Analysis of motives and trends in Stock Splits in the Spanish Stock Market.
Do Stock Splits Improve Liquidity?

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Abstract: Stock splits represent corporate cosmetic events which should theoretically not alter the fundamentals of a company. However, extensive literature analyses the effects of stock splits on publicly traded companies' capitalization, liquidity and ownership structure.

Applying the methodology used by academic experts studying the NYSE and NASDAQ stock exchange markets, we analyze a sample of Spanish companies which undertook a split between 2001 and 2018. Our aim is to examine the effects that stock split events generate on the liquidity of publicly traded Spanish companies and compare the results with previous literature.

Using as a proxy of liquidity the percentage bid-ask spread, our findings suggest that stock splits damage the liquidity of the security traded.

Keywords: Stock splits, Liquidity, Bid-Ask, Corporate governance

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1. Introduction

Stock splits are a company's decision to increase the amount of shares outstanding by a specific ratio, while stock prices are decreased proportionally leaving investor's capital unaffected. For example, take company X with a price of 150€ per share, with a total number of shares outstanding equal to 1.500.000 and making a total market value of 225.000.000€. Suddenly, the company wants to increase the number of shares by a ratio 2:1, meaning that two shares will be given for every single share each shareholder is currently holding, with a value of 75€ per share now, making a total market value of 3.000.000 times 75€ equal to 225.000.000€, the same exact amount as before.

We will attempt to find the rationale behind this event by replicating the paper "*The Effect of Stock Splits on Bid-Ask Spreads"* developed by Robert M. Conroy, Robert S. Harris and Bruce A. Benet (1990). Doing so we will analyze which is the effect of stock splits on the liquidity of the Spanish stock market, taking as the main variables the bid-ask spread for the companies analyzed - which is a representation of the liquidity cost to the investors - and the volume traded.

The structure of the dissertation will be the following: first we will extensively present different theories that emerged since the 70s and proposed an explanation on the motivations of stock splits. Then we will focus on the Spanish stock market by summarizing both the main findings and the legal framework needed to understand stock split's features. Finally, we will explain the methodology followed to perform the statistical analysis and compare our conclusions with that of the replicated paper.

2. Literary review

Fama et al. (1969) carried out the first study on stock splits, when assessing the overall efficiency of the stock market, claiming that splits had an informational role to which the market reacted. Since then, there have been numerous attempts to identify the motives behind stock splits of public companies and their effects on liquidity together with the variables that should be used to assess it.

2.1. Signalling Hypothesis

Signalling hypothesis has been an explanation for stock splits since the 1980's. As it has been stated before, stock splits are merely cosmetic changes with no effect on the company's cash flow, being this a weighted motive to categorize stock splits like a useless tool as each shareholder is retaining his previous ownership proportionately.

Thus, the only motivation why firms pursue stock splits is to signal the firm's favorable future prospects, as long as there is asymmetric information between investors and managers, because of the costs implied in a stock split, i.e. printing, administrative, legal and transaction costs. Hence, this hypothesis is grounded on the assumption that stock splits are not costless and there are information asymmetries between stakeholders and the managerial team of the company.

If this cost is also transferred to investors, in the form of increased liquidity costs, the signaling hypothesis may be validated. In fact, Copeland (1979) argued that stock splits generally resulted in higher commissions for round-lot transactions in the long run. Choi and Strong (1983) proved that after-split shares were trading at a premium around 1% over its equivalence pre-splitted shares. Edmister and Subramanian (1982) found that share price was still an inflexion point for brokerage commissions, after the era of fixed commissions. Their research highlighted the importance of the stock prices for transactions costs asynchronously.

Brennan and Copeland (1988) developed a model in which stock splits were able to signal managerial information about the prospects of the firm because of the influence of the different stock prices on the trading costs (transaction costs). Thanks to their model, management teams are able to communicate its private information about the firm's prospects to investors through stock splits announcements, as the cost of trading depends on the price of the stock. Thus, the firm's announcement of the new shares proportion acts as a costly signal of the value of the company.

Taking for granted the fact that stock prices are the main determinant of trading costs, the best policy to apply by firms would be to keep adjusting the amount of shares outstanding so the stock price is at the cost-minimizing level, therefore at its efficient point. As this policy would be independent of any private information that the management team may have about the future path of the stock price (expectations), it would not signal any private information.

However, stock splits and consolidations, as it has been stated before, are not free due to printing, legal and administrative expenses. Hence, these costs are a direct argument against the “permanent adjustment of outstanding shares” policy, raising the possibility that a split might reveal private information, since the new amount of shares chosen by management will remain for a discrete period of time.

2.2. Optimal Trading Range Hypothesis

Another of the most widely accepted theories is the optimal trading range hypothesis, proposed by Copeland (1979). The rationale behind it is that managers aim to keep share prices between an optimal range such that individual investors have access to them, expanding therefore the ownership base. This in turn should make the stock more liquid, and

ease its trade. For this reason, the trading range hypothesis is often cited as the liquidity hypothesis.

A proper pricing of a stock should allow investors to diversify their capital among a wide number of securities. However, other authors also contended that *"this optimal range is considered to be a compromise between the desires of wealthy investors and institutions who will minimize brokerage costs if securities are high-priced, and the desires of small investors" (Copeland, 1979)*. Higher operational costs for institutional investors that buy splitted stocks are the result of the fixed per-share transaction cost component (Lakonishok and Lev, 1987). A survey made by Baker and Gallagher (1980) confirmed that managers believe in the use of splits as a tool to bring the stock price to the desired range.

Studies intending to rubber-stamp the prophesied increases in liquidity following stock splits have revealed mixed results, with some authors pointing out that liquidity decreases because of increasing bid-ask spreads (Conroy et al, 1990) and others suggesting that liquidity is favoured thanks to increased investor base (Schultz et al, 2000). The variables utilized to measure liquidity seem to be the main determinant of the results, because they lead to opposite conclusions. There is even a third group of scholars (Goyenko et al, 2006) reporting that liquidity is worsened over a short horizon but experiences gains over longer time horizons.

2.3. Tax-option hypothesis

This theory was developed by Lamoreux and Poon (1987) in the paper titled *The Market Reaction to Stock Splits*. Its argument relies on the fact that a stock split provides a "tax option" to the investors, regarding that *ceteris paribus*, the investor has more possible tax alternatives the more volatile the stock price is. The founding stone of this theory is that the stock split sets off a chain of events where the volume traded increases, thus increasing the noise introduced in the market and the amount of diversifiable risk that investors face.

The research, based on the US markets, argues that securities volatility is desirable given the nature of their tax code, where there is preferential treatment to long-term capital gains; thus the investors are willing to pay for a "tax-option" component of the security.

Through the lens of the Capital Asset Pricing Model and the Arbitrage Pricing Theory, diversifiable risk of a given security becomes desirable for investors, creating an inverse relationship between securities' pure diversifiable risk and the equilibrium rates of return. The consequence of this finding is that if this risk was subject to firm's management, they would aim to optimize shareholder's wealth by pursuing policies that increase the amount of diversifiable risk. So, a stock split is what provides a mechanism to increase the "tax option" value of the stock and effectively alter the stock's clientele, as institutional investors find the new stocks less desirable as they must renounce expected returns in exchange for a "tax option" virtually worthless for them.

The results of the research supported their initial theory, as the authors found that splits follow the previously mentioned patterns (increased volatility, lower institutional ownership, increased the number of shareholders). Furthermore, following the split, they observed an increase in the number of transactions per day and a drop in the dollar-value of shares traded, which drove a permanent reduction in the liquidity of the stock. However, it is precisely the "tax option" what mitigates the adverse effect on liquidity.

2.4. Managerial entrenchment hypothesis.

According to this theory, managers concerned with a takeover threat have an incentive to broaden the number of shareholders (Lakonishok and Lev, 1987), reducing the proportion of equity owned by institutional investors in favor of individual ones. The rationale is that institutional investors are more focused on short-term portfolio performance and will be prone to respond to takeover bids quicker. Contrarily, an individual investor may not even be aware of the bid and respond less promptly, lowering the chances of a hostile takeover.

This theory predicts that lowering the stock price, changes in the ownership structure are expected, which will lead to a more heterogeneous shareholder base. Managers of publicly listed companies, therefore benefit through a stock split which decreases the number of institutional shareholders and its stake in the company's ownership since they are less vulnerable to hostile takeovers that commonly trigger a replacement of the current C-suite of the firm. In the framework of this Hypothesis, favouring individual investors which singulary held a minority of the company equity act as an hostile-takeover defense for the company.

The following table provides a resume of the predicted effect that a Stock Split has on returns, liquidity and the ownership structure of a firm:

Summary Table I
Predicted effects on each variable according to the main hypothesis presetend

	Signaling Hypothesis	Optimal Trading Range Hypothesis	Tax-Option Hypothesis	Managerial Entrenchment Hypothesis
Effect of stock splits on the stock variables				
Returns for Investors	Increase	NA*	Increase	NA*
Liquidity Costs	Increase	Mixed	Increase	NA*
Volume of shares traded	Increase	Increase	Increase	NA*
Effect of stock splits on the ownership structure of the firm				
Number of Individual investors	Increase	Increase	Increase	Increase
Number of Instituional investors	Increase	Decrease	Decrease	Decrease
Proportion of Equity Hold by institutions	No Effect	Decrease	Decrease	Decrease

**That theory does not present relevant results for that variable*

Summary Table I: Predicted effects on each variable according to the hypothesis presented

3. Stock splits in the Spanish Stock Market

After analyzing the academic literature and the studies which have been carried out throughout the years, It is relevant to briefly relate to more recent papers which focused on the Spanish stock market to have a better understanding of it and build-up on the conclusions that are nowadays available in the literature.

3.1. Previous studies carried out on stock splits in Spain

In the case of the paper developed by Gómez Ansón, et al. *"Stock splits: motivations and valuation effects in the Spanish market"*, the authors aim to provide a different insight into the relative explanatory power of the existing theories about the motivations and market valuation of stock splits in the Spanish market.

Their findings support the liquidity hypothesis as the main determinant for stock splits. It is shown how stock prices for splitting firms are significantly higher than their industry peers' prices, before the stock split announcement. Furthermore, it is also proved that the greater the difference between splitting and non-splitting firms prices, the greater is the splitting ratio. Also, significant increases in the number of separated transactions accompanied by a reduction in the trading volume per transaction have been noticed after the split event.

All in all, their findings aim to support the reasons why stock splits occur and the positive market reaction around this event (and its announcement) is a higher share price than the normal trading range, as a mark-up for their peers in the industry. The common path after the split is that the lower price attracts small investors and there is a corresponding increase in the number of transactions whilst a decrease in the volume per transaction dealt. Eventually, the adjustment of the share price to the normal trading range is perceived positively by the investors in the Spanish market.

Farinós, et al. on their paper *"¿Tienen las empresas que realizan un split rendimientos anormales a largo plazo? Un estudio para la bolsa española"* investigate whether the companies of the SIBE (Sistema de Interconexión Bursátil Español) that carried out a stock split in the period between January 1, 1996 and December 31, 2001 exhibitted abnormal long-term returns after this event. There is a lot of literature about positive short-term returns from the announcement and execution dates of the split (with effects on returns, liquidity, volatility, and capital composition around the execution date), yet not for the long-term. More specifically, their research is carried out using 3 study methods: the compound returns method, the accumulated abnormal returns method, and the announcement date portfolios method.

The compound returns method developed in the study provides significant negative abnormal returns during the first year, although when weighting the returns by their market value, no significant returns are observed for any of the time horizons considered, these being 12, 24 and 36 months windows. Next, the accumulated abnormal returns method provides results consistent with those obtained with the previous method. Finally, the method of the announcement date portfolio, in the two proposed variables, shows the non-significance of the returns obtained after the execution of the Split.

The conclusions drawn by these researchers show the absence of significant abnormal returns, as other researchers have proven for the Swiss and US stock exchanges, showing that investors do not systematically overreact or underreact to the event of a Split stock.

3.2. Spanish legal framework

A stock split requires the modification of the Company's Bylaws, that is, the document that contains all the rules that govern the internal functioning of a company, from the rights and obligations of the shareholders to the functions of the Board of Administration.

Said modification is the sole and exclusive competence of the General Shareholders' Meeting, as specified in Artículo 285. Competencia orgánica del Real Decreto Legislativo 1/2010, de 2 de julio, which approves the “Ley de Sociedades de Capital ”, for which they must be made aware of any possible modification of the Company Bylaws in advance.

The stock split proposal may originate either from the company's Board of Directors, or from its own partners. These must draft in a full text the amendment of the Company Bylaws that they propose - in the case of being Public Limited Companies, the letter must be accompanied by the justification of the proposal - to submit the proposal to the General Shareholders' Meeting, as specified above.

In the case of share splits, it is common practice to announce the proportion of the splits, as well as the corresponding change in the unit nominal value of each security. Current shareholders will automatically exchange the shares of which they are holders for the corresponding total, leaving their proportion of the company's capital stock intact. As regards to Public Limited Companies, the most widely read justification regarding this split is that by reducing the unit nominal value of each share and increasing the number of outstanding shares, the aim is to facilitate liquidity and trading of shares of the Company, hoping that it will have a favorable effect on its price and benefit the shareholders, without affecting the structure of the Company's own resources.

Nevertheless, this is not the only motivation: this action aims to reduce price variations in certain trading sessions, which would benefit shareholders and investors. Besides, this adjustment can facilitate access for small investors who may a priori rule out buying certain shares due to their high trading price.

Therefore, the proposed modification of the Company Bylaws for the General Shareholders' Meeting regarding the company's capital stock will be to adapt the new capital structure with respect to the number and nominal value of the shares into which the capital

stock will be divided, keeping its full value intact. In accordance with Artículo 287. Convocatoria de la junta general del Real Decreto Legislativo 1/2010, de 2 de julio, the announcement of the call must state all the extremes to be modified and to state the right of the partners to examine the full text of the proposed modification.

Finally, it will be at the General Shareholders' Meeting itself where the proposed modification of the share split will be approved, or not, which being a modification of the Company Bylaws, it will be adopted in accordance with the provisions of Article 199 in the case of Companies of Limited Liability, of the provisions of Article 194 in the case of Public Limited Companies or of the provisions of Article 201 in the case of Limited Partnerships by Shares, all belonging to the Real Decreto Legislativo 1/2010, de 2 de julio.

The modification agreement, once approved, must be recorded in a public deed that will be registered in the Mercantile Registry, and once registered in this, it will be recorded in the CNMV' registers, making official the new capital structure of the company, with the new shares issued and at the new stipulated price.

4. Methodology

As mentioned in the introduction, our study is based on the paper "The Effect of Stock Splits on Bid-Ask Spreads", from Robert M. Conroy, Robert S. Harris and Bruce A. Benet, published in 1990. Consequently, our methodology is similar to that of the original paper, but focused on the Spanish equity market.

We use two samples: the first consisting of all the firms that have performed at least one stock split from 2001 to 2018 in the Spanish market according to the Eikon database. The total observations are 67, however, after a validating and cleaning process, we have ended up with 29 observations. We have discarded all firms that performed more than one split and all those which had incomplete financial information (daily prices, volume, turnover

and Bid-Ask spreads). Additionally, we limit our dataset to splits of at least 1:2. Finally, for the construction of the dataset, we have avoided adjusting daily prices to the outstanding number of shares of the last split of every company, and thus, a drop in prices can be observed after splits.

The second sample is the control group. A reference portfolio of 29 firms has been selected randomly from Madrid SE General Index, which we use to compare the effects on Bid-Ask spreads with the splitting firms. This control group has been selected using Conroy et al. methodology, according to which, it is necessary to assume that the characteristics of the firms that execute a split are not inherently different than the other firms trading in the market. For example, if the splitting firms operate in a specific industry or if Brendan-Copeland assumption is correct and all the firms that execute a split signal positive future earnings, a random sample would not be adequate, therefore invalidating Conroy analysis. To execute the required comparisons, the announcement dates of the splitting firms have been allocated randomly to the firms of the reference portfolio. This announcement date is the day in which the stock split was approved by the board, and has been found using data from CNMV and reputable economic Spanish newspapers. In case public news of this split took place before its approval, this date has prevailed.

To analyse the liquidity of the market, the measure of Bid-Ask spread has prevailed over volume traded, although volume will also be analysed. This is because according to the paper of reference, “spread is a direct measure of the cost of liquidity when liquidity is defined as the ease or rapidity with which a financial instrument can be exchanged for currency”. The treatment of the data is the following: daily data of a 2-month window before the date of announcement of the split and a 2 month window after the ex-date will be taken into account for the analysis. This is to prevent errors from dual trading that could bias the Bid-Ask spread. All the measures used (price, spread, volatility and volume) will be calculated using all the data available from these time spawns.

Two tests are performed: We first do a t-test, adopting the methodology of a prevalence study. This study means that we use data from variables that have one common feature, but differ in the rest of them. The aim of this first test is to determine whether the cross-sectional mean of the variables was different between the splitting and the non splitting firms.

Next, a more ambitious test is conducted: For each stock, we compute the mean spread in the two months before the announcement date and in the two months after the ex-date. If the spread was unaffected by a stock split, we would expect to find the same frequency of increases in the spread for splitting and non-splitting companies. This will be our null hypothesis. To prove this, the difference between both spreads is taken from every stock and we run a chi-squared test. In the event that our null hypothesis was false and stock splits increased liquidity having lower Bid-Ask spreads, the results of the test should show a higher quantity of spread decreases for splitting firms than for non-splitting ones.

To conclude the statistical analysis, we are performing a regression to study the trends of liquidity with respect to the stock trading characteristics (price, volume and volatility), as well as analyzing if the fact that a firm performs a split actually increases the bid-ask percentage spread in our sample.

5. Results

5.1.1. T-test: expectations

We study the behavior of the following variables: Average Daily Closing Price, Volume Traded in Shares, Absolute Spread and Percentage Spread (Absolute Spread divided by Average Daily Closing price). We are performing an unpaired two-tailed test, assuming normal distribution and similar variances for all populations and samples.

The test is unpaired since we compare two separate groups, splitting firms and non splitting firms, over the different variables. This comparison is done twice: before the announcement of the split, and after the split. Our null hypothesis is that there is no statistical significant difference between the two samples.

Following the results of the paper, we expect to find a lower mean of Price for splitting firms after the split has been conducted compared to the mean in the pre-announcement period. Accordingly, we look for the volume of shares traded to increase. In the paper of reference these results are obtained while keeping a stable volume turnover, which due to missing data it could not be calculated. Finally, while we strongly believe that absolute spreads will decrease for the splitting group, it will be capital to understand the effects on liquidity to compare the percentage spread of the control and the splitting group before and after the split.

5.1.2. T-Test: Results

In the table below, the cells display the means of the different variables (Price, Volume, Absolute Spread and Percentage Spread) calculated for the individual securities of splitting and non-splitting firms calculated two months before announcement date and two months after the execution date. The t-value compares the means of the splitting with non-splitting firms and is calculated as $(\mu_1 - \mu_2) / SE_1$, which is the formula for a t-value with a null hypothesis that compares whether means are equal, where: μ_1 refers to the mean of the analyzed variable for the sample of splitting firms, μ_2 is the mean of the analyzed variable for the sample of non splitting firms and SE1 and SE1 are respectively the square root of the sum of the Standard deviation of splitting firms divided by its number of observations plus the Standard deviation of non splitting firms divided by its number of observations.

Table I:
Price, Trading Volume in Shares, and Bid-Ask Spreads for Splitting and Nonsplitting stocks

	Pre-Announcement			Post-Split		
	Split	Nonsplit	t-Value	Split	Nonsplit	t-Value
Price (Average Daily Closing)	52,08 €	14,48 €	**3,32**	12,58 €	15,02 €	**-0,64**
Standard deviation	58,88	15,58		12,15	16,62	
Observations	*29*	*29*		*29*	*29*	
Volume (shares)	1473606	3502635	**-1,03**	4830333	3640589	**0,34**
Standard deviation	3816906	6888616		12114430	7315977	
Observations	*16*	*16*		*16*	*16*	
Absolute spread	0,4349	0,0866	**2,43**	0,0706	0,0900	**-0,52**
Standard deviation	0,7484	0,1856		0,1010	0,1718	
Observations	*29*	*29*		*29*	*29*	
Percentage spread (# Of Average Closing price)	0,0091	0,0062	**0,70**	0,0091	0,0086	**0,11**
Standard deviation	0,0202	0,00962044		0,0146	0,0169	
Observations	*29*	*29*		*29*	*29*	

Table I: Price, Volume in Shares, and Bid-Ask Spreads for Splitting & Non-Splitting stocks.

Table I allows us to compare the splitting and control group before and after the split. Noticeably, prior to the split, splitting stocks trade at a higher price compared to non-splitting stocks (52,08€ vs. 14,48€). The difference in means is significant at all standard significance levels (critical value for a 1% significance level equals 2,47; two-tailed test with 28 degrees of freedom). This evidence is in accordance with the normal trading range hypothesis as well as our reference paper.

We can state that prior to the split, splitting firms tend to exhibit a higher absolute spread when compared to the control group. This result is significant at a 5% significance level. However, as explained in the methodology, the preferred proxy for liquidity is the percentage spread and we are not able to find any significant difference from splitting and non-splitting firms. With regard to the average volume of shares traded, we observe that splitting firms tend to have a lower volume (due to the higher price of each share) prior to the split. After the execution date, the volume of shares traded for splitting firms increased from 1.473.606 to 4.803.333. The average number of shares traded within the control group changes only slightly from 3.502.635 to 3.640.589 shares traded on average in the analysis' timespan. Despite this qualitative analysis, there is no evidence of a statistically significant difference in Volume of shares traded between the splitting and control group. To be able to

reject the null hypothesis at the 5% significance level, for the sample of 16 firms for which we have complete data on Volume in shares, we would need a critical value of 1.92. We registered a t-value equal to 1,03 which does not allow us to reject the null hypothesis.

Overall, the theory which best backs-up our result is the optimal trading range and our t-Test results only partially resemble the analysis on the NASDAQ and NYSE listed stocks analyzed in the reference paper.

5.2.1. Chi-squared test: expectations

There are three types of chi-squared tests commonly used: Goodness of Fit, which describes how well a sample fits a given distribution; Homogeneity tests, that examines whether two variables that come from separate samples have the same distribution and the Independence test. This last test checks if the two variables analysed are related or independent, but it has a prerequisite: the two variables observed must come from the same population (stocks traded in Spain between 2001 and 2020).

To ensure that the results of the test are reliable, we shall work with categorical variables (whether the absolute and relative spread increases or decreases after a stock split) and follow a handful of assumptions: The test compares the expected value of each frequency (number of stocks that increased or decreased its spread after a split) with its realized value, and this expected value should be greater or equal than 5 for all categories. Moreover, categories should be mutually exclusive, as it is the case with “split” - “non-split” and “increase” - “decrease”. Nevertheless, the degree of freedom in our particular example equals 1, which is (number of columns - 1) * (number of rows - 1).

Before getting to the results of our paper, it is interesting to consider what the expected results look like, observing both the theory and the paper of reference: Knowing

that absolute spreads are the difference between Bid and Ask prices, and that percentage Bid-Ask spreads are this difference over the stock price we can hypothesize that:

$$\text{Closing Price}\downarrow \rightarrow \text{Bid-Ask Price}\downarrow \rightarrow \text{Absolute Spread}\downarrow \rightarrow \text{Percenteage Spread} = \frac{\text{Absolute Spread}\downarrow}{\text{Closing Price}\downarrow} \ ?$$

As it can be seen on the hypothesis, the decrease in the stock price is a direct consequence of the stock split. Hence, Bid and Ask prices will also decrease to adapt to the new trading range of the security. Next, we can argue that the absolute spread may decrease. The argument is the following: A given investor that wants to purchase X€ of shares of company “i” has to pay (X€/Price of a share) * Spread for the transaction before the split. Since after the split the price has dropped, it is sensible to anticipate that part or all of the additional cost will be compensated by a decrease in the absolute spread. Here it is worth noting that for splits with a lower ratio, an increase in absolute spread could take place, given that other variables have an effect on spread. Yet, in the event of high-ratio splits, this is more unlikely.

Finally, the percentage spread will determine whether there was an overall reduction in the liquidity cost of trading that stock, or this cost increased. The results on the replicated paper show an increase in the relative spread for splitting firms, which is linked to the argument made in the signalling hypothesis of the literary review.

5.2.2. Chi-squared test: results

Table II
Frequency Distribution of Chnages in Bid-Ask Spreads after the Stock Splits

A. Changes in Absolute Spread

	Split	Nonsplit	
Increase	1	14	Prob. = 9,6862E-05
Decrease	28	15	
Total	29	29	

B. Changes in Percentage Spread

	Split	Nonsplit	
Increase	18	14	Prob. = 0,2909
Decrease	11	15	
Total	29	29	

Table II: Frequency Distribution in Bid-Ask Spreads after the stock splits

On Table II, the cells are the number of firms from the samples observing increases or decreases in Average daily absolute and percentage Spread after the ex-date of the split. Percentage Spread is calculated over the average daily closing price. The chi-square value tests the null hypothesis that the relative frequencies for splitting and non-splitting firms are the same.

Starting with the changes in absolute spread, we see our previous hypothesis confirmed. The chi-square test allows us to reject the null hypothesis of relative frequencies being the same for the two groups at any 1% significance level. Therefore, we can conclude that for splitting stocks, the absolute value of the spread tends to decrease after a stock split. This contrasts with the results of the control group, for which we had no reasons to think that absolute spread would go in one direction or another. It is also interesting to see that all of the top 10% companies that had the highest decrease in spread, had a splitting ratio of 5 or more, meaning that absolute spread and stock price have a strong positive correlation.

Next, focussing on the results of the changes in percentage spread we can draw the following conclusions: The fact that the null hypothesis is not rejected at any standard significance level does not allow us to link the relative spread of firms to the fact whether they had splitted their shares or not. While the picture of splitting firms seeing their percentage spread increased is still possible, it could well be that the distribution extracted from our sample (where 62% of splitters had an increase in relative spread in the period following the ex-date) is due to noise.

Opposite to the conclusions of Robert M. Conroy, Robert S. Harris and Bruce A. Benet, up to this stage, we are not able to distinguish an explicit cost faced by investors following the split. Although the absolute bid-ask spread will decrease after the split for splitting firms, it is not possible to discern whether closing price will decrease more than proportionally leading to a relative increase in the costs of liquidity.

5.3. Regression Analysis

To conclude, we want to assess the patterns of changes in percentage spreads, as to strengthen our analysis on the study of liquidity changes after stock splits in the Spanish market. According to the reference paper, the bid-ask spread is related, among other factors, with the stock's trading characteristics, including price, volume and volatility. To assess the trends in percentage spread changes, we have replicated the following regression analysis, to test whether the same patterns hold in our data:

$$\Delta Si = a_0 + a_1 Di + a_2 \Delta Pi + a_3 \Delta \ln(Vi) + a_4 \Delta ORi + \mu i$$

Where:

Δ = change from pre-announcement to post-split period

Si = the mean percentage spread for a stock i

Di = a dummy variable that is 1 if the firm has performed a stock split or 0 otherwise

Pi = the mean closing price for a stock i

ln(Vi) = the natural logarithm of the mean daily volume for a stock i

ORi = observed variance of the daily returns for a stock i

Our first intuition is that, if splits effectively alter the bid-ask spread, we would expect the parameter a_1 to be significantly different from zero. The result of the regression is:

*ΔSi = 0.0035466 - 4,498e-4*Di + 1.334e-4*ΔPi + 8.614e-4*Δln(Vi) - 3.484e-4*ΔORi*

(1.192) (0.064) (1.105) (0.239) (-0.697); R2= -0.07565

However, when replicating Conroy's study, we have not obtained the same results in our sample. Applying the regression study over means proposed by Conroy does not provide us with any conclusive statistical information, given none of the parameters of the mentioned variables of study are relevant (see the t-values below each parameter). Additionally, the fact that the Adjusted R2 is negative has made us disdain this analysis. One of the factors that may affect our statistical precision is the low size of the sample we are working with in the replication of the regression analysis. Smaller samples are more prone to be affected by outliers and sampling errors, and an overall reduction in the precision of the estimates and power for making accurate statistical inferences.

To overcome this issue, we have come up with an alternative regression to assess the patterns of the bid-ask spread in our sample. With the alternative regression, instead of taking the difference of means between the pre-announcement and post-split periods of the price, volume and volatility, we have selected the whole range of data for each firm in our sample. This difference in model specification increases the amount of observations per variable of study from 32 to 2,663. The new regression we have built is the following:

$$ASi = a_0 + a_1 Di + a_2 APi + a_3 \Delta ln(AVi) + a_4 PCCi + \mu i$$

ASi = the daily percentage spread for a stock i

Di = a dummy variable that is 1 if the firm has performed a stock split or 0 otherwise

APi = the daily closing price of a stock i

ln(AVi) = the natural logarithm of the daily volume for a stock i

PCCi = the percentage change in daily closing price for a stock i

The results of this regression specification are the following:

$$Si = 0.04654 + 0.003647*Di - 1.047e\text{-}4*APi - 0.002898*\Delta ln(AVi) + 0.07845*PCCi$$

$$(19.724) \quad (3.465) \qquad (-7.773) \qquad (-16.177) \qquad (3.363); \quad R2 = 0.0973$$

Seeing the output of the regression obtained, we can assess that in this second test we have been able to achieve statistically significant results, which will allow us to draw some findings from the regression. All the variables of study are relevant and we have achieved a larger adjusted R2, which matches better the one obtained on the reference regression. The initial intuition, that the stock's trading characteristics effectively alter the bid-ask spread, is confirmed empirically in our sample, given the price, volume and volatility are statistically significant variables of study. However, in contrast to the findings of Conroy et al., we have been able to assess the fact that a firm splitting its stock has meaningful effects on its spread.

Analyzing the output of the regression, we first observe that both executing a split and a rise in the volatility of returns generates an increase in the percentage bid-ask spread of the stock. In other words, on average, we can expect a firm that has performed a stock split to have higher percentage bid-ask spreads, and the same relation applies with volatility and the cost of liquidity. With respect to negative relationships, we have identified that both volume and price are negatively related to our variable of study. This means that in our sample, increases of price or volume are expected to, *ceteris paribus,* reduce the spread of the stock. The negative relationship between volume and bid-ask percentage spread has been widely reported in the literature since the former has positive correlation with liquidity.

The joint effect of these trends may be hard to interpret, given the only isolated, “direct” relationship in our findings is the one related to the split dummy variable. To understand the effect of the other variables, we shall use the information we have extracted in the previous tests, as to provide adequate findings with respect to the data in our sample.

First, regarding volume, in the t-test we have not found statistical evidence that in our sample there are significant differences in volume between the group of splitting firms and the control group. In our regression, the volume is one of the variables that could offset the negative impact on spreads of performing a split given its negative coefficient, but the findings of the t-test makes us dismiss volume as a tool for analysis. This statement does not mean that volume does not play an important role in the study of the spread, but that we cannot use it in the study of liquidity trends in our sample.

Second, we have seen that there are statistically significant differences in the price pre-split and post-split for the splitting firms, concretely, a reduction of the price of the splitting firms (which was rather expected given the nature of splits and the time-span we work in this analysis). Given the negative coefficient of the price in our regression, we can see that this dynamic is harming, on average, the stock’s liquidity. Third, as regards the stock’s risk measure captured as the percentage change in daily returns, we can observe that more risky stocks tend to have a higher percentage bid-ask spread.

Lastly, we observe that performing a split has an intrinsic negative impact in the spread (see the dummy variable of the regression), and that the stock trading characteristics after the split do not offset this negative trend. These findings make us discern a pattern in our sample in which stock splits are harming the liquidity of the stocks of the firms in the Spanish market. The results go in line with those of the signalling and tax-option hypothesis, where these increased costs of liquidity faced by investors were justified by favourable prospects of the firm or tax benefits for investors.

6. Conclusions

In the literature review, we detailed which are the main hypotheses that explain why firms decide to perform a stock split. In different time-spans, the stock markets behaved differently and mixed evidence arose which prevented academia to reach a common consensus on the motives behind these management decisions.

Following the methodology of Conroy et al, we performed a t-test, chi-square test and regression analysis. We were partially able to find the same results of the replicated paper. This might be a limitation given by the unavailability of some data which forced us to clean our dataset to 29 enterprises, as well as a difference between the Spanish market and the one of the reference paper. Overall, carrying out the t-test and the chi-square test we were able to register that splitting firms generally have a significantly pre-split higher price than non-splitting firms and that the absolute bid-ask spread decreased following the split. However, no clear conclusion could be drawn upon the percentage bid-ask spread which really represents the cost of liquidity that investors face to trade the stock. To complement these preliminary analysis, we performed a regression analysis to better understand the relationship between stock splits, stock characteristics and the percentage spreads.

Similarly to Conroy, we observe that the percentage of bid-ask spreads depends on the intrinsic characteristics of the stock such as the closing price, volume traded and the risk of the stock measured as the volatility of returns. Moreover, in the regression we are able to determine that stock splits endanger the percentage of bid-ask spreads, which was a conclusion that could not be drawn in the t-test and chi-square test. To conclude, our statistical analysis provides evidence sustaining that stock splits damage the liquidity of the stock. However, we recognize that further analyses would be required to understand the general market behavior surrounding these corporate actions.

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8. Annex

Annex 1: Table of Splitting and Nonsplitting Firms

Appendix I

Announcement Date is the lower between announcement through major newspaper to the general public or official day of the shareholders meetings. The average days between Ann and ExDate is 62,5 Days and the Average Ratio of the Split is 4,31. For Nonsplitting firm Announcement Date and Execution date have been randomly allocated in order to generate a control sample. Nonsplitting firm sample has been randomly selected as well.

	Enterprise	Ticket	Ann-Date	Ex-Date	Year	Days in between Ann-Date / Ex-Date	Ratio
	Sample Splitting Firms:						
1	Masmovil Ibercom	MASM.MC	29/11/2018	13/12/2018	2018	14	5
2	Nextil Group (Nueva empresa textil)	NXTE.MC	26/06/2018	03/08/2018	2018	38	4
3	Borges Agricultural & Industrial Nuts	BAINS.MC	20/10/2017	18/12/2017	2017	59	7
4	Construcciones y Auxiliar de Ferrocarriles (CAF)	CAF.MC	06/05/2016	30/11/2016	2016	208	10
5	Red Eléctrica Corporación, S.A.	REE.MC	28/06/2016	11/07/2016	2016	13	4
6	Grifols	GRLSbn.MC	03/12/2015	04/01/2016	2016	32	2
7	Grifols	GRLS.MC	03/12/2015	04/01/2016	2016	32	2
8	INDITEX, S.A.	ITX.MC	10/06/2014	28/07/2014	2014	48	5
9	Prosegur Compañía de Seguridad, S.A	PSG.MC	28/05/2012	06/07/2012	2012	39	10
10	Elecnor S. A	ENOR.MC	22/04/2008	15/09/2008	2008	146	2
11	TUBOS REUNIDOS, S.A	TUR.MC	26/09/2007	08/10/2007	2007	12	4
12	Iberdrola	IBE.MC	29/03/2007	08/10/2007	2007	193	4
13	Bankinter	BKT.MC	19/04/2007	23/07/2007	2007	95	5
14	Banco Sabadell. S.A	SABE.MC	23/02/2007	07/05/2007	2007	73	4
15	ENCE Energía y Celulosa	ENC.MC	30/03/2007	26/04/2007	2007	27	5
16	Faes Farma, S.A	FAE.MC	22/05/2006	29/01/2007	2007	252	2
17	Mapfre, S.A.	MAP.MC	27/04/2006	30/10/2006	2006	186	5
18	Airtificial Intelligence Structures S.A.	AI.MC	28/06/2006	22/09/2006	2006	86	2
19	Grupo Catalana Occidente	GCO.MC	25/05/2006	10/07/2006	2006	46	5
20	Duro Felguera, S.A	MDF.MC	18/05/2006	20/06/2006	2006	33	6
21	CIE Automotive	CIEA.MC	15/05/2006	22/05/2006	2006	7	5
22	Prim	PRIM.MC	31/01/2006	20/02/2006	2006	20	2
23	Deoleo	OLEO.MC	06/05/2005	23/05/2005	2005	17	4
24	Antena 3 TV, S.A.	A3M.MC	09/03/2005	27/04/2005	2005	49	4
25	Acerinox, S.A	ACX.MC	18/05/2004	26/07/2004	2004	69	4
26	Corporación Empresarial de Materiales de Construcción, S	CCMC.MC	26/05/2004	14/06/2004	2004	19	3
27	ACS, Actividades de Construcción y Servicios, S.A	ACS.MC	20/05/2004	10/06/2004	2004	21	3
28	Siemens Gamesa Renewable Energy, S.A.	SGREN.MC	28/05/2004	07/06/2004	2004	10	3
29	Abengoa	ABG.MC	24/06/2001	26/07/2001	2001	32	4
	Sample Nonsplitting firms						
1	Adolfo Dominguez SA	ADZ.MC	29/11/2018	13/12/2018	2018	14	NA
2	Aedas Homes SA	AEDAS.MC	30/03/2018	04/04/2018	2012	5	NA
3	Airbus SE	AIR.MC	03/07/2009	24/07/2009	2009	21	NA
4	Corporacion Financiera Alba SA	ALB.MC	04/09/2016	16/10/2016	2016	42	NA
5	Almirall SA	ALM.MC	23/04/2012	07/05/2012	2012	14	NA
6	Amadeus It Group SA	AMA.MC	03/03/2017	21/03/2017	2008	18	NA
7	Acciona SA	ANA.MC	06/09/2018	19/09/2018	2018	13	NA
8	Applus Services SA	APPS.MC	15/02/2015	20/02/2015	2006	5	NA
9	Bankia SA	BKIA.MC	02/01/2015	12/01/2015	2015	10	NA
10	CaixaBank SA	CABK.MC	14/04/2016	04/05/2016	2016	20	NA
11	Prosegur Cash SA	CASHP.MC	26/07/2017	15/08/2017	2004	20	NA
12	COCA-COLA EUROPEAN PARTNERS PLC	CCEP.MC	21/11/2016	07/12/2016	2009	16	NA
13	Cellnex Telecom SA	CLNX.MC	14/04/2016	04/05/2016	2015	20	NA
14	Distribuidora Inter de Alimentacion	DIDA.MC	14/03/2016	03/04/2016	2016	20	NA
15	Amrest Holdings SE	EATP.MC	05/06/2019	01/08/2019	2006	57	NA
16	Ebro Foods SA	EBRO.MC	16/12/2013	03/01/2014	2013	18	NA
17	eDreams Odigeo SA	EDRE.MC	27/09/2014	13/10/2014	2010	16	NA
18	Euskaltel SA	EKTL.MC	18/11/2015	31/12/2015	2008	43	NA
19	Endesa SA	ELE.MC	10/03/2012	04/05/2012	2012	55	NA
20	Enagas SA	ENAG.MC	01/04/2017	05/04/2017	2017	4	NA
21	Fomento de Construcciones y Contratas	FCC.MC	17/09/2010	28/09/2010	2010	11	NA
22	Ferrovial SA	FER.MC	05/02/2008	19/02/2008	2008	14	NA
23	Fluidra SA	FLUI.MC	09/02/2008	10/02/2008	2007	1	NA
24	Gestamp Automocion SA	GEST.MC	21/12/2017	13/01/2018	2018	23	NA
25	International Consolidated Airlns Grp SA	ICAG.MC	18/06/2011	30/06/2011	2011	12	NA
26	Indra Sistemas SA	IDR.MC	20/06/2015	28/06/2015	2016	8	NA
27	Cia de Distribn Integral Logista Hldg SA	LOG.MC	26/12/2014	15/01/2015	2015	20	NA
28	Melia Hotels International SA	MEL.MC	21/11/2009	07/12/2009	2010	16	NA
29	MERLIN Properties SOCIMI	MRL.MC	01/01/2015	07/03/2015	2015	65	NA

Annex 2: Calculations used to adjust the Database:

1. $Adjusted\ Closing\ Price_{i} = Normalized\ Closing\ Price_{i} * Ratio\ of\ the\ Split_{i}$
2. $Adjusted\ Volume\ of\ Shares_{i} = Normalized\ Volume\ of\ Shares_{i} / Ratio\ of\ the\ Split_{i}$
3. $Adjusted\ Bid_{i} = Normalized\ Bid_{i} * Ratio\ of\ the\ Split_{i}$
4. $Adjusted\ Ask_{i} = Normalized\ Ask_{i} * Ratio\ of\ the\ Split_{i}$
5. $Adjusted\ Bid - Ask\ Spread_{i} = Adjusted\ Ask_{i} - Adjusted\ Bid_{i}$
6.. $Adjusted\ percentage\ Bid - Ask\ Spread_{i} = Adjusted\ Bid - Ask\ Spread_{i} / Adjusted\ Closing\ Pr$

Note: *the ratio of the Split represents the number of shares received by a stock-holder per each share owned. Example: 5x1, five new shares will be trading the market after the ex-date for each share previously trading.*

Annex 3: Input data for Splitting Firms

TICKET EMPRESA	Adjusted Price			Adjusted Volume		Adjusted spread Abs-V			Adjusted Spread %		
	Pre-split	Post-split	CATEGORICAL	Pre-split	Post-split	Pre-split	Post-split	CATEGORICAL	Pre-split	Post-split	CATEGORICAL
MASM.MC	106,31 €	19,11 €	Decrease	66635,3721	359444	0,2302	0,0442	Decrease	0,0022	0,0023	Increase
NXTE.MC	3,30 €	0,87 €	Decrease	33313,502	68081,1101	0,0417	0,0147	Decrease	0,0126	0,0169	Increase
BAINS.MC	37,11 €	5,60 €	Decrease	826,762732	3370,24324	1,2144	0,2422	Decrease	0,0327	0,0433	Increase
CAF.MC	282,12 €	37,44 €	Decrease	4171,5122	110361,146	0,9098	0,0429	Decrease	0,0032	0,0011	Decrease
REE.MC	78,07 €	19,99 €	Decrease	730938,61	1606654,23	0,0283	0,0072	Decrease	0,0004	0,0004	Decrease
GRLSbn.MC	31,31 €	13,76 €	Decrease	125679,512	255863,884	0,0519	0,0288	Decrease	0,0017	0,0021	Increase
GRLS.MC	41,90 €	19,33 €	Decrease	761383,721	1631313,79	0,0131	0,0099	Decrease	0,0003	0,0005	Increase
ITX.MC	106,51 €	22,14 €	Decrease	2814368,03	4926387,77	1,2434	0,0443	Decrease	0,0117	0,0020	Decrease
PSG.MC	42,37 €	4,02 €	Decrease	91916,5263	262947,756	3,3313	0,2500	Decrease	0,0786	0,0622	Decrease
ENOR.MC	30,00 €	10,51 €	Decrease	5626,15385	8694,37209	0,2805	0,1684	Decrease	0,0094	0,0160	Increase
TUR.MC	19,94 €	5,32 €	Decrease	101852,857	705967,116	0,0921	0,0240	Decrease	0,0046	0,0045	Decrease
IBE.MC	23,22 €	7,67 €	Decrease	15427560,9	48625263,1	0,0110	0,0068	Decrease	0,0005	0,0009	Increase
BKT.MC	35,91 €	6,99 €	Decrease	825765,43	5166927,98	0,0549	0,0137	Decrease	0,0015	0,0020	Increase
SABE.MC	22,89 €	5,37 €	Decrease	2336232	12351903,8	0,0178	0,0096	Decrease	0,0008	0,0018	Increase
ENC.MC	33,80 €	7,30 €	Decrease	225246,386	666912,227	0,0758	0,0247	Decrease	0,0022	0,0034	Increase
FAE.MC	8,31 €	7,82 €	Decrease			0,0313	0,0212	Decrease	0,0038	0,0027	Decrease
MAP.MC	16,14 €	3,38 €	Decrease			0,0314	0,0110	Decrease	0,0019	0,0033	Increase
AI.MC	2,48 €	1,94 €	Decrease	26179,9477	535241,313	-0,0564	0,0144	Increase	-0,0227	0,0074	Increase
GCO.MC	107,32 €	21,24 €	Decrease			0,7812	0,1242	Decrease	0,0073	0,0058	Decrease
MDF.MC	80,03 €	13,40 €	Decrease			0,5068	0,0869	Decrease	0,0063	0,0065	Increase
CIEA.MC	25,70 €	4,71 €	Decrease			1,8674	0,1849	Decrease	0,0726	0,0393	Decrease
PRIM.MC	18,10 €	12,11 €	Decrease			0,1986	0,0863	Decrease	0,0110	0,0071	Decrease
OLEO.MC	21,00 €	5,91 €	Decrease			0,0311	0,0178	Decrease	0,0015	0,0030	Increase
A3M.MC	51,43 €	14,39 €	Decrease			0,1169	0,0291	Decrease	0,0023	0,0020	Decrease
ACX.MC	34,14 €	9,14 €	Decrease			0,0504	0,0140	Decrease	0,0015	0,0015	Increase
CCMC.MC	175,71 €	60,49 €	Decrease			1,2800	0,4512	Decrease	0,0073	0,0075	Increase
ACS.MC	36,13 €	12,38 €	Decrease			0,0630	0,0192	Decrease	0,0017	0,0016	Decrease
SGREN.MC	30,92 €	10,61 €	Decrease			0,0677	0,0299	Decrease	0,0022	0,0028	Increase
ABG.MC	8,21 €	1,93 €	Decrease			0,0463	0,0255	Decrease	0,0056	0,0132	Increase
AVERAGE	52,08 €	12,58 €		1473606,07	4830333,36	0,4349	0,0706		0,0091	0,0091	
ST.DEV	58,88	12,15		3816905,8	12114429,8	0,7484	0,1010		0,0202	0,0146	
Observations	29	29		16	16	29	29		29	29	

Annex 4: Input data for Non-Splitting Firms

TICKET EMPRESA	Price			Volume		Spread Abs-V			Spread %		
	Pre-split	Post-split	CATEGORICAL	Pre-split	Post-split	Pre-split	Post-split	CATEGORICAL	Pre-split	Post-split	CATEGORICAL
ADZ.MC	7,24 €	6,86 €	Decrease	5666,93	6952,24	0,1614	0,1437	Decrease	0,0223	0,0209	Decrease
AEDAS.MC	29,55 €	30,81 €	Increase	47598,51	46440,07	0,0986	0,1200	Increase	0,0033	0,0039	Increase
AIR.MC	11,47 €	14,19 €	Increase	24632,42	14134,39	0,1379	0,1283	Decrease	0,0120	0,0090	Decrease
ALB.MC	37,10 €	39,96 €	Increase	13222,60	13750,72	0,1414	0,1105	Decrease	0,0038	0,0028	Decrease
ALM.MC	6,04 €	5,49 €	Decrease	309457,21	166740,68	0,0375	0,2973	Increase	0,0062	0,0542	Increase
AMA.MC	43,49 €	48,69 €	Increase	2707437,84	1116482,58	0,0141	0,0151	Increase	0,0003	0,0003	Decrease
ANA.MC	72,32 €	76,36 €	Increase	130106,28	142136,69	0,0474	0,0595	Increase	0,0007	0,0008	Increase
APPS.MC	9,21 €	10,82 €	Increase	613708,97	1219914,54	0,0128	0,0220	Increase	0,0014	0,0020	Increase
BKIA.MC	5,31 €	4,96 €	Decrease	8965666,41	12584570,88	0,0043	0,0043	Decrease	0,0008	0,0009	Increase
CABK.MC	2,59 €	2,28 €	Decrease	18746195,25	24357308,52	0,0016	0,0014	Decrease	0,0006	0,0006	Increase
CASHP.MC	2,24 €	2,46 €	Increase	826447,22	659014,37	0,0090	0,0106	Increase	0,0040	0,0043	Increase
CCEP.MC	34,36 €	30,95 €	Decrease	4506,88	8648,51	0,9459	0,6116	Decrease	0,0275	0,0198	Decrease
CLNX.MC	11,78 €	11,56 €	Decrease	1453244,11	1223741,07	0,0115	0,0080	Decrease	0,0010	0,0007	Decrease
DIDA.MC	1,42 €	1,46 €	Increase	21570418,42	16067406,29	0,0007	0,0006	Decrease	0,0005	0,0004	Decrease
EATP.MC	9,24 €	9,45 €	Increase	1696,69	609,14	0,3913	0,5841	Increase	0,0423	0,0618	Increase
EBRO.MC	16,84 €	16,36 €	Decrease	622155,71	621579,12	0,2126	0,2616	Increase	0,0126	0,0160	Increase
EDRE.MC	3,46 €	1,84 €	Decrease			0,0286	0,0150	Decrease	0,0083	0,0082	Decrease
EKTL.MC	10,32 €	10,39 €	Increase			0,0436	-0,2172	Decrease	0,0042	-0,0209	Decrease
ELE.MC	8,16 €	6,77 €	Decrease			0,0111	0,2633	Increase	0,0014	0,0389	Increase
ENAG.MC	23,33 €	25,12 €	Increase			0,0123	0,0136	Increase	0,0005	0,0005	Increase
FCC.MC	12,92 €	13,02 €	Increase			0,0114	0,0099	Decrease	0,0009	0,0008	Decrease
FER.MC	10,16 €	10,19 €	Increase			0,0115	0,0126	Increase	0,0011	0,0012	Increase
FLUI.MC	5,31 €	4,70 €	Decrease			0,0668	0,0559	Decrease	0,0126	0,0119	Decrease
GEST.MC	5,74 €	6,36 €	Increase			0,0106	0,0117	Increase	0,0018	0,0018	Decrease
ICAG.MC	1,78 €	1,60 €	Decrease			0,0016	0,0026	Increase	0,0009	0,0016	Increase
IDR.MC	9,63 €	10,29 €	Increase			0,0050	0,0075	Increase	0,0005	0,0007	Increase
LOG.MC	14,60 €	16,57 €	Increase			0,0334	0,0200	Decrease	0,0023	0,0012	Decrease
MEL.MC	6,55 €	5,84 €	Decrease			0,0238	0,0179	Decrease	0,0036	0,0031	Decrease
MRL.MC	7,86 €	10,15 €	Increase			0,0235	0,0192	Decrease	0,0030	0,0019	Decrease
AVERAGE	14,48 €	15,02 €	NA	3502635,09	3640589,36	0,0866	0,0900	NA	0,0062	0,0086	NA
ST.DEV	15,58 €	16,62 €	NA	6888615,65	7315977,01	0,1856	0,1718	NA	0,0096	0,0169	NA
Observations	29	29		16	16	29	29		29	29	

Annex 5: Output of Regression I - Difference of Means

Regression I: difference of Means				
Regression applying Conroy et al. Methodology. Number of variables used is equal to 4 and total degrees of freedom 27. No statistical significant evidence arised from the analysis.				
lm(formula=DAF$DS~DAF$S+DAF$DP+DAF$DV+DAF$DRV)				
Coefficients	**Estimate**	**Standard Error**	**t value**	**Pr(>| t |)**
Intercept	0,0035466	0,0029758	1,192	0,244
Di	0,0004498	0,0069765	0,064	0,949
Pi	1,33E-04	0,0001207	1,1050	0,279
Vi	0,00008614	0,0036038	0,239	0,813
ORi	-0,00034840	0,0004999	-0,697	0,492
Residual standard error: 0,01175				
Multiple R-Squared: 0,06315			**Adjusted R-squared:** -0,07565	
F-statistic: 0,455			**p-Value:** 0,7679	

Annex 6: Outputs of the regressions tested on Difference of Means (with R)

```
> summary(lm(DAF$DS~DAF$S+DAF$DP+DAF$DV+DAF$DOV))

Call:
lm(formula = DAF$DS ~ DAF$S + DAF$DP + DAF$DV + DAF$DOV)

Residuals:
      Min        1Q    Median        3Q       Max
-0.017465 -0.004110 -0.003161 -0.000073  0.045017

Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept)  0.0035466  0.0029758   1.192    0.244
DAF$S        0.0004498  0.0069765   0.064    0.949
DAF$DP       0.0001334  0.0001207   1.105    0.279
DAF$DV       0.0008614  0.0036038   0.239    0.813
DAF$DOV     -0.0003484  0.0004999  -0.697    0.492

Residual standard error: 0.01175 on 27 degrees of freedom
Multiple R-squared:  0.06315,   Adjusted R-squared:  -0.07565
F-statistic: 0.455 on 4 and 27 DF,  p-value: 0.7679
```

Annex 7: Output of Regression II - Alternative Specification

Regression II: Alternative Specifications				
Regression applied on the whole range of data available per firm. Number of variables used is equal to 4, and total degrees of freedom of 2658. 22 observations were deleted due to missingness of data				
lm(formula=DCR$PCS~DCR$`Dummy Split`+DCR$ACL+log(DCR$AVOL)+DCR$PCC)				
Coefficients	**Estimate**	**Standard Error**	**t value**	**Pr(>| t |)**
Intercept	0,04654	0,00236	19.724	<2e-16
Di	0,003647	0,001052	3.465	0,000538
Pi	-1,05E-01	0,00001347	-7.773	1.09e-14
Vi	-0,002898	0,0001791	-16.177	<2e-16
ORi	0,078450	0,00233	3.363	0,000781
Residual standard error: 0,02661				
Multiple R-Squared: 0,09866			**Adjusted R-squared:** 0,0973	
F-statistic: 72,73			**p-Value:** <2,2e^-16	

Annex 8: Outputs of the regressions tested on second model (with R)

```
> summary(lm(DCR$PCS~DCR$`Dummy Split`+DCR$ACL+log(DCR$AVOL)+DCR$PCC))

Call:
lm(formula = DCR$PCS ~ DCR$`Dummy Split` + DCR$ACL + log(DCR$AVOL) +
    DCR$PCC)

Residuals:
     Min       1Q   Median       3Q      Max
-0.03122 -0.00862 -0.00420  0.00200  0.97516

Coefficients:
                   Estimate Std. Error t value Pr(>|t|)
(Intercept)       4.654e-02  2.360e-03  19.724  < 2e-16 ***
DCR$`Dummy Split` 3.647e-03  1.052e-03   3.465 0.000538 ***
DCR$ACL          -1.047e-04  1.347e-05  -7.773 1.09e-14 ***
log(DCR$AVOL)    -2.898e-03  1.791e-04 -16.177  < 2e-16 ***
DCR$PCC           7.845e-02  2.332e-02   3.363 0.000781 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.02661 on 2658 degrees of freedom
  (22 observations deleted due to missingness)
Multiple R-squared:  0.09866,   Adjusted R-squared:  0.0973
F-statistic: 72.73 on 4 and 2658 DF,  p-value: < 2.2e-16
```