Idiosyncratic risk really drives stock returns. Spanish evidence

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Abstract

Following the theoretical model of Merton (1987), we provide a new perspective of study about the role of idiosyncratic risk in the asset pricing process. More precisely, we analyze whether the idiosyncratic risk premium depends on the idiosyncratic risk level of an asset as well as the variations in the market-wide measure of idiosyncratic risk. As expected, we obtain a net positive risk premium for the Spanish stock market over the period 1987-2007. Our results show a positive relation between returns and individual idiosyncratic risk levels and a negative but lower relation with the aggregate measure of idiosyncratic risk. These findings have important implications for portfolio and risk management and contribute to provide a unified and coherent answer for the main and still unsolved question about the idiosyncratic risk puzzle: whether or not there exists a premium associated to this kind of risk and the sign for this risk premium.

Keywords: Idiosyncratic risk, diversification, shadow costs, equity risk premium.

JEL Classification: G10, G12.

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1. Introduction

The question about what kind of risk drives stock returns has been a challenge for academics and practitioners ever since the seminal papers that established the fundamentals of modern finance (Markowitz, 1959; Sharpe, 1964; Linter, 1965) and also introduced the notion of decomposing total risk into systematic and idiosyncratic risks.

These initial studies argue, within the framework of the CAPM, that idiosyncratic risk can be eliminated in a well-diversified portfolio and hence it should not be priced. However, there are numerous papers that document that investors do not hold diversified portfolios because of wealth constraints or by choice, and hence they should be careful about the specific risk of the securities they hold (Blume and Friend, 1975; Odean, 1998; Barber and Odean, 2001; Liu, 2008).

Moreover, idiosyncratic risk has been the subject of a great deal of research in recent years. In particular, three of the most influential works related to the US market are: Campbell *et al.* (2001) which documented that idiosyncratic risk is the largest component of total risk and is time-varying; Goyal and Santa-Clara (2003) which found that aggregate measures of idiosyncratic volatility predict one-month-ahead excess market returns; and Ang *et al*. (2006) which reported a negative and significant relation between idiosyncratic risk and cross-sectional stock returns. However, most recent studies about these three lines of research present mixed results depending on the market, sample period or methodology employed in the analysis.

In this context, the aim of this paper is to shed light on the idiosyncratic risk puzzle with Spanish data. Our study contributes to the existing body of financial literature in three ways. The first one relates to the database employed. This study exclusively analyzes the Spanish case. Although there are some papers that analyze idiosyncratic risk implications in an international context,[1] this is the first in-depth study about the

[1] On one hand, Kearney and Poti (2007) study the aggregate firm level volatility of the stocks listed on the markets of the European Monetary Union (euro area) as a whole and find that idiosyncratic risk is the largest component of total volatility. On the other hand, Guo and Savickas (2007) find that average idiosyncratic volatility is a significant predictor of stock market returns in many markets of the G7

pricing of idiosyncratic risk in the Spanish stock market. This is a medium-sized market that plays a relevant role in the shaping of the stock market map in Europe, but whose evolution and particular characteristics are very different from other markets such as the US one. In this sense, comparison with US data results should be quite useful for investors and researchers. Otherwise, it is important to report empirical results from other data sets to check the robustness of the available results and to support the conviction that it is not due to a data-snooping problem (Lo and Mackinlay, 1990).

The second contribution is related to the theoretical and methodological proposal for analyzing the role of idiosyncratic risk in asset pricing. Based on the theoretical model of Merton (1987), we provide a new perspective of study about the role of idiosyncratic risk in the asset pricing process. More precisely, we analyze whether this premium depends on the idiosyncratic risk level of an asset as well as the variations in the market-wide measure of idiosyncratic risk.

Finally, the third contribution of our study is related to the results that we obtain. As expected, we obtain a net positive premium related to idiosyncratic risk. Our results show a positive relation between returns and individual idiosyncratic risk levels and a negative but lower relation with the aggregate measure of idiosyncratic risk. These findings contribute to provide a unified and coherent answer for the main and still unsolved question about idiosyncratic risk: whether or not there exists a premium associated to this kind of risk and the sign for this risk premium.

The remainder of the article is organized as follows. Section 2 presents previous empirical evidence about asset pricing with idiosyncratic risk. In Section 3 we illustrate the theoretical framework and propose a new perspective of study. Section 4 contains the empirical analysis for the Spanish stock market divided in four subsections. In the first subsection we present the market and data set. In the second subsection we present the methodology employed to decompose total risk in its systematic and idiosyncratic components as well as the descriptive statistics for these risk series. The third subsection shows the empirical analysis of the asset pricing implications with the cross-sectional analysis of competing asset pricing models. Finally, Section 5 has concluding remarks.

group of countries. However, Angelidis and Tessaromatis (2008a) find little evidence for ten European markets with non significant results for Spanish stocks.

2. Should idiosyncratic risk be priced? Previous empirical evidence

As we have mentioned previously, the relevant literature on idiosyncratic risk is divided into three main areas following the findings of Campbell et al. (2001), Goyal and Santa-Clara (2003), and Ang *et al.* (2006). They analyze the time trends in idiosyncratic volatility, the relationship between average idiosyncratic volatility and future market returns and the relation between idiosyncratic risk and cross-sectional stock returns respectively. However, we are going to focus our attention on the third of these areas of research because of its implications for financial theory.

Traditional asset pricing theories suggest that idiosyncratic risk is either irrelevant in a frictionless market or positively related to asset returns when investors are under-diversified. However, Ang *et al.* (2006) examined the cross-sectional patterns of idiosyncratic risk in the US market and documents the puzzle commonly referred to as "idiosyncratic risk puzzle". They found that expected returns are negatively correlated with idiosyncratic risk. Their results are robust when they control for various firm characteristics (size, value, volume, liquidity, momentum, analyst forecast dispersion) and market conditions (bull and bear markets, recession and expansions, high and low market volatility).

Subsequent evidence presents a substantial controversy regarding the relationship between idiosyncratic risk and the cross-section of expected returns. However, we also have to point out that this evidence is sensitive to model specifications for measuring idiosyncratic risk as well as sample data. In this context, Huang *et al.* (2007) demonstrate that the findings in Ang *et al*. (2006) are driven by return reversals from stocks with high idiosyncratic risk in the last month. On the other hand, Bali and Cakici (2008) indicate that no robustly significant connection exists between idiosyncratic risk and the cross-section of expected returns. Moreover, Fu (2009) argues that idiosyncratic risk estimated in Ang *et al*. (2006) is not a good proxy for expected idiosyncratic risk and shows that conditional idiosyncratic volatility computed from an EGARCH model is positively correlated with expected returns. More recently, Boehme *et al*. (2009) and Chua *et al*. (2010) present evidence in favour of a significant and positive relationship from different methodological proposals while Guo and Savickas (2010) document a negative relationship in line with Ang *et al*. (2006).

Controversy also exists in an international context. While Ang *et al*. (2009) confirm their US findings for 23 developed markets around the word, Pukthuanthong-Le and

Visaltanachoti (2009) find that idiosyncratic risk is priced on a significantly positive risk premium for stock returns across 36 countries. Furthermore, Beakert *et al*. (2010) document that idiosyncratic volatility is highly correlated across countries.

In this context, the objective of this study is to improve the international empirical evidence with an in-depth analysis for the Spanish stock market trying to answer three crucial questions. Firstly, whether or not idiosyncratic risk plays a relevant role in the asset pricing process. Secondly, how should it be introduced in asset pricing models. Finally, whether the sign of the idiosyncratic risk premium should be positive or negative.

3. Theoretical framework

Modern portfolio theory predicts that idiosyncratic risk is eliminated in equilibrium through diversification and therefore does not affect the cross-section of expected returns. The failure of investors to fully diversify, however, can lead to an idiosyncratic risk premium in required rates of return. Merton (1987) and Malkiel and Xu (2006) argue that the relation between idiosyncratic risk and expected returns depends on the extent to which investors hold diversified portfolios. The less diversified the portfolios, the higher the proportion of idiosyncratic risk impounded into expected returns.

There is a large body of work documenting the reasons why investors might fail to hold fully-diversified portfolios. These reasons can be classified into two main categories: investor and market characteristics. Investor characteristics include income levels and risk tolerance. In this sense, Blume and Friend (1975) and Liu (2008) find that the level of investor diversification increases with the level of personal wealth while Odean (1998) and Barber and Odean (2001) show that risk-tolerant investors tend to be overconfident, trade excessively, and hold under-diversified portfolios. On the other hand, market frictions such as information and transaction costs can also cause investors to under-diversify. Merton (1987) argues that investors have a tendency to over invest in stocks which have more readily available information. As a result, higher information costs are expected to lead to less diversification and, therefore, a higher idiosyncratic risk premium.

More precisely, Merton (1987) develops a theoretical capital market equilibrium model in an information-segmented market, the resulting equation of which is:

$$E(r_j) = r_f + \beta_j \left[E(r_m) - R_f\right] + \lambda_j - \beta_j \lambda_m \quad (1)$$

where, in addition to the systematic risk premium, there is a disinformation risk premium that not only depends on the relationship between the cost of incomplete information of the firms but also on the whole disinformation cost in the market. This is because not all investors have information about all assets, although they do have homogeneous expectations. Consequently, we presume the existence of a lack of information on the market as a whole. Moreover, this additional risk premium should be positive or negative, depending on the magnitude of λ_j and $\beta_j \lambda_m$ respectively.

Although we follow this theoretical framework to analyze the role of idiosyncratic risk in asset pricing, our empirical work doesn't represent a direct analysis of Merton's model for two main reasons. The first one is that we simplify the empirical set and propose two alternative formulas for analyzing separately the two contrarian effects previously documented. The other reason is related to the measure commonly referred to as shadow cost. This depends on three different variables: the shareholder base, the relative market size and the idiosyncratic risk level of an asset. In this sense, we follow one strand of the literature which tests Merton's model controlling for size and shareholders base, and then analyze the relationship with idiosyncratic risk.[2]

From a theoretical point of view, the two alternative formulas[3] that we propose are the following:

$$E_{t-1}\left(r_{jt} - c_{jt} - r_f\right) = \lambda_{t-1} \frac{Cov_{t-1}\left(r_{jt} - c_{jt}; r_{mt}\right)}{Var_{t-1}\left(r_{mt}\right)} \quad (2)$$

where r_{jt}, r_{mt} and r_f denote the return of the stock *j* in month *t*, the return of the market in the month *t* and the return of a risk-free asset respectively, while c_{jt} represents the disinformation cost for investors of asset *j* which causes investor under-diversification and the relevance of idiosyncratic risk in asset pricing.

2 Another strand of the literature focuses on the study of the returns of stocks that receive more attention. In this order, López, Marhuenda and Nieto (2009) use the attention of financial analysts on each stock as a proxy for the quantity of available information of a firm and study if the quantity of information about an asset determines its return for the Spanish market. Although they are based on the same theoretical principles behind Merton's model, their empirical methodology differs from ours. Finally, we consider that both studies complement each other.

3 In line with Miralles and Miralles (2006) work, in which they study the role of liquidity in asset pricing for the Spanish stock market.

For the second specification, we consider that there is a lack of information in the market as a whole suggesting a systematic risk factor related to the level of available information. In this case, we propose an alternative asset pricing model that follows the equation:

$$E_{t-1}\left(r_{jt} - r_f\right) = \gamma_{t-1} \frac{Cov_{t-1}\left(r_{jt}; r_{mt} - c_{mt}\right)}{Var_{t-1}\left(r_{mt} - c_{mt}\right)} \tag{3}$$

And, if we decompose the covariance, we obtain:

$$E_{t-1}\left(r_{jt} - r_f\right) = \gamma_{t-1}\left[\frac{Cov_{t-1}\left(r_{jt}; r_{mt}\right)}{Var_{t-1}\left(r_{mt} - c_{mt}\right)} - \frac{Cov_{t-1}\left(r_{jt}; c_{mt}\right)}{Var_{t-1}\left(r_{mt} - c_{mt}\right)}\right] \tag{4}$$

On the other hand, from an empirical point of view, the first model is:

$$r_{jt} - r_{ft} = \alpha + \gamma\, \beta_{jt} + \kappa\, c_{jt} + \mu_{jt} \tag{5}$$

where,

$$\beta_{jt} = \frac{Cov\left(r_{jt} - c_{jt}; r_{mt}\right)}{Var\left(r_{mt}\right)} \tag{6}$$

And the second one:

$$r_{jt} - r_{ft} = \alpha + \gamma_1\, \beta_{1jt} - \gamma_2\, \beta_{2jt} + \mu_{jt} \tag{7}$$

where,

$$\beta_{1jt} = \frac{Cov\left(r_{jt}; r_{mt}\right)}{Var\left(r_{mt}\right)} \qquad \beta_{p2} = \frac{Cov\left(r_{pt}; c_{mt}\right)}{Var\left(c_{mt}\right)} \tag{8}$$

Finally, we propose the analysis of the empirical performance of these two asset pricing models which includes disinformation costs of a specific asset as well as those associated to the market as a whole in order to determine their contributions to the explanation of returns.

4. Empirical evidence

4.1. Spanish market and data

We collect firm-level data for all stocks listed on the Spanish stock market over the period 1987-2007. The sample includes 207 different stocks. The total number of stocks increased from 54 in July 1987 to 135 in July 2007,[4] with a maximum of 154 stocks in the period between the end of 1998 and the beginning of 1999, which was characterized by the privatization of large public companies.[5]

Over the sample period, not only has the Spanish stock market experienced a great development in terms of the number of listed firms, but also in the modernization of administrative procedures and the presence of foreign and institutional investors, which has spectacularly increased capitalization and trade volume.

The presence of institutional investors (insurance companies, investment companies, pension funds, and other forms of institutional saving funds) in the Spanish stock market in the early nineties was relatively small. However, by the end of the nineties, the share of institutional investors in the Spanish financial system had multiplied by three, and had caught up with the Continental European Countries. This increase in the importance of institutional investment is explained by the entrance of foreign capital (Aguilera, 2004).

All these facts, that took place in the Spanish stock market during the sample period, provide us with an interest case that allows us to analyze how such events may have affected the behaviour of aggregate idiosyncratic volatility.

For this study we have used data from two dataset: Thomson DataStream and the Statistics Bulletins of the Spanish Central Bank. Data on stock prices, capitalization, trading volume, equity issues and book value are taken from the Thomson Datastream dataset. And monthly short-term Treasury Bills rates are taken from the Statistics Bulletins published by the Spanish Central Bank.

4.2. Idiosyncratic risk measure and preliminary results

Although models such as Merton (1987) have a precise definition of idiosyncratic risk, they do not offer a way to estimate it. This study follows Campbell *et al.* (2001) to

4 We follow previous empirical studies and only include the most liquid class of shares for a given stock. Neither do we include preferred stocks nor the stocks traded on the floor of the market. Although the number of firms is limited, we consider there is not any bias towards larger or surviving stocks.

5 The bulk of Spanish privatizations took place after the enactment of the Spanish Privatization Plan of 1996, with proceeds from privatization reaching their peak in 1997 and 1998.

decompose the return of a typical stock into a systematic and an idiosyncratic component without having to estimate co-variances or betas for individual stocks. After that, we estimate the time series of volatility measures of those two components for a typical firm.

Firms are indexed by j. r_{ij} represents the excess return over the risk-free rate of an individual firm j in period t and the excess return of the market in period t is given by $r_{mt}=\Sigma_j r_{jt}$.

Based on the market-adjusted return model, the excess return of a stock j is decomposed into a market-wide excess return and a firm specific residual:

$$r_{jt} = r_{mt} + \eta_{jt} \tag{9}$$

where η_{jt} is the difference between the individual stock return R_{jt} and the market return r_{mt}.

As Campbell *et al*. (2001) suggest, there is no need to estimate betas[6] and the volatility of a typical stock can be computed as:

$$\sum_j Var(r_{jt}) = Var(r_{mt}) + \sum_j Var(\eta_{jt}) = \sigma^2_{mt} + \sigma^2_{\eta t} \tag{10}$$

We use daily data to estimate the volatility components in equation (9). The sample volatility of the market return in month t is computed as:

$$\hat{\sigma}^2_{mt} = \sum_{s \in t} (r_{ms} - \mu_m)^2 \tag{11}$$

where μ_m is the daily mean of the market return r_{ms} over the sample period and s denotes the trading days in a particular month.

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6 In a CAPM framework a firm's excess return could be expressed as $r_{jt} = \beta_{jm} r_{mt} + \tilde{\eta}_{jt}$. As such, $\eta_{jt} = \tilde{\eta}_{jt} + (\beta_{jm} - 1) R_{mt}$ and $Var(r_{jt}) = \beta^2_{jm} Var(r_{mt}) + Var(\tilde{\eta}_{jt})$ where β_{jm} is the market beta for stock j and $\tilde{\eta}_{jt}$ is the firm specific residual. r_{mt} and $\tilde{\eta}_{jt}$ are orthogonal, by construction. The residual $\tilde{\eta}_{jt}$ equals η_{jt} only when beta is 1 or the market return is zero.

For the simplified version the variance of an individual stock is given by:

$$Var(r_{jt}) = Var(r_{mt}) + Var(\eta_{jt}) + 2Cov(r_{mt}, \eta_{jt}) = Var(r_{mt}) + Var(\eta_{jt}) + 2(\beta_{jm} - 1) Var(r_{mt})$$

This decomposition requires the estimation of stock betas but this is unproblematic given that we are concerned with average variances across stocks. Given that $\sum_j \beta_{jm} = 1$.

To obtain a measure of average firm-level volatility first we add the squares of the firm-specific residual in equation (9) for each firm j and each month t in the sample:

$$\hat{\sigma}_{\eta jt}^2 = \sum_{s \in t} \eta_{js}^2 \tag{12}$$

Next, we compute the weighted average of the firm-specific volatilities over the market:

$$\hat{\sigma}_{\eta t}^2 = \sum_{j} \hat{\sigma}_{\eta jt}^2 \tag{13}$$

Figure 1 shows systematic and idiosyncratic volatility components for the Spanish stock market over the period July 1987 to July 2007. Both series seem to move together but with a few differences. This might reflect that not all stocks influence the different volatility components in the same way. We also observe that the level of idiosyncratic volatility is larger than the market one. This might confirm that firm-specific volatility is the most important component of total volatility.

Figure 1

Table 1 reports the statistical properties of the volatility components series. In Panel A we present descriptive statistics for the volatility series. We observe that the idiosyncratic volatility component presents higher average and dispersion levels than does the market volatility component.

Panel B in Table 1 reports the autocorrelation coefficients for the two volatility measures considered. In both cases, volatility series show positive serial correlation, mainly in the short run. In Panel C we present the results of the augmented Dickey-Fuller unit root tests including a constant and a constant and a time trend. In both cases the hypothesis of a unit root is rejected at the 1% significance level, reflecting that deviations from the long run mean are temporary. Given these results, we analyze the volatility series in levels rather than using first differences.

Table 1

In order to assess the relative importance of each volatility component in total volatility, we perform mean and variance decomposition results. Results are reported in Panel D of Table 1 and illustrate that the idiosyncratic component represents the largest share of total volatility (81%). As for the variance of the volatility series, again the highest contribution is given by the variance of idiosyncratic risk (63%) instead of market risk (21%) while the covariance with market risk is only of 8%.

Finally, following Bali *et al*. (2005), the results might be sensitive to the slight extension of the sample period. However, following more recently published works, we do not include data after mid-2007 because this period of crisis could be conditioning the full results (eg., Boheme *et al*., 2009; and Guo and Savickas, 2010).

4.3. Asset pricing implications

This section is divided into three main areas. Firstly, we perform a test of commonality in idiosyncratic volatility. The goal of this test to provide a first step about both theoretical arguments presented in this text: whether idiosyncratic risk follows a pattern of individual behaviour or a pattern of common behaviour in the whole market. Hence, this test answers the question whether it should be considered as a firm characteristic or as a risk factor. Secondly, we report the statistical properties of ten portfolios sorted by idiosyncratic volatility. Finally, we present the cross-sectional analysis for some competitive asset pricing models.

4.3.1. Commonality in Idiosyncratic risk

The discussion presented in the theoretical section of this paper suggests that asset pricing and idiosyncratic volatility have not been properly addressed in previous empirical studies. For that reason, we do not know whether we should regress common stocks returns on their idiosyncratic volatility levels, as an individual characteristic, or whether we should regress them on a new risk factor reflecting aggregate market-wide restrictions based on common movements in the firm-specific risk of companies listed on the market.

To solve that question, and to analyze whether commonality exists in idiosyncratic risk in the Spanish stock market, we regress the monthly percentage change in the idiosyncratic risk for each company available in the sample, $\Delta\sigma_{\eta_{jt}}$, on a cross-sectional average of the same variable representing the market-wide relative idiosyncratic risk, $\Delta\sigma_{\eta_{mt}}$.

$$\Delta\sigma_{\eta_{jt}} = \alpha_j + \beta_j \Delta\sigma_{\eta_{mt}} + \varepsilon_{jt} \tag{14}$$

The cross-sectional average of the individual coefficients is reported in Table 2. The average sensitive of changes in the idiosyncratic risk relative to changes in the aggregate measure of idiosyncratic risk is a significant 40%. Moreover, most of the individual coefficients are positive and significantly different from zero (80% and 42% respectively). This indicates that individual firm-specific risk moves with the market-wide measure of this kind of risk.

Table 2

4.3.2. Portfolios returns

Previous to the cross-sectional analysis, we divide our sample into deciles according to the average idiosyncratic volatility value of each security in the previous year and we examine the characteristics of portfolio sorted by idiosyncratic volatility.

Table 3

In Table 3 we report mean and standard deviation statistics, firm-specific risk, average capitalization level, and the CAPM and Fama and French alphas for each portfolio being P1 the portfolio that includes the stocks with the highest idiosyncratic volatility within the sample and P10 is the portfolio that contains the stocks with the lowest idiosyncratic volatility.

Our findings point out that P1 is the portfolio with the highest idiosyncratic volatility level of the market, higher media return (undoubtedly superior to the rest of portfolios) and lower capitalization level. These preliminary results indicate the close relation between idiosyncratic volatility and size, previously documented by Brown and Ferreira (2004), Bali *et al.* (2005) for the US market and Angelidis and Tessaromatis (2008b) for the UK market.

We also examine the performance of idiosyncratic volatility-sorted portfolios with respect to the CAPM and Fama and French three-factor model. Unexpectedly, there isn't an obvious monotonical decrease relationship between alphas and idiosyncratic volatility. However, we observe that P1 is the portfolio with higher risk-adjusted mean return. Finally, the last row of the table provides the results of the parametric Wald test that confirms the significant differences between the alphas of the extreme portfolios.

4.3.3. Competing asset pricing models

As we expound in the theoretical section, we propose two alternative models to analyze the role of idiosyncratic risk in asset pricing. Firstly, we propose a model that incorporates individual idiosyncratic risk levels as a relevant characteristic of an asset that should be priced. Secondly, we propose another model that analyzes the role of market-wide idiosyncratic risk variations into the asset pricing process. We expect significant results for both competitive and alternative models. Finally, we propose a combination of these two idiosyncratic risk measures in a third and definitive model. We present a robustness check for these analyses at the end of the section.

When we introduce idiosyncratic risk in the CAPM context as a firm-specific characteristic, the resulting equation is as follows:

$$r_{pt} = \gamma_0 + \gamma_m \beta_{pt}^m + \kappa \sigma_{\eta_{pt}} + \mu_{pt} \tag{15}$$

where r_{pt} is the excess of return of portfolio *p* at month *t*, β_{pt}^m is the market beta coefficient for each *p* idiosyncratic volatility-sorted portfolio and $\sigma_{\eta_{pt}}$ is the average idiosyncratic risk of all the stocks that are included in portfolio *p* at month *t*. In a CAPM context, we expect a non-significant γ_2 coefficient.

In a second study we analyze the role of market-wide idiosyncratic risk variations in the asset pricing process. As we expound in the theoretical section, the model that we propose is as follows:

$$r_{pt} = \gamma_0 + \gamma_m \beta_{pt}^m + \gamma_{\sigma_{\eta t}} \beta_{pt}^{\sigma_{\eta t}} + u_{pt} \tag{16}$$

where $\beta_{pt}^{\sigma_{\eta t}}$ denotes a portfolio's sensibility to variations in market-wide idiosyncratic volatility.

We estimate the monthly factor loadings for ten idiosyncratic volatility-sorted portfolios using the past 35 months plus the current one. Given these explanatory variables, we performed the Fama and MacBeth (1973) regression. Moreover, the R^2 statistic and the adjusted R^2 of the cross-sectional regression are calculated as an intuitive measure which expresses the fraction of the cross-sectional variation of average excess returns captured by the model. Results are reported in Table 4.

Table 4

For all models considered, the idiosyncratic risk premium is significantly different from zero. This might indicate the relevance of idiosyncratic risk in the asset pricing process. However, the sign of the idiosyncratic risk premium is different depending on the alternative employed to introduce it in asset pricing models.

In the model in which we introduce idiosyncratic risk as a firm characteristic, as we show in the second row of Table 4, the gamma coefficient associated to idiosyncratic risk is significantly positive. This means that investors require an extra-premium to hold assets with high idiosyncratic risk levels in their portfolios. This might also indicate that investors require a positive risk premium because they are unable to avoid idiosyncratic risk through diversification or it requires a high cost.

On the other hand, for the model that incorporates the effect of an aggregate measure of idiosyncratic risk, third row in Table 4, we show that the risk premium associated with this state variable is significant and negative as we expected. However, the magnitude of this additional term is lower than the previous one. In consequence, as we observe in the fourth row, when we present the results for a model that incorporates both idiosyncratic risk effects, we obtain a net positive premium associated to idiosyncratic risk.

In relation to the systematic risk premium, in contrast to standard financial theory, we obtain a significant negative risk premium for all models considered. Although we did not expect it, these results do not differ from those previously obtained by Rubio (1988, 1991), Gallego, Gómez and Marhuenda (1992) and Nieto (2004) for the Spanish stock market which document a non-significant market premium and even a risk premium with a negative sign.

Overall, whether we focus on R^2 and adjusted-R^2 statistics, the last two ones are the best models regarding the relationship between idiosyncratic volatility and the cross-section of expected returns.

Before drawing some overall conclusions regarding the asset pricing role of systematic and idiosyncratic risks, it is instructive to conduct a robustness check. In particular, we report results using the Fama and French (1993) three-factor model as an alternative benchmark model. Finally, for the purpose of comparison, we report results obtained with portfolios sorted by industry employing both alternative benchmark asset pricing models.

Table 5

In Table 5 we present the results obtained when we employ the Fama and French (1993) three-factor model as a benchmark and incorporate the SMB and HML risk factors into our empirical analysis. We observe the same cluster of results as before taking into consideration all the models and both kinds of risk.

As stated above, we check whether our results are robust for different portfolio weighting schemes. To that end, we estimate the competing asset pricing models with portfolios sorted by industry.[7] The source behind the consideration of industries in the study of idiosyncratic risk is based on the point of view of Benett and Sias (2006), Gaspar and Massa (2006) and Irving and Pontiff (2009). They argue that the growing internationalization of financial markets provides a huge variety of different financial products for investors all over the word. Consequently, the portfolio selection process is going to be more complex and investors can hold assets from different industries independently of the market in which they are traded. For that reason, we expect a significant relation between industry concentration and diversification, and hence with idiosyncratic risk.

Results for portfolios sorted by industry are showed in Table 6. Again, we obtain the same conclusions as above. In the model in which we introduce idiosyncratic risk as a firm characteristic, the gamma coefficient associated to idiosyncratic risk is significantly positive. However, for the model that incorporates the effect of an aggregate measure of idiosyncratic risk, we show that the risk premium associated with this state variable is significant and negative or non-significant. The results are robust for the benchmark model employed for estimates. On the other hand, the systematic risk premium presents a negative risk premium. Although the results contradict financial theory, they are consistent with previous empirical evidence of Spanish data.

Table 6

The conclusion that emerges from the tests of this section is that idiosyncratic risk is relevant in the explanation of the cross-section of asset prices, while systematic risk is

[7] Following Datastream base, we construct ten portfolios that represent ten different industries: Basic Materials, Consumer Goods, Consumer Services, Financials, Health Care, Industrials, Oil and Gas, Technology, Telecommunications and Utilities.

less relevant and presents conflicting results in relation to financial theory.

5. Conclusions

The idiosyncratic risk puzzle has been largely documented for the US market and nowadays empirical evidence has been extended to an international setting. However, this is the first in-depth study of the pricing of idiosyncratic risk in the Spanish stock market. Furthermore, all the previous empirical evidence presents mixed results depending on the market, sample period or methodology employed in the analysis.

Our work contributes to provide a unified and coherent answer for the main question still unsolved about idiosyncratic risk: whether or not there is a premium associated to this kind of risk and the sign of it.

To that end, we propose an empirical analysis based on the theoretical model of incomplete information developed by Merton (1987). In line with him, we believe that, in addition to the systematic risk premium, there is a disinformation risk premium that not only depends on the relationship between the cost of incomplete information of the firms but also on the whole disinformation cost in the market. However, as is known, the measure of disinformation depends on different variables. In this sense we follow one strand of the literature that test Merton's model controlling for size and shareholders base and then analyze the relationship with idiosyncratic risk.

Overall, our results show a positive relation between returns and individual idiosyncratic risk levels and a negative but lower relation with the aggregate measure of idiosyncratic risk, obtaining a net positive premium associated to this kind of risk. These results are robust for different portfolio weighted schemes and benchmark models.

These findings have important implications for portfolio and risk management and highlight the need for additional research in two alternative lines of investigation. Firstly, to provide an alternative measure of systematic risk that captures the positive and significant relation in accordance with financial theory. Secondly, to further analyze the relationship between the level of international diversification and idiosyncratic risk and its role in the asset pricing process.

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Table 1: Statistical properties of risk series

	Systematic risk	Idiosyncratic risk
Panel A. Descriptive statistics[a]		
Mean	0.1438	0.6471
Median	0.0787	0.5326
Maximum	2.5416	2.9519
Minimum	0.0042	0.1070
Standard Deviation	0.2538	0.4459
Panel B. Autocorrelations structure		
ρ_1	0.481	0.357
ρ_2	0.343	0.207
ρ_4	0.118	0.197
ρ_{12}	0.100	0.134
Panel C. Unit root test		
Constant		
t-statistic	-9.0972	-10.5875
Critical value at 1%	-3.4576	-3.4576
Constant and trend		
t-statistic	-9.9780	-10.5639
Critical value at 1%	-3.9969	-3.9969
Panel D. Mean and variance decomposition		
Mean	0.1818	0.8182
Variance		
FIRM	0.0814	0.6323
MKT	0.2048	

Panel A reports descriptive statistics (mean, median, maximum, minimum and standard deviation) of monthly systematic and idiosyncratic risk measures constructed from daily data. Panel B reports the autocorrelation structure of monthly volatility measures constructed from daily data where ρ_i denotes the *i*th monthly autocorrelation. Panel C reports unit root t-statistics for volatility series considered. This test is based on regressions that include a constant or a constant and time trend. In the last row we present the 1 percent critical value for the t-test in each case. Finally, Panel D reports mean and variance decomposition of monthly volatility measures constructed from daily data. Given that $\sigma_{jt}^2 = \sigma_{mt}^2 + \sigma_{\eta t}^2$, the decomposition of the mean of volatility is such that:

$$E(\sigma_{mt}^2)/E(\sigma_{jt}^2) + E(\sigma_{\eta t}^2)/E(\sigma_{jt}^2) = 1$$

For the variance of total volatility, the decomposition is such that:

$$Var(\sigma_{mt}^2)/Var(\sigma_{jt}^2) + Var(\sigma_{\eta t}^2)/Var(\sigma_{jt}^2) + 2Cov(\sigma_{mt}^2, \sigma_{\eta t}^2)/Var(\sigma_{jt}^2) = 1$$

[a] Result multiplied by 10^2

Table 2: Commonality in idiosyncratic risk

	Average alpha	Average beta	Average R^2	Average Adj.R^2
Coefficient (average t statistic)	42.002	40.861* (1.875)	3.537	1.798
% Positive		84.26%		
% + and significant		41.64%		

This table reports the results of the regression $\Delta\sigma_{\eta\, jt} = \alpha_j + \beta_j \Delta\sigma_{\eta\, mt} + \varepsilon_{jt}$ where $\Delta\sigma_{\eta\, jt}$ is the percentage change from month *t*-1 to *t* in the idiosyncratic risk of firm *j*, and $\Delta\sigma_{\eta\, mt}$ is the concurrent change in a cross-sectional average of the same variable or the market-wide idiosyncratic risk.

Note: * denote 10% significance level.

Table 3: Descriptive statistics of portfolios sorted by idiosyncratic risk

	Mean[a]	Std. dev.	Firm volatility[a]	Size[b]	CAPM alpha (*t*-stat)	FF3 alpha (*t*-stat)
P1-high	1.065	0.071	1.82	6.55	6.96*** (3.33)	4.92*** (2.76)
P2	0.333	0.078	1.71	33.52	2.33*** (2.48)	1.29* (1.72)
P3	0.470	0.079	1.57	85.00	1.71*** (2.11)	0.88*** (1.23)
P4	0.066	0.082	1.17	130.73	2.39*** (2.82)	1.52*** (2.08)
P5	0.076	0.066	1.04	259.66	2.80*** (3.20)	2.43*** (3.03)
P6	0.619	0.062	0.92	443.41	1.83*** (2.64)	1.49*** (2.29)
P7	0.572	0.060	0.70	803.39	2.13*** (3.24)	1.80*** (3.12)
P8	0.413	0.063	0.70	1278.94	2.01*** (3.69)	1.77*** (3.33)
P9	0.334	0.063	0.64	2508.38	1.86*** (3.28)	1.74*** (3.27)
P10-low	0.504	0.059	0.57	13044.07	2.46*** (2.86)	2.18*** (2.58)
Wald Test. Null hypothesis: $H_0 : \{\alpha_1 = \alpha_{10}\}$ Chi square (*p*-value)					6.4255*** (0.011)	4.0748** (0.044)

We divide our sample into deciles according to the average idiosyncratic volatility value of each security in the previous year. P1 includes the stocks with the highest idiosyncratic volatility within the sample and P10 contains the stocks with the lowest idiosyncratic volatility. This table reports mean and standard deviation statistics, average firm-specific risk, average capitalization level, and the CAPM and Fama and French alphas for each portfolio. Last row contains the Chi-squared and p-value results of a Wald test to analyze the significant differences between extreme portfolio alphas.

[a] Result multiplied by 10^2.

[b] Average capitalization in millions of euros.

Note: ***, ** and * denote 1%, 5%, and 10% significance level respectively.

Table 4: Cross-sectional analysis of competing asset pricing with the standard CAPM as the benchmark model

γ_0	γ_m	κ	$\gamma_{\sigma_{\eta t}}$	R^2	$Adj.R^2$
0.0312*** (6.38)	-0.0581*** (-5.57)			53.30	47.46
0.0259*** (5.11)	-0.0571*** (-5.04)	0.4633* (1.87)		58.94	47.21
0.0340*** (7.32)	-0.0661*** (-6.44)		-0.0041** (-2.51)	72.07	64.10
0.0292*** (5.91)	-0.0689*** (-6.27)	0.5123** (2.15)	-0.0046*** (-2.59)	77.41	66.12

This table contains the time series averages of the monthly coefficients in cross-sectional asset pricing tests using Fama-MacBeth methodology. In each row we present the results for one of the four models considered, the standard CAPM as a benchmark model, a model that incorporate individual idiosyncratic risk levels effect, a model that incorporate market-wide idiosyncratic risk effect, and a model that incorporate both effects:

$$r_{pt} = \gamma_0 + \gamma_m \, \beta_{pt}^{m} + \kappa \, \sigma_{\eta_{pt}} + \mu_{pt}$$

$$r_{pt} = \gamma_0 + \gamma_m \, \beta_{pt}^{m} + \gamma_{\sigma_{\eta t}} \, \beta_{pt}^{\sigma_{\eta t}} + u_{pt}$$

The explanatory variables are the betas of the different factors or firm characteristics estimated with the 35 previous monthly returns to each cross-sectional estimation and the corresponding month itself for a total of 36 observations in each regression. And each_gamma coefficient represents the risk premium associated with each beta. In total, the results are based on 204 monthly observations. In parentheses we report the Fama-MacBeth *t*-statistic. Note: ***, ** and * denote 1%, 5% and 10% significance level respectively.

Table 5: Cross-sectional analysis of competing asset pricing models with the Fama and French model as the benchmark model

γ_0	γ_m	γ_{smb}	γ_{hml}	κ	$\gamma_{\sigma_{\eta t}}$	R^2	$Adj.R^2$
0.0279*** (5.16)	-0.0368** (-2.21)	0.0217 (0.91)	0.0133 (0.88)			77.38	66.07
0.0220*** (3.94)	-0.0349** (-2.03)	0.0014 (0.06)	0.0149 (0.97)	0.7791*** (2.79)		81.46	66.62
0.0355*** (7.58)	-0.0739*** (-4.92)	0.0486** (2.33)	-0.0066 (-0.47)		-0.0032** (-2.16)	85.02	73.04
0.0304*** (6.04)	-0.0680*** (-4.44)	0.0198 (0.94)	-0.0047 (-0.33)	0.6883*** (2.64)	-0.0031** (-1.96)	88.42	73.95

This table contains the time series averages of the monthly coefficients in cross-sectional asset pricing tests using Fama-MacBeth methodology. In each row we present the results for one of the four models considered, the Fama and French three-factor model as a benchmark model, a model that incorporate individual idiosyncratic risk levels effect, a model that incorporate market-wide idiosyncratic risk effect, and a model that incorporate both effects:

$$r_{pt} = \gamma_0 + \gamma_m \beta_{pt}^{m} + \gamma_{smb} \beta_{pt}^{smb} + \gamma_{hml} \beta_{pt}^{hml} + \kappa \sigma_{\eta_{pt}} + u_{pt}$$

$$r_{pt} = \gamma_0 + \gamma_m \beta_{pt}^{m} + \gamma_{smb} \beta_{pt}^{smb} + \gamma_{hml} \beta_{pt}^{hml} + \gamma_{\sigma_{\eta t}} \beta_{pt}^{\sigma_{\eta t}} + u_{pt}$$

The explanatory variables are the betas of the different factors estimated with the 35 previous monthly returns to each cross-sectional estimation and the corresponding month itself for a total of 36 observations in each regression. And each_gamma coefficient represents the risk premium associated with each beta. In total, the results are based on 204 monthly observations. In parentheses we report the Fama-MacBeth *t*-statistic. Note: ***, ** and * denote 1%, 5% and 10% significance level respectively.

Table 6: Cross-sectional analysis of competing asset pricing models with portfolios sorted by industry

γ_0	γ_m	γ_{smb}	γ_{hml}	κ	$\gamma_{\sigma_{\eta t}}$	R^2	$Adj.R^2$
Panel A: with the standard CAPM as a benchmark							
0.0241^{***} (9.51)	-0.0458^{***} (-7.37)					40.68	33.26
0.0106^{***} (3.23)	-0.0446^{***} (-7.32)			2.2296^{***} (4.00)		51.08	37.10
0.0196^{***} (8.98)	-0.0299^{***} (-4.10)				-0.0037^{**} (-2.13)	65.09	55.12
0.0118^{***} (4.32)	-0.0315^{***} (-4.50)			1.5164^{***} (3.60)	0.0024 (1.49)	72.27	58.40
Panel B: with the Fama and French model as a benchmark							
0.0154^{***} (4.37)	-0.0415^{**} (-3.24)	-0.0026 (-0.07)	0.0382^{**} (2.03)			76.63	64.95
0.0096^{**} (2.39)	-0.0417^{***} (-3.49)	-0.0055 (-0.16)	0.0405^{**} (2.47)	1.1459^{**} (2.45)		82.40	68.33
0.0173^{***} (5.21)	-0.0435^{**} (-3.82)	0.0083 (0.21)	-0.0013 (-0.09)		-0.0036^{**} (-2.09)	84.93	72.87
0.0122^{***} (3.02)	-0.0448^{***} (-3.83)	-0.0007 (-0.02)	0.0010 (0.06)	0.8509^{**} (2.19)	0.0022 (1.24)	89.19	75.67

This table contains the time series averages of the monthly coefficients in cross-sectional asset pricing tests using Fama-MacBeth methodology. In each row of each Panel we present the results for one of the four models considered, the standard CAPM or the Fama and French three-factor model as a benchmark model, a model that incorporate individual idiosyncratic risk levels effect, a model that incorporate market-wide idiosyncratic risk effect, and a model that incorporate both effects. The explanatory variables are the betas of the different factors estimated with the 35 previous monthly returns to each cross-sectional estimation and the corresponding month itself for a total of 36 observations in each regression. And each_gamma coefficient represents the risk premium associated with each beta. In total, the results are based on 204 monthly observations. In parentheses we report the Fama-MacBeth *t*-statistic. Note: ***, ** and * denote 1%, 5% and 10% significance level respectively.

Figure 1. Systematic and idiosyncratic risk components series

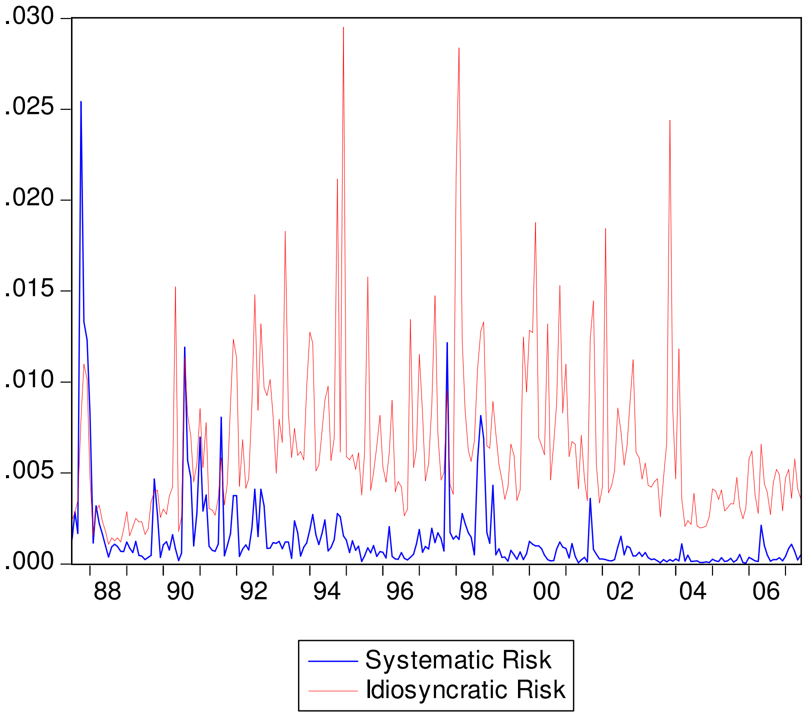

Figure 1 shows systematic and idiosyncratic risk components series for the Spanish stock market over the period 1987-2007.