uses a combination of financial ratios to predict a company's bankruptcy. The higher the *Z*-Score, the greater the solvency of the company, and therefore the lower its risk of insolvency. Instead of Altman's original proposal, this paper uses the Z' statistic, which was updated by Altman et al. in a paper published in 2017. The new proposal updates the original ratio and allows a better measurement of firms' financial insolvency according to their industry.

2.2.2 | Operating risk

The second group of factors is related to operating risk, which is measured in two ways: operating leverage and company liquidity. Operating leverage refers to the existence of a higher proportion of fixed costs to obtain a higher return per unit sold. The greater the company's operating leverage, the greater its risk. A company's liquidity is directly linked to its ability to meet its short-term financial obligations. The greater the company's liquidity, the easier it is for the firm to meet its short-term financial obligations and, consequently, the lower its operating risk. In order to measure operating leverage, we have designed two variables: LAO and LAO1 (see Table 1).

We propose measuring asset flexibility with two ratios: LL1 and L2. The LL1 ratio measures the company's ability to meet its short-term commitments, while L2 represents the company's capacity to meet all its commitments with the resources available in the short term (see Table 1).

2.2.3 | Other factors explaining corporate risk

Finally, the third group – other factors – includes company characteristics such as size, growth, and profitability. As the size of a company increases, it enjoys better conditions for obtaining financing and for increasing its visibility in the market. In this sense, the 'too big to fail' effect enjoyed by very large companies allows authorities to monitor them more closely and somehow force them to avoid excessive risks. In addition, large companies tend to be more diversified than small ones, thereby generating synergies, leveraging resources, and thus mitigating their risk. This is why we should expect that the larger the size of the company, the lower its risk. We propose two measures of size: LT and LV (see Table 1).

The company's growth – CR – is measured as a function of the annual change in its assets, while we construct six ratios to measure company profitability: R1–R6 (see Table 1). In our case, we are interested in return as a measure of the company's ability to generate profits. According to the risk return binomial, in a break-even situation, higher return will be associated with higher risk. In our work, we use different measures of return to observe it from different angles. Finally, we measure growth opportunities with the market to book ratio.

2.3 | Factor analysis of economic and financial variables

The difficulty involved in working with many ratios –18 in our case – as well as the high correlations between some of the ratios chosen and the resulting multicollinearity problems advocate conducting a factor analysis that makes it possible to summarise the proposed variables in a reduced number of factors. We obtained seven factors that summarise 76% of the total variance explained by the model and that extract at least 50% of the information contained in each of the proposed ratios.

The factors resulting from the factor analysis are linear combinations of the proposed ratios ordered in decreasing order according to the information provided or, in other words, according to the proportion of explained variance contained in the original variables. In addition, the factors are orthogonal to each other and yield standardised values with mean 0 and standard deviation equal to 1.

Factor analysis is performed over the whole sample and not year by year, such that the factors have the same interpretation and are associated with identical ratios in all the years of the study. Clarke (2022) argues that using principal component analysis to extract factors performs as well or better than other models. Once the factor analysis and the rotation of the factors obtained through the varimax procedure are carried out, the results can be associated with a specific subset of ratios. Consequently, the explanatory risk factors used in the research are as follows (see Table 2):

Factor 1 (Size and LT debt): measures the size of each company, such that larger companies tend to correspond to less liquid companies with higher long-term debt. It is positively and significantly correlated with size and long-term debt ratios (D2, LT, and LV), and negatively correlated with liquidity ratios (LL1 and L2). It thus summarises information related to the company's long-term debt, liquidity, and size.
Factor 2 (Profitability): measures the profitability of the companies in the sample. It is significantly and positively correlated with ratios R1, R4, and R6 and therefore summarises the information related to company return in its different dimensions.
Factor 3 (Operating leverage): this is a measure of operating leverage. It is significantly and positively correlated with the ratios that measure operating leverage (LAO and LAO1).
Factor 4 (Market to book): measures companies' growth opportunities and is linked to the capacity of the company's assets to generate profits. It is positively and significantly correlated with the R5 and market to book ratios.
Factor 5 (Insolvency): measures insolvency. The higher this factor for a company, the closer to insolvency the company is. It is significantly correlated with ratios D1 and Z'. With the D1 ratio, the correlation is positive, while with the Z' ratio, it is negative. It should be noted that higher values of Z' indicate a lower probability of insolvency. This factor summarises the information related to the capacity of indebtedness without falling into insolvency.
Factor 6 (Growth): measures the growth of the companies. It depends almost exclusively on the ratio that measures the annual growth of a company's assets.
Factor 7 (Financial Leverage): this last factor measures financial leverage. It is positively and significantly correlated with the LAF ratio. It therefore summarises the information related to companies' financial leverage.

2.4 | Estimating the impact of factors on risk measures

The use of panel data enables us to address the issues of constant and unobservable heterogeneity among firms while incorporating information about the relationship between variables in previous periods (Bond, 2002). The 'system estimator' proposed by Blundell and

TABLE 2 Relevance of each ratio in each factor.

Matrix of rotated components							
	Factors						
Ratios	**Size & LT debt**	**Profitability**	**Operating L.**	**Market to book**	**Insolvency**	**Growth**	**Financial L.**
D1 = LOG (Debt/Equity)	0.495	−0.234	0.218	0.448	0.561	−0.010	−0.027
D2 = LT Debt/Total Assets	0.751	−0.183	−0.172	0.218	0.128	0.194	−0.017
LAF = LOG (l(EBIT/(EBIT-Financial expenditures))l)	0.151	0.135	0.040	−0.015	−0.003	0.063	0.899
LAO = LOG (l((NI + F. expenditures)/NI)l)	0.040	0.049	0.859	0.066	−0.030	−0.002	0.208
LAO1 = LOG (l(Sales/EBIT)l)	0.075	−0.091	0.839	0.001	0.123	−0.068	−0.349
LL1 = LOG (C. Assets/C. Liabilities)	−0.546	0.165	−0.351	−0.270	0.081	0.186	0.046
L2 = C. Assets/Total Assets	−0.608	0.074	0.302	−0.082	0.567	0.005	0.067
LT = LOG (Total assets)	0.849	0.129	0.002	−0.168	0.102	0.105	0.095
LV = LOG (Sales)	0.777	0.212	0.285	−0.160	0.253	−0.088	0.108
CR = (Assets t − Assets t −)/Assets t − 1)	0.035	−0.050	−0.030	−0.048	0.110	0.849	0.041
R1 = EBT/Equity	−0.034	0.726	0.098	0.396	−0.106	0.218	0.097
R2 = Sales/Assets	−0.160	0.241	0.530	0.052	0.322	−0.532	0.059
R3 = EBIT/Sales	0.262	0.259	0.244	−0.132	0.080	0.113	−0.345
R4 = EBIT/Assets	−0.027	0.931	−0.042	−0.008	0.013	−0.106	0.027
R5 = EBIT/Equity	0.010	0.423	0.111	0.765	−0.060	0.146	0.058
R6 = Cash Flow/Assets	0.037	0.901	−0.007	−0.008	0.041	−0.167	0.017
MTB = Market value/Book value	−0.002	−0.035	−0.029	0.817	0.080	−0.170	−0.011
$Z'' = 3.25 + 6.56X_1 + 3.26X_2 + 6.72X_3 + 1.05X_4$	−0.221	−0.006	0.019	−0.012	−0.819	−0.067	0.054

Note: This table reports the results of the factor analysis among the 18 ratios on the economic and financial variables proposed. Color shades show the most relevant ratios for each factor.

Bond (1998) is used to overcome the problem of simultaneity between economic and financial variables based on financial statements (Wooldridge, 2002). Additionally, we apply the small sample adjustment proposed by Windmeijer (2005). The Hansen test is used to test the validity of the instruments. A Hansen test value close to 1 suggests over-identification due to use of excessive instruments.

The regression model to be tested and estimated using the generalised method of moments is as follows:

$$\text{Risk}_{i,T} = \alpha_0 + \sum_{j=1}^{n} \beta^j X^j_{i,T} + \sum_{j=1}^{n} \gamma^k \text{DummyYear}^k_{i,T} + \eta_i + \varepsilon_{i,T} \quad (10)$$

where $\text{Risk}_{i,T}$: risk of asset i in year T. α_0: constant term. $\sum_{j=1}^{n} \beta^j X^j_{i,T}$: sum of the factors or explanatory variables j of asset i in year T multiplied by the coefficient of factor j. $\sum_{j=1}^{n} \gamma^k \text{DummyYear}^k_{i,T}$: sum of the annual *dummy k* of asset i in year T multiplied by the coefficient of *dummy k*. η_i: fixed effects of asset i.[4] $\varepsilon_{i,T}$: regression residuals of asset i in year T.

As can be seen, the formulation of the model includes individual effects associated with each security and time effects that attempt to reflect the existence of influences associated with the economic cycle.

3 | RESULTS

3.1 | Types of risk descriptive statistics

3.1.1 | Total and diversifiable risks

As shown in Tables 3 and 4, Spanish companies in 2017 showed the highest total risk and diversifiable risks. It is worth highlighting that this year shows the greatest difference between the mean and the median, indicating there was a group of companies that were subject to enormous variability in their market returns in 2017. This leads to the maximum value of the total risk and diversifiable risk of the whole period analysed. Years 2016 and 2019 also stand out as the years in which Spanish companies obtained the lowest total risk and diversifiable risk means, which was significantly lower than the average for the period analysed. The distribution of risk is skewed to the left.

3.1.2 | Non-diversifiable risks

The market risk measure used is characterised by negative values in all years, except 2012, which contradicts the theory of a positive value for risk, given that a higher value for risk should correspond to a higher return. However, the negative values in almost all the years (Table 5) should be understood as a period in which the prices of financial assets moved downwards and, therefore, generate negative returns. This variable is the one with the greatest dispersion of all the risk measures. However, results are consistent with those obtained for total and diversifiable risks since it is again observed that 2017 was a year of extreme values as far as market risk is concerned.

The mean for size risk in the period analysed comes to 0.4815 and its median to 0.2143, such that its distribution – as in the case of total risk – is skewed to the left. The year 2017 is confirmed as a year of high risk for Spanish companies and provides us with the highest values for this risk measure, including the maximum for the whole period analysed (Table 6). However, the years with the lowest mean values for size risk were 2015 and 2016.

The values obtained for value risk differ from the results obtained for the other risks analysed (Table 7). The measure we used for value risk has a less skewed distribution than in the other risks studied. The mean and median for the whole period are practically the same. Moreover, there is no year in which the risk is much higher or lower than the overall mean of the 8 years studied. The years with the highest mean values are 2016 and 2019. This risk might be behaving contrary to the other two risks that are

TABLE 3 Total risk evolution in Spanish companies.

Year	Observ.	Mean	Median	Stand. dev.	Min	Max
2012	76	0.1843	0.1678	0.1393	0.0093	0.8706
2013	77	0.1736	0.1423	0.1197	0.0073	0.6108
2014	82	0.1648	0.1167	0.1593	0.0045	0.8551
2015	87	0.1750	0.1496	0.1103	0.0028	0.5669
2016	90	0.1581	0.1475	0.0973	0.0023	0.4960
2017	89	0.2752	0.1138	1.2197	0.0025	11.6088
2018	87	0.1873	0.1361	0.2358	0.0022	1.9891
2019	86	0.1465	0.1173	0.1209	0.0013	0.7511
2012–2019	674	0.1836	0.1345	0.4632	0.0013	11.6088

Note: This table reports the results of total risk using the standard deviation of a firm's return.

TABLE 4 Diversifiable risk evolution in Spanish companies.

Year	Observ.	Mean	Median	Stand. dev.	Min	Max
2012	76	0.1238	0.1154	0.0893	0.0083	0.4747
2013	77	0.1319	0.1062	0.1060	0.0065	0.5650
2014	82	0.1289	0.0960	0.1368	0.0041	0.8392
2015	87	0.1196	0.1151	0.0786	0.0025	0.4460
2016	90	0.1159	0.0969	0.0804	0.0019	0.4149
2017	89	0.1929	0.0887	0.7397	0.0020	7.0427
2018	87	0.1437	0.0981	0.1668	0.0018	1.3254
2019	86	0.1127	0.0897	0.0929	0.0011	0.5439
2012–2019	674	0.1340	0.1007	0.2879	0.0011	7.0427

Note: This table reports the results for diversifiable risk measured as the residuals $\varepsilon_{i,t}$ of the Fama and French (1993) three factor model: $R_{i,t} - R_{F,t} = \beta_i * (R_{M,t} - R_{F,t}) + \gamma_i * (SMB_t) + \delta_i * (HML_t) + \varepsilon_{i,t}$.

TABLE 5 Market risk (systematic) of Spanish companies.

Year	Observ.	Mean	Median	Stand. dev.	Min	Max
2012	76	0.0058	−0.0029	0.6629	−3.4175	2.0145
2013	77	−0.1157	−0.0567	0.6957	−1.9587	2.5275
2014	82	−0.0336	−0.0840	1.3609	−3.3075	6.6237
2015	87	−0.3224	−0.1067	1.0645	−4.7233	3.0853
2016	90	−0.2807	−0.1540	0.7506	−2.8778	1.5422
2017	89	−1.7932	−0.0408	15.2178	−143.5380	1.7348
2018	87	−0.1800	−0.0918	0.9462	−3.0140	2.9803
2019	86	−0.2115	−0.1576	0.6496	−1.6439	1.0712
2012–2019	674	−0.3827	−0.0830	5.5954	−143.5380	6.6237

Note: This table reports the results for market risk using the Fama and French (1993) three-factor model. Market risk is the estimator of the β coefficient in the model: $R_{i,t} - R_{F,t} = \beta_i * (R_{M,t} - R_{F,t}) + \gamma_i * (SMB_t) + \delta_i * (HML_t) + \varepsilon_{i,t}$.

TABLE 6 Size risk (systematic) evolution of Spanish companies.

Year	Observ.	Mean	Median	Stand. dev.	Min	Max
2012	76	0.3580	0.0982	0.7800	−1.0340	3.6095
2013	77	0.4475	0.3324	0.6557	−0.4705	3.0836
2014	82	0.7878	0.4578	1.7519	−6.1704	9.1007
2015	87	0.2053	0.0046	0.9150	−1.1907	4.2921
2016	90	0.3552	0.1671	0.6993	−0.8666	3.0786
2017	89	0.7599	0.3146	2.5889	−1.1414	22.8532
2018	87	0.5008	0.2545	1.5187	−2.1944	12.6503
2019	86	0.4328	0.1868	1.0410	−1.5315	4.9493
2012–2019	674	0.4815	0.2143	1.4146	−6.1704	22.8532

Note: This table reports the results for market risk using the Fama and French (1993) three-factor model. Size risk is the estimator of the γ coefficient in the model: $R_{i,t} - R_{F,t} = \beta_i * (R_{M,t} - R_{F,t}) + \gamma_i * (SMB_t) + \delta_i * (HML_t) + \varepsilon_{i,t}$.

part of systematic or non-diversifiable risk (market and size), or the measure used might not be accurate enough – as indicated by some authors (Ammann et al., 2023). González-Sánchez et al. (2018, 2020) have demonstrated that the value factor possesses robust economic foundations due to its association with uncertainty and risk aversion. Nevertheless, it is noteworthy that the value risk component within the Fama and French three-factor model exhibits suboptimal performance in emerging markets, which is potentially indicative of investor irrationality and inefficient markets. In these markets, investors tend to maintain

TABLE 7 Value risk (systematic) evolution of Spanish companies.

Year	Observ.	Mean	Median	Stand. dev.	Min	Max
2012	76	0.7085	0.6184	0.7681	−0.2275	4.8276
2013	77	0.7102	0.6485	0.6196	−0.2461	2.2900
2014	82	0.6947	0.7068	2.1465	−14.8692	4.7259
2015	87	0.7735	0.6810	0.7064	−0.8974	2.8416
2016	90	0.7676	0.6903	0.6795	−1.6468	2.3251
2017	89	0.5096	0.7300	2.0728	−17.5099	3.9779
2018	87	0.5501	0.5194	0.7726	−2.4995	3.2395
2019	86	0.7826	0.6244	1.2531	−1.6927	7.2145
2012–2019	674	0.6860	0.6616	1.2785	−17.5099	7.2145

Note: This table reports the results for market risk using the Fama and French (1993) three-factor model. Size risk is the estimator of the δ coefficient in the model: $R_{i,t} - R_{F,t} = \beta_i * (R_{M,t} - R_{F,t}) + \gamma_i * (SMB_t) + \delta_i * (HML_t) + \epsilon_{i,t}$.

TABLE 8 Correlation matrix among risk types.

	Total	Market	Size	Value	Diversifiable
Total	1.00				
Market	−0.94	1.00			
Size	0.72	−0.63	1.00		
Value	−0.46	0.50	−0.08	1.00	
Diversifiable	0.99	−0.92	0.71	−0.46	1.00

Note: This table reports the coefficients of correlation between different types of risk.

a persistent pessimistic outlook on value stocks, while remaining optimistic about growth stocks, regardless of favourable or unfavourable news.

It is clear that the events which occurred in 2017, encompassing the declaration of independence in Catalonia (Spain), the United States' withdrawal from the Paris Agreement, the British government's formal notification of its intent to withdraw from the EU, election years in France and Britain, the swearing-in of President Trump, terrorist attacks in London, Manchester, Paris, and Barcelona, as well as the recognition of Jerusalem as the capital of Israel, collectively fostered an environment of significant uncertainty for Spanish companies. This prevailing uncertainty is palpably reflected in our risk measures.

3.1.3 | The correlation between the different types of risk

The decomposition of total risk into non-systematic risk and systematic risk explains the high correlation between total risk and non-systematic risk. What is more interesting in terms of understanding the results of this work are the correlations between the three risks that make up systematic risk: market, size, and value (Table 8). Market risk is highly correlated with size and value risks, although we obtain a low correlation between size and value risks. The negative correlation between market and size and between size and value is also noteworthy. The negative correlation between market and size risks can be explained by the fact that during the period chosen for the study, the stock market experienced many periods of negative returns, which justifies a negative beta for many of the companies in the sample.

3.2 | Determinants of company risks

A priori – and based on what the literature suggests – the determinants of each type of risk are expected to impact them with different significance and/or sign. Table 9 shows the results of the regressions carried out between the different types of risk and their explanatory factors. All the analyses performed provide a significant Wald test, reflecting that the relationships between each of the risks and the factors from the factor analysis are statistically significant. Similarly, the second-order autocorrelation test (AR2) is not significant in any of the estimates, which implies there are no autocorrelation problems in the regression analysis. The Hansen test does not yield significant values in any of the regressions, which means that the model is well-specified or – in other words – that the instruments used are valid. There are also no problems of over-identification.

Furthermore – and having incorporated dummy variables to capture the time effect associated with each year – the result shows that the characteristics of each year do influence the risks.

TABLE 9 Explanatory factors of risk types.

		Non diversifiable			
Variables	**Total risk**	**Market**	**Size**	**Value**	**Diversifiable risk**
Size & LT debt	0.1034***	−1.2224***	0.4363***	0.2262***	0.0510***
	(0.0000)	(0.0000)	(0.0000)	(0.0027)	(0.0000)
Return	0.2151***	−3.2325***	0.3997***	−0.2915***	0.1170***
	(0.0000)	(0.0000)	(0.0000)	(0.0013)	(0.0000)
Operating L.	−0.0305***	0.6569***	0.0031	0.0643	−0.0157***
	(0.0000)	(0.0000)	(0.8684)	(0.1300)	(0.0000)
Market to book	0.3910***	−4.7475***	0.6896***	0.0032	0.2416***
	(0.0000)	(0.0000)	(0.0000)	(0.9649)	(0.0000)
Insolvency	−0.0098***	0.4512***	0.0502***	0.0351	0.0049***
	(0.0000)	(0.0000)	(0.0003)	(0.4794)	(0.0005)
Growth	0.0841***	−1.1602***	0.1244***	0.0449	0.0448***
	(0.0000)	(0.0000)	(0.0002)	(0.3152)	(0.0000)
Financial L.	0.0310***	−0.4044***	−0.1253***	−0.1267**	0.0198***
	(0.0000)	(0.0000)	(0.0000)	(0.0120)	(0.0000)
2013	−0.0167***	−0.0183	0.0782**	−0.1313**	0.0421***
	(0.0020)	(0.7589)	(0.0264)	(0.0255)	(0.0000)
2014	−0.0380***	0.3975***	0.3693***	−0.0274	0.0261***
	(0.0000)	(0.0000)	(0.0000)	(0.7729)	(0.0000)
2015	0.0288***	−0.6585***	−0.2938***	0.1044*	−0.0158***
	(0.0000)	(0.0000)	(0.0000)	(0.0983)	(0.0000)
2016	0.0222***	−0.4900***	−0.0520*	−0.0172	0.0105***
	(0.0000)	(0.0000)	(0.0954)	(0.8027)	(0.0000)
2017	0.0482***	−0.6680***	0.2070***	−0.2188***	0.0404***
	(0.0000)	(0.0000)	(0.0000)	(0.0094)	(0.0000)
2018	−0.0132***	0.5258***	0.0773***	−0.1553***	0.0319***
	(0.0000)	(0.0000)	(0.0000)	(0.0035)	(0.0000)
Constant	0.1780***	0.1426*	0.4035***	0.7526***	0.1078***
	(0.0000)	(0.0558)	(0.0000)	(0.0000)	(0.0000)
Observations	674	674	674	674	674
AR1	−2.147	−2.234	−3.461	−1.990	−2.241
p-Value	0.0318	0	0.000538	0.0859	0
AR2	−1.246	−0.127	−0.796	1.718	−0.955
p-Value	0.213	0.409	0.511	0.179	0.340
Hansen test	76.59	79.20	75.99	62.31	81.43
p-Value	0.492	0.899	0.426	0.0466	0.343

Note: This table reports the results from GMM estimations of the model: $\text{Risk}_{i,T} = \alpha_0 + \sum_{j=1}^{n} \beta^j X^j_{i,T} + \sum_{j=1}^{n} \gamma^k \text{DummyYear}^k_{i,T} + \eta_i + \varepsilon_{i,T}$. Size & LT debt, Return, Operating Leverage, Market to book ratio, Insolvency, Growth, and Financial leverage are the factors obtained in the factor analysis of the 18 original ratios, and they are our explanatory variables of company risks. *p* Value in parenthesis.

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

3.2.1 | Total risk determinants

All of the factors explaining total risk have a very high level of significance (Table 9). Thus, companies who grow in assets, increase in size with higher levels of long-term debt and lower liquid assets, and who obtain a higher market to book ratio are those who most increase their total risk. These characteristics tend to be associated with lower levels of solvency and lower levels of operating leverage. This therefore means that companies who increase their size and long-term debt by using new growth opportunities (high market to book ratios) tend to have higher risks, such that the market demands higher returns. According to our results, there

is a positive relationship between return and total risk – as predicted by financial theory – in Spanish companies over the period 2012–2019.

It is precisely the increases in the market to book ratio that present a greater sensitivity to total company risk and that to a greater extent are transferred to total company risk. Changes in the probability of insolvency are the least sensitive to changes in total company risk.

By year, 2013, 2014, and 2018 were the years with total risk decrease. For its part, 2017 is a year that had a positive impact on the total risk of Spanish companies, given the exceptional circumstances which occurred that year.

3.2.2 | Diversifiable risk determinants

Non-systematic risk is one component of total risk and indicates the part of the risk that can be eliminated through diversification since it is specific to each company. The pursuit of growth opportunities that lead companies to increase their size with greater long-term debt and lower liquidity is the factor that most increases the diversifiable risk of Spanish companies (Table 9). These companies tend to reflect the new situation by increasing their financial leverage and by decreasing their operating leverage, and they have higher return requirements to cope with greater risk. As with total risk, an increase in diversifiable risk is associated with an increase in the probability of insolvency, which results in a higher required rate of return. The market to book ratio is the factor that has the greatest impact on the non-systematic risk of Spanish companies, although it is less sensitive than in the case of total risk. Profitability is the second most influential factor in changes to Spanish companies' diversifiable risk. In general, diversifiable risk is less sensitive to changes in all the explanatory factors than in the case of total risk.

The reduction in diversifiable risk experienced by Spanish companies in 2015 was due to factors such as a more stable economic environment and lower levels of political uncertainty. In the remaining years, we see an increase in diversifiable risk – particularly in 2013 and 2017 – possibly due to the political situation in those years, which compounded the uncertainty that companies had to operate in.

3.2.3 | Non-diversifiable risk determinants

Market risk is one of the components of non-diversifiable risk in a portfolio. Azofra Palenzuela et al. (1997) previously measured market risk using the beta of the CAPM model. In our work, however, it is measured using the beta of the three-factor model of Fama and French (1993), which also includes size and value risks in the non-diversifiable risk component. Among the explanatory factors, the market to book ratio displays the greatest sensitivity to changes in firms' market risk, although the sign is negative, which is counterintuitive given its positive influence on total risk and diversifiable risk. This result can be explained by the negative value of beta in our estimations of the three-factor model. While beta estimates can be positive or negative, total risk and diversifiable risks – given the way they are measured – can only have positive values.

Companies that experience growth in their assets to realise the growth opportunities found in the market – accompanied by a large size and greater financial leverage – show an inverse relation with market risk. On the other hand, increases in the probability of insolvency and operating leverage are positively associated with market risk. We then observe that the portfolio's market risk can be balanced by combining companies that experience growth in assets, realise growth opportunities, increase long-term debt and profitability, and that tend to reduce their liquidity with companies who increase their operating leverage and insolvency. The results show reductions in market risk for most years in our sample – except for 2014 and 2018 – where market risk increases for reasons related to market volatility in those years.

The risk associated with firm size is one of the three components of a firm's systematic or non-diversifiable risk. Our results (Table 9) indicate that companies see an increase in their size risk if they grow by increasing the size of their assets with new investments as a result of the company's growth opportunities and greater use of long-term debt. Such an increase is also related to a greater probability of insolvency and operating leverage. This increase in size risk also goes hand in hand with an increase in profitability. Size risk increases in line with a company's greater use of long-term debt and less liquid assets. Companies capable of reducing their financial leverage will, nevertheless, see their size risk reduced. Moreover, size risk is particularly sensitive to changes in the market to book ratio. For every one unit change in this ratio, size risk increases 0.7 times. The second variable whose changes have a high impact on size risk is the factor that measures changes in size, long-term indebtedness, and liquidity. When analysing the impact observed in each year on size risk, we see that size risk increased in all years, except in 2015, when it decreased.

The third component of non-diversifiable risk is the risk associated with the company strategy. For value risk, an increase in size financed with long-term debt and lower asset liquidity is the main factor contributing to its increase. In turn, increases in profitability or financial leverage are associated with reductions in value risk. Furthermore, value risk is highly sensitive to changes in a company's return. Changes

in size, long-term debt, and liquidity are the second most sensitive to value risk. However, changes in growth opportunities, insolvency, operating leverage, or asset growth are not significant factors in explaining changes in value risk. Only in 2015 did we observe a significant increase in value risk. In the other years, changes in value risk were either negative or not significant.

4 | CONCLUSIONS

This paper aims to explain the determinants of the different types of risk that we identify in 90 Spanish companies over the period 2012–2019. For this purpose, we measure total risk, diversifiable risk, and systematic risk. We use the three-factor model of Fama and French (1993) to estimate for each security the three dimensions of systematic risk: market, size, and value risk. To obtain the determinants of risk in Spanish companies, economic and financial information from their financial statements was collected and summarised in seven factors: size and LT debt, profitability, operating leverage, market to book, insolvency, growth, and financial leverage.

Except for market risk, the rest of the types of risk analysed increase as companies become larger, more indebted, and have less liquid assets. Size risk is the most sensitive to changes in company size. In contrast, the results indicate that an increase in company size is associated with lower beta coefficients or market risk.

Financial leverage helps to explain all types of risk: positively in total and diversifiable risk and negatively in the three variants of systematic risk, such that systematic risk decreases when the company's financial leverage increases.

Profitability is another of the factors with the greatest presence in our analysis and which also helps to explain all the risks analysed. In this case, increases in return are associated with higher total and diversifiable risks, with total risk showing the greatest sensitivity to changes in profitability. However, changes in profitability have a negative influence on two of the three measures into which systematic risk is decomposed – market risk and value risk – suggesting a decrease in non-diversifiable risk when corporate return increases.

Growth opportunities, profitability, asset growth, and operating leverage influence both total risk and diversifiable risk in the same direction. This leads us to conclude that companies who increase their assets by taking advantage of available growth opportunities and by generating higher earnings see both their total risk and their diversifiable risk increase, although total risk is always more sensitive than diversifiable risk to changes in these variables. Considered on a more individual basis, the growth factor is associated with a reduction in market risk, such that as company assets grow, the latter will be less affected by market movements. However, when operating leverage increases, we see reductions in both total risk and diversifiable risk, albeit to a greater extent in the latter. Operating leverage, on the other hand, does influence the generation of non-diversifiable risk. Finally, it can be concluded that while the probability of insolvency implies an increase in diversifiable risk and two of the three types of systematic risk, it causes a decrease in total risk.

In general terms, the study shows that the new systematic risk factors proposed by Fama and French in their three-factor model of 1993 incorporate dimensions of systematic risk that are relevant to the investor and that the set of economic and financial variables proposed have an explanatory capacity for these factors that is worth considering. Of all the variables and factors considered, those which have the greatest impact when explaining company risk are profitability and the market to book ratio, whereas factors such as operating and financial leverage, asset growth, or company insolvency have a much smaller effect as risk explanatory factors.

It can therefore be affirmed that – for Spanish companies – the higher the level of profitability and the higher the market to book value ratio, the greater the risks. Companies that increase their growth opportunities and their returns will thus increase their contribution, in terms of systematic risk, to a well-diversified portfolio of securities.

This research highlights several limitations that suggest avenues for future inquiry. Firstly, a more detailed examination of the evolution of company risk during the COVID-19 period and its comparison with other crisis periods, such as the financial crisis, could yield valuable insights. Nieto and Rubio (2022) argue that the COVID-19 crisis represents a unique opportunity to understand the performance of risk factors. Another promising area for further investigation is the use of the Level, Slope, and Curve Factor Model introduced by Clarke (2022). This model emphasises asset comovements and their connection to firm characteristics. Additionally, exploring comparisons with other European countries within the Eurozone may provide valuable context. Further research is also needed to explore the relation between defensive factors and a firm's risk.

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DATA AVAILABILITY STATEMENT

The data that support the findings will be available in [repository name] at [DOI/URL] following an embargo

from the date of publication to allow for commercialization of research findings.

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ENDNOTES

[1] Even though the three-factor model has been in implemenation since 30 years, it has continued to be the subject of analysis throughout this period in different countries and legal contexts and for very different purposes: Brighi et al. (2013), Bhatt and Rajaram (2014), Trinh et al. (2016), and Su and Taltavull (2021) to name just a few.

[2] González-Urteaga et al. (2020) recently published a report on the Spanish capital market.

[3] Several studies carried out at different points in time confirm the high correlation (between 92% and 99%) between these two indexes. Among these, we can cite the work of Menéndez-Plans et al. (2012), and the working papers of Vallejos (2008) and Fernandez (1993).

[4] Constant and latent unobservable effects that the panel methodology estimates by having a time series associated with each individual company in this case.

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