“Size, value and leverage. How are they accounted for?”

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Size, value and leverage. How are they accounted for?

Abstract

This paper aims at improving the findings of the three-factor model, both adding a topical explanatory variable, financial leverage, and expanding the perspective to the European context.

We perform both cross-sectional and time-series correlations to test the existence of a linear relation between factors studied and the company returns. For each factor, the authors break down the dataset into quartiles to investigate the possible return difference between the first and fourth quartile. Then, through a paired comparison test, the hypothesis that the mean vectors of the first and last quartile are equal is tested.

Results indicate that small companies generate higher cumulative returns than large caps but, also bear a larger level of volatility. In the same way, value stock companies record better performances than growth stock companies but, a clear connection between values vs. growth factor and returns cannot be claimed. Cumulative returns of higher leveraged firms are only slightly superior to lower leveraged ones, with a comparable level of variance.

Keywords: firm value, market capitalization, leverage, international business, size, financial management, return, economic performances.
JEL Classification: G10, G30, L10, L20.

Introduction

Different empirical analyses have been conducted to study the relationship between some key firm variables and companies' economic performances and related risk. In this article, we analyze the correlation between the key risk factors, as stated in the Fama and French (1993) three-factor model, and the return of companies. Differently from previous contributions, the novelty of this work is represented by the extremely extensive time horizon covered, making it possible to test the assumptions in periods distinguished by different economic and financial trends. The three-factor model is, particularly, interesting since – in addition to the market risk represented by company beta – it tests two other key variables: company size and book to market value. Fama and French's (1993) findings are surely solid, as they are based on sound studies conducted over an extended time span and, for this reason, they represent a very important reference in the literature. Notwithstanding, some of their conclusions have been confuted at different extent by later studies.

This paper attempts to make a contribution to literature by testing the validity of the assumptions over a more extended period of time, in order to assess both the soundness of the theory (from the 90s up to recent years) and the specific results in correspondence with specified years distinguished by anomalous market behaviors. More specifically, the association between the key variables and the performances obtained by companies in the highly volatile market of the beginning of the millennium distinguished by the dot-com bubble, and prior to the 2007/2008 financial crisis, would be extremely interesting data to be investigated and analyzed (Elango, 2011). In addition to these considerations, we hold that financial leverage, expressed as the ratio between net debt and equity, is an additional key factor that needs to be investigated, as the hypertrophic recourse to debt in the last decade has heavily affected the performance of many companies at an international level (Von Thadden et al., 2010; Dell'Acqua et al., 2012). Therefore, the investigation of the influence of market capitalization and book to market value variables on firm risk and return, is supplemented in this paper by the inclusion of the leverage factor.

The remainder of the article is structured as follows. In the next section literature debating the validity of the model under discussion will be presented, also considering literature debate on the additional variable included, financial leverage. Section 2 introduces the large dataset and explains methodology used. Section 3 presents the results of the analysis conducted. The article ends with conclusive section where we also state the limitations of the work.

1. Literature review

1.1. Returns and factors. Numerous empirical contributions have discussed to a different extent the validity of the postulates put forward by Fama and French in their three-factor model (1993). Different recent contributions, by conducting empirical analyses or literature review, have widely discussed of the obvious effectiveness of the three-factor model as well as CAPM theory (Wei, 2012; Siegel, 2010). Asset returns typically depend on a wide-ranging cluster of factors (Hou et al., 2011; Chang, et al., 2012). The controversial results of previous studies on the appropriateness of the original financial models to explain the asset return should

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consider that the influence on any single factor examined cannot be comprehensive enough to explain the whole asset returns. Therefore, while most previous works find a positive association between analyzed factors and returns (Jareno, 2008; Bundoo, 2008), their conclusions should be partly reassessed on the basis of the limited level of correlation found. Further, while other studies that assert that the examined factors fail to explain the variations in returns (Griffin, 2002; Busse, 2010) or do not explain them so significantly (Azam and Ilyas, 2011), it must be in any case noticed that few studies observe a completely absence of correlation between the investigated factors and firm performances (Borys and Zemcik, 2011; Lieskin, 2011).

1.2. Book-to-market factor is a static factor. While the same company could have different size (start-up vs. maturity) and leverage levels (higher or lower recourse to banks vs. shareholders) over its life cycle, the book-to-market factor is much more a steady factor that accompanies most firms over their whole life cycle. The consideration of the book-to-market value, more as an industry factor than a company factor, and its relationship with return premium has been already advanced by other recent studies (Trainor, 2010; Nandha et al., 2012). Other works stressed the lower risk associated with book-to-market factor (Iñiguez and Poveda 2004), while Agarwal and Poshakwale (2010) emphasized the "book-to-market anomalies" in assessing asset return. Other studies have also discussed at length on relative importance of country versus industry factors (Brooks and Del Negro, 2004; Cavaglia et al., 2000).

1.3. Increasing weight of financial leverage. Most research conducted in the last ten years also assesses the connection between financial leverage and asset returns, due to the rapid increase in the recourse to debt over the last decade (Teti and Perrini, 2012; Lee and Moon, 2011). Previous results on this factor are partial and disputed, albeit it has been demonstrated that leverage management and adequate financial reporting have been assuming more and more importance in controlling possible financial crises and dealing with economic health of the companies (Orens and Lybaert, 2010). Maroney et al. (2004) also find that beta increases are the consequence of high leverage values linked to exchange rates and show the role of the debt to equity ratio in explaining the likelihood of the financial crises.

1.4. Association between leverage and returns. Previous studies have stressed the positive perception of low-leveraged companies, since the debt component is negatively associated with future stock returns (Penman et al., 2007; Myers, 2001; Negash, 2001). However, a few contributions state that debt to equity ratio is the main source of the value premium (Ozdagli, 2009). Results arising from any analysis on this factor should be re-evaluated, since the high-leverage sample of firms examined always also includes companies with high debt-to-equity ratios because they are under heavy financial distress or close to bankruptcy. In brief, some of the companies falling within the high-leverage sample are grouped in this cluster because they are "financially unhealthy companies" and not because their optimal financial structure is typically made up of high debt to equity ratios. Thus, the hypothesis is that results stating a negative association with leverage should be consistently interpreted and re-evaluated, since the exclusion of "financially unhealthy" companies from datasets would clearly lead to least unbiased results.

2. Theoretical model and methodology

To test whether or not there is a statistical association between the factors identified and the company returns analyzed over an extended period of time, two correlation analyses are performed:

- a *cross-sectional correlation* to study the relation between the different company returns in a defined year and the factors analyzed. In mathematical terms:

$$\rho_t = \frac{\sigma^t_{f,r}}{\sigma^t_f \sigma^t_r} \quad \text{with } t = 1,2,...,n$$

  where ρ_t is the cross-sectional correlation as of year t, $\sigma^t_{f,r}$ is the covariance between the factor studied and the returns in the year t, while σ^t_f and σ^t_r are, respectively, the standard deviations of the factor studied and the standard deviations of returns in year t;
- a *time-series correlation* to investigate the relation between the time-series company returns for a defined company and the factors analyzed. In mathematical terms:

$$\rho_i = \frac{\sigma^i_{f,r}}{\sigma^i_f \sigma^i_r} \quad \text{with } i = 1,2,...,n$$

  where ρ_i is the time series correlation for the company i, $\sigma^i_{f,r}$ is the covariance between the factor studied and the return of the company i, while σ^i_f and σ^i_r are, respectively, the standard deviations of the factor studied and the standard deviations of returns for the company i.

The second methodological step taken is to isolate the factors effect on returns on an annual basis, to understand the different performance behaviors with

regard to the specific variable analyzed, depending on the different periods investigated. We divide the dataset in two groups, G_1^t and G_2^t, as follows:

$$G_1^t = \left\{ r_i^t \middle| r_i^t \in R^t \wedge f_i^t < Q_1^t \right\} \text{ with } t = 1, 2, ..., n$$

$$G_2^t = \left\{ r_i^t \middle| r_i^t \in R^t \wedge f_i^t > Q_1^t \right\} \text{ with } t = 1, 2, ..., n,$$

where R^t is the set of all the returns as of time t; n is the total number of years considered; r_i^t is the generic return of the company i as of time t; f_i^t is the value of the factor studied associated with r_i^t, where $\forall i\, f_i^t \to r_i^t$; Q_1^t is the lower quartile at the time t and Q_3^t is the upper quartile at the time t of the set F^t containing all the value of the factors as of time t.

For G_1^t and G_2^t the mean and the median values are calculated and the returns compared, to understand whether a significant difference between the two groups studied exists, as well as the values of return standard deviation are measured to assess the relating level of volatility. In detail, at the beginning of each investigated year, G_1 and G_2 – that can be seen as portfolios – will be rebuilt. Furthermore, at the end of each year we have performed a t-test based on data arranged in paired observations. Let μ_d stand for the population mean difference, we can formulate the following hypotheses:

$$H_0 : \mu_d = 0 \; versus \; H_a : \mu_d \neq 0.$$

In order to calculate the t-statistic, we first found the sample mean difference:

$$\bar{d} = \frac{1}{n} \sum_{i=1}^{n} d_i,$$

where n is the number of paired observations. The sample standard deviation, denoted by $S_{\bar{d}}$, is:

$$S_{\bar{d}} = \frac{S_d}{\sqrt{n}}.$$

When we have data consisting of paired observations from samples generated by normally distributed populations with unknown variances, we can use the following t-test:

$$t = \frac{\bar{d} - \mu_{d0}}{S_{\bar{d}}}$$

with $n - 1$ degrees of freedom.

More than 9,000 companies are analyzed over an overall period of 58 years, between 1950 and 2007. In any case, for some key factors the analysis is possible only for a more restricted period of time, from 1980 to 2007. Companies operating in forty of the major industries and belonging to fifteen of the most important European countries have been considered. Table 1 introduces the dataset investigated by listing market of the companies analyzed.

Table 1. Dataset by listing market of the companies

Market	Number of firms	Percentage
Austria	157	1.7%
Belgium	264	2.9%
Denmark	245	2.6%
Finland	166	1.8%
France	1,252	13.5%
Germany	1,538	16.6%
Greece	369	4.0%
Ireland	102	1.1%
Italy	372	4.0%
Netherlands	248	2.7%
Norway	330	3.6%
Portugal	114	1.2%
Spain	229	2.5%
Sweden	607	6.6%
United Kingdom	3,267	35.3%
	9,260	100.0%

3. Results

3.1. The size factor. The cross-section and time-series correlation analyses do not highlight any statistically significant connection. In particular, the cross-section correlation indices (Figure 1) show a higher volatility during the 60s, 70s and partially 80s, compared to the last investigated years. However, the range value is quite small (± 0.16), underlining the absence of any association. In particular, extreme results are observed between 1969 and 1972, with a high negative correlation but, as from the 90s until recent years, the cross-section correlations of market capitalization to returns is not significant, with indexes always lower than |0.05|.

These results agree with those arising from the time-series analysis. In this case, we have only studied companies with at least ten years of data for the market cap, to maximize statistical significance of results. Thus, the sample size is reduced to 3,405 companies. The histogram of the correlation indexes (Figure 2) shows that in the last forty years a clear association between market capitalization and returns cannot be identified. Even though the correlation values are not substantial, with most of the observations included in the range from 0 to |0.4|, it can be affirmed that size is, however, able to explain, at least partially, the returns. Of course, return depends on more than one factor only, in this case size, therefore, extremely high correlation values were not expected. More than high values of correlation indices, the positive or negative sign of the correlation analysis is important here; in this regard, we observe that small caps have, on average, positive correlations values, thus, basically higher returns than large caps. We also note that the

influence of correlation decreases as time goes by, indicating a diminishing association between size factor and returns, coming to almost nonexistent correlation during the 2003-2005 period. In brief, the graph can be interpreted, in affirming that, in life cycles when companies have smaller size, they get higher returns. This could be associated to start-up companies or previous conglomerates not sufficiently remunerative in all that the businesses hold, that have remised some of their non-operating businesses to refocus on their core business, with higher profitability.

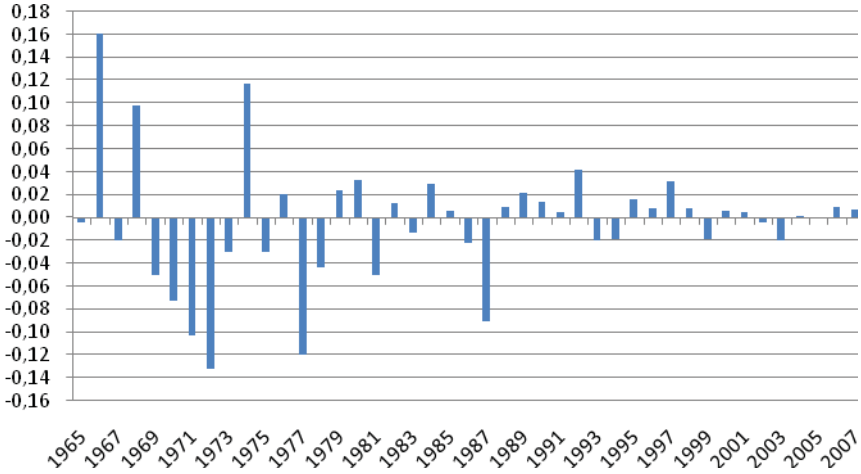


Fig. 1. Cross-section correlation returns to market capitalization: 1965 to 2007

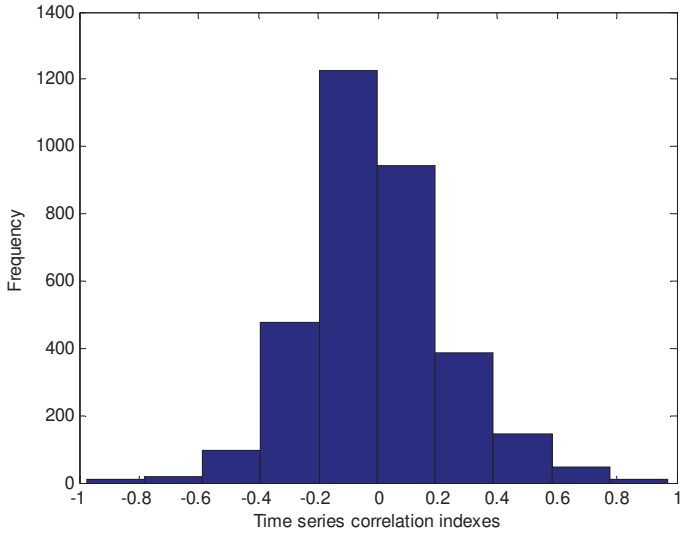


Fig. 2. Correlation indices between returns and market caps: 1965 to 2007

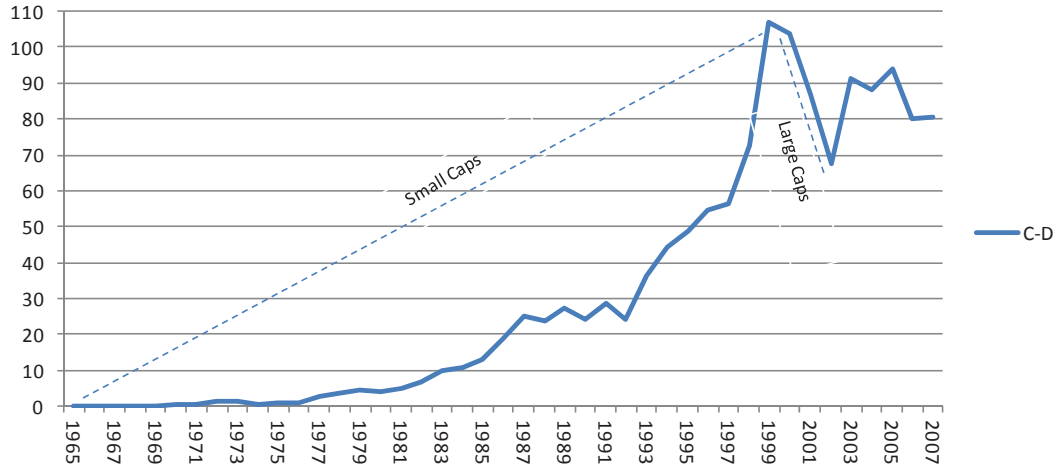
By analyzing Table 2, that examines the returns from 1965 to 2007 of a portfolio composed of small caps (market cap included in the first quartile) versus large caps (market cap included in the fourth quartile), two results are noteworthy: on the one hand, the returns volatility of the small caps are (slightly) higher (0.214) than the volatility of the large caps (0.195); on the other hand, the average return of smaller size firms is higher (15.4%) than the return of larger size ones (13.8%).

Table 2. Comparative performance analysis of small caps vs. large caps portfolios

	Small caps	Large caps	(A)-(B)	Small caps	Large caps	(C)-(D)
	Mean return 25	Mean return 75		(C) Cumulative mean return 25	(D) Cumulative mean return 75	
Mean	0.154	0.138	0.016	59.609	28.253	31.356
Median	0.132	0.176	-0.044	33.580	12.978	18.668
Standard deviation	0.214	0.195	0.019	69.659	36.663	35.042

Note: The table compares the mean performances of two portfolios rebuilt every year as from 1965 to 2007, with the first portfolio composed by small caps, and the second by large caps. Mean return 25 = mean of returns of 1st quartile; mean return 75 = mean of returns of 4th quartile.

The compounded cumulated returns of the two portfolios presented in Figure 3 are the results of a hypothetical investment of 1 € that started in 1965 and ends in 2007. The difference between the cumulated returns of the two portfolios, as it can be noticed in the figure, indicates, quite clearly, the increasingly higher returns of small caps towards large caps, corroborating the relevance of the size factor in explaining at least part of the company returns. This result is confirmed by the *t*-test that in most of the years, generates an average *p*-value lower than 0.05, that makes it possible to reject the null hypothesis and conclude that the size factor plays a key role in explaining asset returns.



Note: The graph shows the difference of the compounded cumulated returns between the "small caps portfolio" (C) and the "large caps portfolio" (D), for an investment of 1 €.

Fig. 3. Compounded cumulated returns: small caps vs. large caps portfolios

3.2. The book-to-market value factor (BV/MV). It is first important to observe that the analysis of this factor can be – more than others – biased by the industry variable. In fact, in the construction of the dataset we have noticed that companies belonging to some industries – such as construction, mining, industrial transportation and industrial retail – have always fallen within the high book-to-market value sample, due to the importance of the book value of their assets compared to their market assessment. Contrariwise, typically all the services industries – in particular, software and computer services, mobile and telecommunication, support services – have fallen within the opposite sample, with lower book-to-market values. The results analyzed as follows must be, hence, contextualized in considering this observation.

The cross-section analysis (Figure 4) highlights both positive and negative correlations, indicating the different performances of the two samples. This could be interpreted as the result of the changeable profitability of specific sectors based on their performances in different historical periods. However, the graph shows the prevalence of the lower book-to-market value sample (more years with negative correlation indexes) over time.

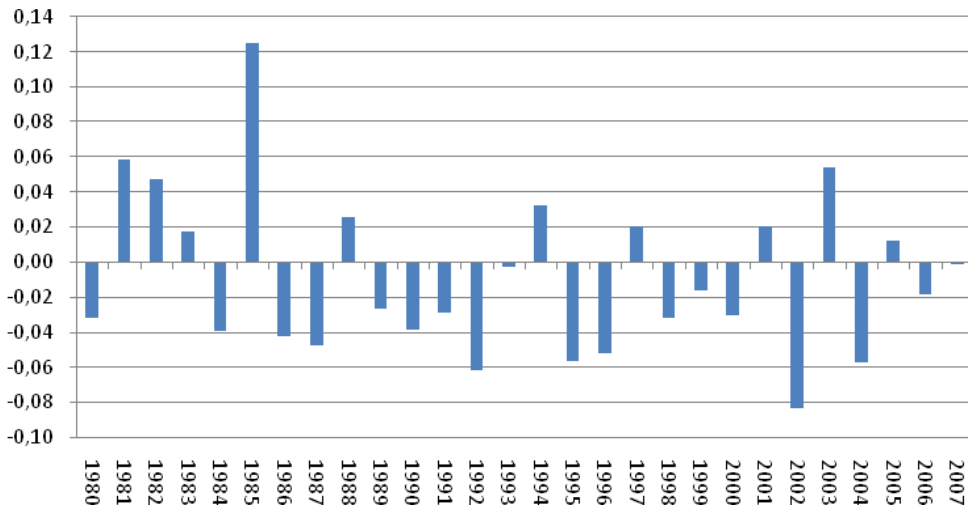


Fig. 4. Cross-section correlation between returns to BV/MV: 1980 to 2007

Just as for the size factor, the times-series analysis on the value factor (Figure 5) also does not identify any substantial connection. These findings could be interpreted by observing that the book-to-market value of, as a reference, a manufacturing company, should not vary significantly over time, since the market assessment of the company is quite strictly related to the book value of the assets included in its balance sheets. This would explain the quasi-normal shape of the probability distribution represented in Figure 5.

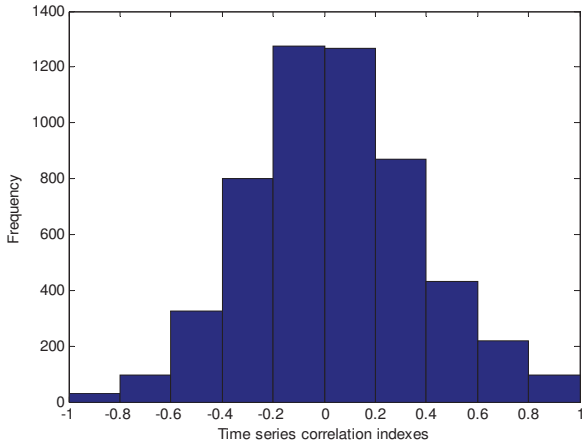


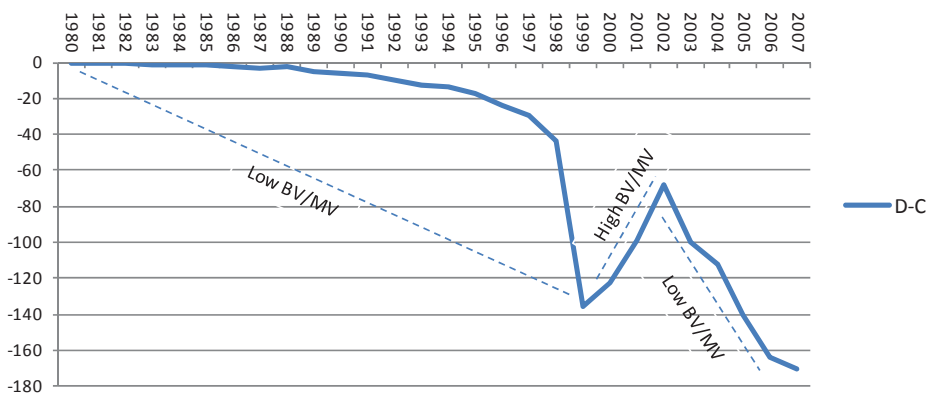
Fig. 5. Correlation indices between returns and BV/MV: 1965 to 2007

The results obtained by comparing the different companies with respect to this factor are particularly interesting. It can be observed that companies with a low BV/MV ratio are more volatile – if the 1999 outlier is considered – otherwise, a similar standard deviation is observed. Companies with a low BV/MV ratio record lower mean returns, while taking the median into consideration, it can be noticed that, as from 2000, cumulative returns decrease, substantially, compared to the mean returns. Thus, a signification correlation between book/market values and returns cannot be identified, even though it can be noticed that, on average, firms with lower BV/MV ratios have performed better than firms with higher BV/MV ratios. This result is supported by the *t*-test. In most of the years, we cannot reject the null hypothesis, and thus we cannot conclude that the factor "book-to-market value" makes any difference in returns.

Table 3. Comparative portfolios performance analysis of low BV/MV vs. low BV/MV companies

	Low BV/MV	High BV/MV	(B)-(A)	Low BV/MV	High BV/MV	(D)-(C)
	(A) Mean return 25	(B) Mean return 75		(C) Cumulative mean return 25	(D) Cumulative mean return 75	
Mean	0.246	0.167	-0.079	60.825	14.566	-46.259
Mean (excluding 1999)	0.195	0.158	-0.037	57.207	14.247	-42.960
Median	0.216	0.166	-0.050	24.171	10.997	-13.174
Standard deviation	0.335	0.238	-0.097	70.236	12.808	57.900
Standard deviation (excluding 1999)	0.203	0.239	0.036	68.862	12.938	56.256

Note: The table compares the mean performances of two portfolios rebuilt every year as from 1965 to 2007, with the first portfolio composed by low BV/MV companies, and the second by high BV/MV companies. Mean return 25 = median of returns of 1st percentile; mean return 75 = mean of returns of 4th percentile.



Note: The graph shows the difference of the compounded cumulated returns between portfolios of "low BV/MV companies" (C) and "high BV/MV companies" (D), for an investment of 1 €.

Fig. 6. Compounded cumulated returns. "High BV/MV" versus the "low BV/MV portfolio"

3.3. The leverage factor. As represented in Figure 7, the most important information that can be drawn from this analysis is the decreasing weight of the leverage factor on returns over time, especially starting from the 90s. During the 80s, a high level of correlation between low-leveraged companies and economic performances is noticed, specifically driven by the presence of some outliers identified.

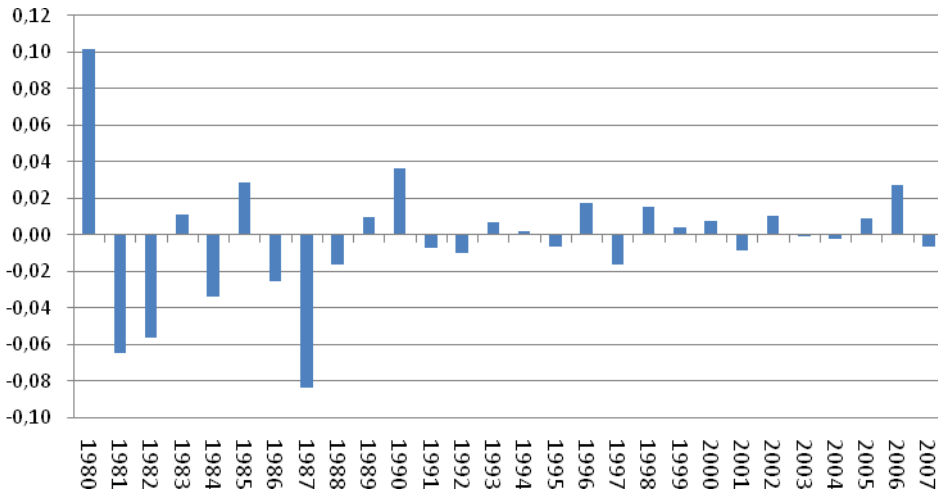


Fig. 7. Cross-section correlation between returns to leverage: 1965 to 2007

The results of the cross-section correlation presented in Figure 8 show both positive and negative correlations. In particular, it could be stated that, when companies are in the stages of their life with a low level of financial leverage (e.g.: start-up stage), they get, on average, higher returns compared to stages when they keep increasing amounts of net debt to equity in their financial structures. This result must be carefully interpreted, since – as aforementioned – it would be inappropriate to affirm that a high level of leverage necessarily implies smaller returns. In fact, the quartile including companies with high debt-to-equity ratios comprises both "financially healthy" firms, and also companies that have an extremely high level of leverage because under financial strain or even close to default (companies at these stages are typically very high leveraged), and that do not fall within this quartile as a consequence of the achievement of their optimal financial structure.

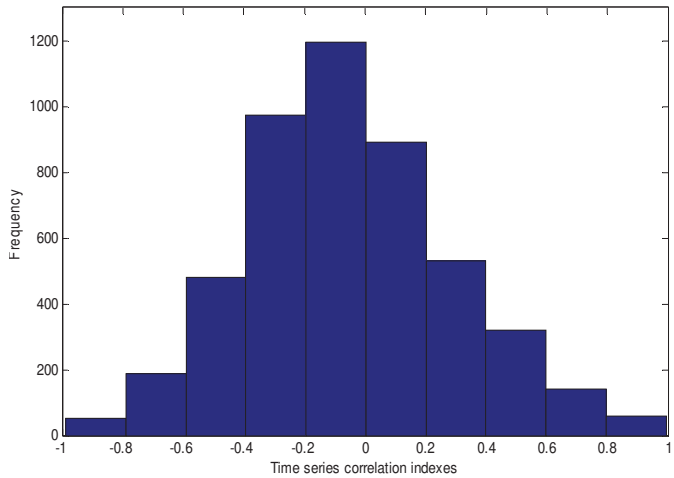


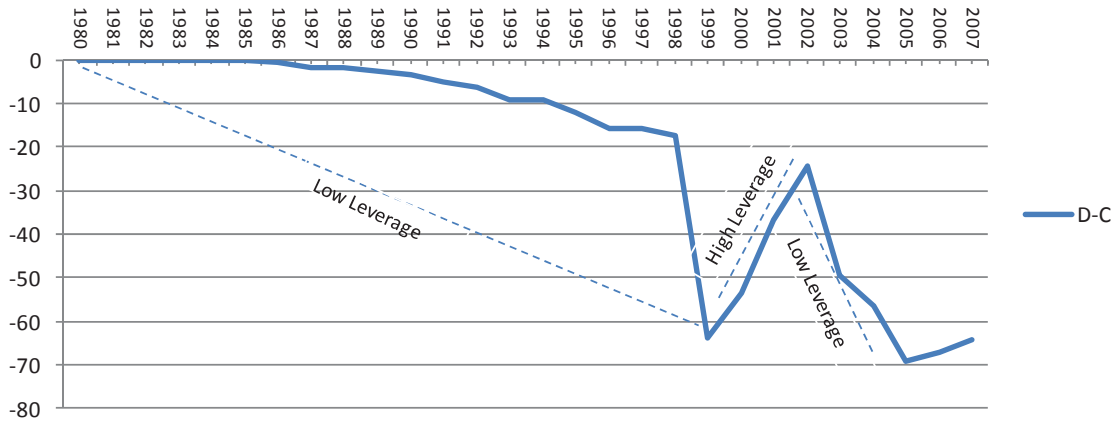
Fig. 8. Correlation indices between returns and leverage: 1965 to 2007

Looking at Table 4, which compares the returns of companies whose leverage falls within the 0-25th percentile interval versus the 75th-100th percentile, the higher volatility of low-leveraged firms can be noticed because of an outlier recorded in 1999. Excluding this outlier from the analysis, the standard deviations of low-leveraged and high-leveraged companies are not dissimilar. As for returns, the mean values are 15 versus 13 times higher for companies with smaller amount of debt in their financial structure. In brief, it can be affirmed that no statistical relationship between leverage ratio and returns can be identified, even though high-leveraged companies have, generally, performed worse than low-leveraged ones. This result is confirmed by the *t*-test. In most of the years, we cannot reject the null hypothesis and conclude that the factor "leverage" makes any difference in returns.

Table 4. Comparative portfolios performance of low-leverage vs. high-leverage companies

	Low leverage	High leverage	(B)-(A)	Low leverage	High leverage	(D)-(C)
	(A) Mean return 25	(B) Mean return 75		(C) Cumulative mean return 25	(D) Cumulative mean return 75	
Mean	0.227	0.187	-0.039	41.079	20.080	-21.000
Mean (excluding 1999)	0.183	0.177	-0.006	38.963	19.556	-19.407
Median	0.183	0.178	-0.016	21.641	12.388	-9.253
Standard deviation	0.325	0.245	0.212	44.353	20.015	24.974
Standard deviation (excluding 1999)	0.235	0.244	0.120	43.734	20.200	23.957

Note: The table compares the mean performances of two portfolios rebuilt every year as from 1965 to 2007, with the first portfolio composed by low leveraged companies, and the second by high leveraged companies. Mean return 25 = mean of returns of 1st percentile; mean return 75 = mean of returns of 4th percentile.



Note: The graph shows the difference of the compounded cumulated returns between portfolios of "high-leveraged companies" (D) and the "low-leveraged companies" (C), for an investment of 1 €.

Fig. 9. Compounded cumulated returns. High leveraged vs. low-leveraged companies portfolios

Even though some of the results identified are quite significant, an important finding emerges: strong correlations in absolute values for any analyzed factor are not observed, otherwise, this would imply that a single factor is able, alone, to itself explain most of an asset return.

Conclusion

The analysis has brought about significant findings. First, the thesis that size is a key factor in determining company return is reinforced, but also carries an important trade-off. The results indicate that small companies record better cumulated performances than larger firms, but at the same time this result goes with a higher return volatility. This is an interesting result, as while Fama and French (1993) demonstrated the superiority of small caps as regards return trend, their higher volatility was not fully treated, giving room to discussion. Also the findings on the second variable investigated – the "value" factor – are noteworthy, as they would prove the higher capability of so-called value stock companies – with higher book to market values – to get larger returns than growth stock companies – with lower book-to-market values, albeit a final judgment on this query cannot be definitively stated. Furthermore, these observations are even more significant considering that the analysis indicates that however firms with lower book-to-market values observe a similar volatility to firms with higher values of the ratio.

With regard to financial leverage influence, results indicate that the return volatility of higher leveraged companies is roughly equivalent to that of lower leveraged ones. In addition, the average cumulative returns of lower leveraged firms are only slightly superior to those of the compared sample of firms. Quite surprisingly, capital structure of companies seems a less significant variable affecting the company returns. These considerations are particularly interesting if we take into account the soundness of data used in the analysis, that consist in a very large number of observations, with an ample geographical diversification, investigated over a very long time horizon. However, as aforementioned, the relevance of the conclusions must be mitigated as could be biased by the fact that the sample of higher leveraged firms also comprises companies under financial strain or close to bankruptcy, that are typically distinguished by extremely high debt-to-equity ratios. It is also interesting to notice what occurs to the leverage factor in specific periods. Even though low leveraged

firms seem to better perform, on average, than high leveraged ones, the opposite occurs just in the years preceding the 2007-2008 crisis, around 2004/2005. Many researchers have outlined how these years have been characterized by complaisant accounting policies with a large amount of financial debt in the capital structures of firms, as well as accommodating monetary policies, with a great amount of liquidity issued, and a consequential increase in the corporate risk propensity (Coates, 2009). This trend seems to stop just from 2007.

A possible limitation of the study can be found in the extensiveness of the dataset used, that includes companies belonging to 40 different industries and covering a very broad time horizon of 58 years. The conclusions reached can be partially affected by the different performances between sectors and periods studied, so limiting to same extent the significance of the time-series results obtained. This possible drawback is, anyway, partly relieved in the light of the results obtained from the cross-section analysis. While the time-series analysis offers "an interpretation of the history" based on assumptions that can be brought into question, the cross-section study shows "the results of the history itself". Future research to build on the inference drawn from this paper is highly recommended, by trying to extend knowledge on the managerial implications as done in this article.

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